

## Economic Analysis of University Library Patrons' Use of Seat Reservation Management Systems: A Case Study of Dingxin Library at Jilin University (Postprint)

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### Abstract

[Purpose/Significance] Current research on university library seat reservation management systems assumes widespread adoption, yet this is not necessarily the case in practice. This study analyzes the causes of the actual usage effectiveness of seat reservation management systems and proposes approaches for improving the seat reservation management institution. [Method/Process] Employing empirical analysis and economic analysis methods, this study collects usage data from the seat reservation management system of the Dingxin Library at Jilin University to describe its usage effectiveness. By examining rule selection costs, allocation costs, adjudication costs, enforcement costs, and supervision costs within the seat reservation management institution, it analyzes the causes of the current usage status of the system. [Results/Conclusion] In practice, the number of users of seat reservation management systems is relatively low. This phenomenon results from a game-theoretic interaction between two seat resource allocation rules: “first-come, first-served” and “reservation-based seat selection.” Due to unreasonable cost allocation in the processes of rule selection, allocation, adjudication, enforcement, and supervision, readers lack incentives to use the system. The degree of system function implementation also affects user adoption. University libraries introduce seat reservation management systems primarily to address seat occupancy problems. The system’s functional implementation varies across four different types of seat occupancy behaviors. To improve the seat reservation management institution, comprehensive and systematic measures are required, including unifying seat resource allocation rules, refining institutional design, and integrating system management with human management.

## Full Text

### Preamble

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**An Economic Analysis of Readers Using Seat Reservation Management Systems in Academic Libraries: A Case Study of Dingxin Library at Jilin University**

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### Abstract

**[Purpose/Significance]** Current research on academic library seat reservation and management systems assumes these systems will be widely adopted, yet this is not necessarily true in practice. This study examines the actual usage effectiveness of seat reservation management systems, analyzes the causes of their usage patterns, and proposes approaches for improving the seat reservation management system.

**[Method/Process]** Using empirical analysis and economic analysis methods, this paper collects usage statistics from the seat reservation management system at Jilin University's Dingxin Library to describe its usage effectiveness. By examining the costs of rule selection, allocation, adjudication, enforcement, and supervision within the seat reservation management system, we analyze the causes behind the current usage status.

**[Result/Conclusion]** In practice, the number of users of seat reservation management systems is relatively low. This phenomenon results from a game between two seat resource allocation rules: "first-come, first-served" and "reserved seat selection." Due to unreasonable cost allocation during the processes of rule selection, allocation, adjudication, enforcement, and supervision, readers lack incentives to use the system. The degree of system functionality realization also affects reader usage. Academic libraries introduce seat reservation management systems primarily to solve the seat occupation problem, but the system's effectiveness varies across four different types of seat occupation behaviors. To improve the seat reservation management system, comprehensive and systematic measures are needed, including unifying seat resource allocation rules, optimizing system design, and effectively combining system management with human management.

**Keywords:** academic library; seat reservation and management system; usage status; cost

## 2 Current Usage Status

Based on different software sources and diverse university needs, seat reservation management systems vary across academic libraries, but they share similar core features, all using technical means to allocate and manage seat resources. Taking Jilin University's Dingxin Library (hereinafter referred to as "Dingxin Library") as the analytical object, the library has seven study spaces (multi-functional areas for reading, self-study, discussion, etc.) with seating capacities of 353, 124, 188, 172, 244, 130, and 187 seats respectively, totaling 1,398 seats. The second floor has one study space, while the third, fourth, and fifth floors each have two.

Dingxin Library's seat reservation management system underwent a one-month trial run during the first semester of the 2017-2018 academic year. After receiving positive feedback from all parties, the system was officially launched on March 5, 2018. The system was promoted through various channels, including LED screens, seat selection machines, and WeChat platforms, as well as through signage and user manuals. Additionally, each seat was affixed with a card containing three items: seat code, QR code, and instructions (scanning the QR code to reserve a seat, check in, renew, temporarily leave, return, and end usage). These promotional channels effectively publicized the seat reservation management system.

From May 10 to July 5, 2018, the author observed and recorded three sets of data (see ). The first dataset counted the number of readers using the seat reservation management system from May 10 to May 17. Although accurate library entry data was unavailable, visual observation clearly indicated that the number of system users was far fewer than the number of library visitors. Additionally, observations revealed that on weekends, more people visited the library, and as the number of visitors increased, the number of system users also increased relatively.

The second dataset recorded weekend usage of the seat reservation management system over six weeks from May 26 to June 30. Statistics from peak usage periods (e.g., 10:00, 15:00) showed that the library's seating capacity was essentially saturated during these times. Compared with the first dataset, the second dataset showed two changes: (1) overall reservation numbers increased, possibly due to increased usage over time or larger weekend visitor numbers; (2) usage in the sixth and seventh study spaces grew rapidly, faster than in other spaces. Since growth on the fourth and fifth floors was not synchronized, geographical location was not the primary influencing factor. The main reason was that the sixth and seventh spaces displayed notices at their entrances stating "Seat occupation is invalid; reservations take precedence," which clarified the rules and reduced readers' rule-selection costs, thereby facilitating increased system usage.

The third dataset recorded system usage from July 2 to July 5, using the same statistical method as the first dataset. This period was close to the end of

final exams and the beginning of vacation, with significant differences in usage between the first and last days, as large numbers of students left campus and summer vacation began, causing a sharp drop in library visitors. Nevertheless, some readers continued to use the seat reservation management system.

Despite positive feedback during the trial phase, the system's usage rate alone indicates less-than-ideal operational effectiveness. The number of users was far fewer than the number of library visitors, which varied on weekdays, weekends, and during final exam periods. Does the supply-demand relationship for seats affect the usage rate of the reservation system? That is, when seat supply exceeds demand, is system usage low, and when seat supply falls short of demand, does system usage increase accordingly? This view does not hold up. Insufficient seat supply is only a necessary condition for high system usage, not a sufficient one, as the reservation system still fails to achieve widespread use even when seat supply is insufficient on weekends and during final exams. According to the statistics, the maximum number of readers selecting seats through the system was 321. Assuming this figure represents system usage when the library's seating capacity is saturated, the system usage rate is only 22.96%. Moreover, observations revealed that when Dingxin Library was at full capacity, new arrivals who could not find seats did not choose to claim priority through seat reservations. In fact, low usage rates for seat reservation management systems have occurred at other universities as well. For example, data shows that in 2013, Nanjing Forestry University's library seat reservation system had usage exceeding 30% of library visitors [9], clearly far from widespread adoption. It is necessary to understand the reasons for this low usage rate.

### 3 Rule Game: The Economic Logic of Readers Using the Seat Reservation Management System

As a resource allocation rule, the logic of the seat reservation management system is that readers submit seat requests, and the system either grants them use of a specific seat or randomly assigns a seat. This model can be termed "reserved seat selection," which includes both online seat selection and selection through reservation machines. The corresponding allocation rule is "first-come, first-served." From an economic perspective, implementing rules in practice incurs certain costs, and different allocation rules require different costs. The magnitude of these costs is a crucial factor influencing readers' choice of seat resource allocation rules. When readers choose to use seats through the reservation system, they are following the reserved seat selection rule; otherwise, they follow the first-come, first-served rule. Therefore, the low usage rate of Dingxin Library's seat reservation management system can be reframed as: why do readers tend to follow the first-come, first-served rule rather than the reserved seat selection rule? This represents a game between two allocation rules.

Compared with first-come, first-served, reserved seat selection not only changes the method of seat resource allocation but also alters the distribution of costs during the allocation process. The party bearing the costs must fulfill corre-

sponding obligations, making this process a redefinition of rights. Nobel Economics laureate Coase argued that when transaction costs are zero, any allocation of rights is efficient. However, in the real world where transaction costs are positive, different rights allocations affect ultimate efficiency [10]. Readers themselves must incur costs to participate. If readers use the seat reservation management system according to regulations, the cost of seat allocation is borne by the readers. Therefore, whether based on habit, reluctance to deal with hassle, or simple non-compliance, the essence is that readers refuse to bear these costs. Since “people are self-centered,” readers may ignore costs imposed on others but will “haggle over” even the slightest cost added to themselves. Examining the economic logic of readers using the seat reservation management system requires analyzing the cost allocation in this process.

### 3.1 Cost of Rule Selection

Regarding seat allocation rules, three situations currently exist: first-come, first-served only; reserved seat selection only; and the coexistence of both. Dingxin Library adopts the coexistence of first-come, first-served and reserved seat selection.

From the perspective of human interaction, society faces two fundamental problems: the first is coordination, and the second is cooperation [11]. How to choose seat resource allocation rules is a coordination problem, whose core is predicting others' behavior [11]. When only one allocation rule exists—either first-come, first-served or reserved seat selection—readers need not predict others' behavior because other readers have only one rule to choose from. However, when both rules coexist, this clearly creates difficulties for readers. From a game theory perspective, when both readers choose or do not choose reserved seat selection, they follow the same rule and no conflict arises. When one reader chooses reserved seat selection while the other does not, a dispute over seat priority rights inevitably emerges. Obviously, readers are unwilling to bear the cost of claiming seat priority rights. In practice, this manifests as Dingxin Library rarely seeing cases where readers claim seat priority rights, let alone intense conflicts between readers. By comparison, readers tend to first find a seat and then use the reservation system, thereby reducing seat usage costs. If most readers adopted this strategy, the usage rate of the seat reservation management system would increase substantially, but this would render the system meaningless, as it would become a variant of first-come, first-served. In fact, this “find a seat first, then reserve it” strategy is not an equilibrium, as evidenced by the fact that Dingxin Library's system usage rate has not increased substantially. Ultimately, readers lack the willingness to adopt this strategy. Specifically, two reasons cause this phenomenon: (1) the cost of reserved seat selection is higher than first-come, first-served; (2) the opportunity cost for readers choosing first-come, first-served is low—that is, because the seat supply-demand relationship is not sufficiently tense, even without obtaining seat priority rights, readers can still secure seat usage (for example, when other readers claim seat priority rights, they can simply

move to another seat).

Rule recognition is another factor influencing readers' incentives to use the seat reservation management system. First-come, first-served is a customary rule, while reserved seat selection is an institutional rule; the former enjoys higher recognition than the latter. Zhang Shengchao argues that seat occupation is customary law [12]. Strictly speaking, first-come, first-served is customary law, while seat occupation is merely an expression of this customary law. First-come, first-served has formed through long-term social practice and enjoys broad social foundation, whereas the seat priority right is established by the library and confirmed only through user manuals, which affects its recognition. Clearly, the authority of first-come, first-served is stronger than library-established rules, giving readers greater motivation to follow it.

In practice, some universities mandate that seats can only be used through the reservation system, while others do not enforce this requirement. Although mandatory enforcement may seem “coercive,” it is an important incentive mechanism for increasing usage. Dingxin Library's sixth and seventh study spaces effectively changed the institutional design of coexisting rules by posting notices stating “Seat occupation is invalid; reservations take precedence,” which clarified rules, reduced readers' rule-selection costs, and facilitated increased system usage.

### 3.2 Allocation Costs and Adjudication Costs

Under first-come, first-served, resource allocation costs are primarily borne by readers during the allocation phase. Some argue that first-come, first-served seat allocation easily devolves into “seat scrambling,” creating tension among students and even physical altercations [13]. The allocation cost of reserved seat selection is borne by the system, which appears to permanently reduce seat resource allocation costs, but this is not actually the case. The allocation logic of reserved seat selection assumes all seats are available when a reader makes a reservation, excluding already selected seats. However, some readers still adopt the first-come, first-served approach, sowing the seeds for conflicts during seat usage. Reserved seat selection shifts costs from the allocation phase to the adjudication and enforcement phases.

If seat resource supply-demand relations are tense and reserved seat selection is the only allocation rule, the seat reservation management system is undoubtedly effective, as it can eliminate readers' waiting time costs and disputes during seat allocation. However, if seat resource supply-demand relations are tense and both “reserved seat selection” and “first-come, first-served” rules operate in parallel, the system's expected effectiveness decreases. Not only does it fail to reduce readers' waiting time costs, but it also increases disputes among readers.

If seat resource supply-demand relations are not tense, phenomena like seat scrambling cannot be attributed to the first-come, first-served rule itself but rather to ineffective adjudication functions. When disputes over seat usage

rights arise between readers, both parties typically serve as adjudicators. However, because both have vested interests in the dispute, impartial adjudication is difficult, making it unlikely for them to resolve the conflict through adjudication. Unless one party yields, the dispute may escalate. If a neutral third party (such as library staff) adjudicates at this point, the dispute can be easily resolved. This indicates that who bears the adjudication cost in seat usage disputes becomes key to solving the problem.

### 3.3 Enforcement Costs

The *Dingxin Library Seat Reservation Management System User Manual* stipulates: “If a reader has not successfully reserved a seat through the reservation system, or if the reservation period has expired, the seat does not belong to you. If another reader has reserved the seat, you must vacate it.” Dingxin Library establishes seat priority rights through this provision. However, the cost of claiming seat priority rights is borne by individual readers, which reduces their motivation to use reserved seat selection. Because selecting a seat through the reservation system grants seat priority rights, if the seat is vacant, these rights convert to seat usage rights. If the seat is occupied by others, the reader must claim their rights. In practice, recognition of seat priority rights is low, with many people unaware of them. In such cases, readers who select seats through the system face high costs in realizing their seat priority rights.

The magnitude of enforcement costs relates to the reasonableness of allocation. Generally, reasonable allocation is more readily accepted, while unreasonable allocation faces constant resistance. To some extent, both reserved seat selection and first-come, first-served are resource allocation policies. In Lasswell’s view, policy represents important decisions affecting value distribution [14]. Clearly, these two allocation rules represent different values: reserved seat selection emphasizes order, while first-come, first-served emphasizes freedom. This can be illustrated through a case: Reader A follows first-come, first-served and uses a seat from 8:00 AM, while Reader B reserves the same seat at 10:00 AM. Should Reader A vacate the seat? During these two hours, Reader A has already obtained seat usage rights—can these rights counter Reader A’s seat priority rights? According to the *Dingxin Library Seat Reservation Management System User Manual*, Reader A should vacate the seat, reflecting Dingxin Library’s commitment to promoting the reservation system. However, in practice, readers do not recognize seat priority rights, mainly manifesting as: ignoring others’ claims to seat priority rights; during peak usage periods when seat supply falls short of demand, despite many seats being unreserved, readers choose to leave rather than use the reservation system to exclude others’ seat usage rights.

The non-recognition of seat priority rights has cost-related reasons. Claiming seat priority rights shifts the cost of providing resources from the library to readers, who are unwilling to bear this cost and therefore take no further action. If the library claimed seat priority rights on behalf of readers, readers’ willingness to use the reservation system would increase. For example, after making a

reservation, readers could click a cleanup function, and library staff would check whether the reserved seat was being used by others and request them to vacate it if necessary.

Additionally, the seat occupation problem increases enforcement costs. Readers use personal belongings to occupy seats, making it necessary to clear these items. If the cost of clearing occupied seats is borne by the library, library staff can take measures once readers violate regulations. However, because readers own the items left on seats, library staff cannot dispose of them arbitrarily but can only take them into custody (i.e., move them elsewhere). If library staff are at fault during this process and damage readers' personal property, the library may bear tort liability. For example, if a reader occupies a seat and staff move a laptop left on the seat, and the laptop is damaged, the library would be held responsible. If regulations authorize other readers to do this, readers would bear corresponding responsibilities, effectively shifting costs from the library to readers. From the perspective of protecting readers' rights and ensuring enforcement fairness, the library should take necessary measures; otherwise, the cost for readers to claim seat priority rights increases, reducing their willingness to use the reservation system.

### 3.4 Supervision Costs

Effective institutional implementation depends on robust safeguard mechanisms. However, Dingxin Library's seat reservation management system lacks sound safeguard mechanisms. The *Dingxin Library Seat Reservation Management System User Manual* identifies the following violations: (1) readers reserve seats but fail to check in within the specified time; (2) abnormal seat usage is discovered during staff patrols; (3) helping others check in or out. Readers who accumulate three violations are automatically blacklisted by the system and cannot reserve seats for seven days, after which the system automatically removes them from the blacklist.

In fact, except for the first violation type, which is system-determined, the second and third types require human effort, incurring substantial costs. Even without a seat reservation management system, these operations could be performed, meaning the system adds no value from an institutional design perspective. In game theory, threats can be categorized as credible or non-credible. Only credible threats can be effective. However, except for the first violation determination, the second and third violation determinations are non-credible. Furthermore, the penalty of being unable to reserve seats for seven days after being blacklisted only works if the seat reservation management system is widely used; otherwise, being blacklisted has no impact. This makes the opportunity cost of violations very low for readers.

Defective institutional design increases supervision costs. The *Dingxin Library Seat Reservation Management System User Manual* stipulates: if readers temporarily leave the library during their reserved period, they must scan the QR

code on the seat or select “temporarily away” on the touchscreen machine, with a 30-minute limit for temporary absence. The “temporarily away” function only works if readers voluntarily use it. If readers do not actively select this function, the system cannot detect violations such as leaving seats for extended periods, requiring human intervention. Regarding students’ requests not to swipe cards when using the restroom or answering phone calls, Sun Fa, Wu Daili, and Zeng Weizhong advocate for reasonable deployment of workstation terminals [15]. Reducing readers’ usage costs does facilitate use of the temporary absence function. However, this approach still relies on reader self-discipline and cannot ensure they will use the temporary absence function.

In practice, some universities shift supervision costs to readers, who monitor and judge seat occupation and violations. To internalize supervision costs into readers’ seat usage costs, comprehensive and systematic design is required to reasonably allocate reserved seat selection costs, making it inevitable for readers to voluntarily bear supervision costs. Otherwise, if readers are required to bear supervision costs while both first-come, first-served and reserved seat selection rules operate simultaneously, readers may simply choose first-come, first-served rather than bear supervision costs. Simultaneously, other aspects of readers’ seat usage costs must be reduced, such as decreasing coordination costs through clear rules and allocating adjudication and enforcement costs to the library, thereby maintaining reasonable cost-sharing throughout the process.

## 4 Functional Expectations: Assessment of System Resource Optimization Functions

Widespread use of seat reservation management systems is a prerequisite for their functional realization, while the degree of functional realization in turn constitutes a usage cost for the system. Good functional expectations can reduce usage costs and facilitate increased usage rates. The realization of system functions depends on institutional design, operational environment, and other factors, requiring specific analysis of system functionality under different conditions.

### 4.1 Functional Positioning

By searching Baidu with the keyword “Notice on the Implementation of Seat Reservation Management Systems in Libraries,” 55 university libraries’ implementation notices were identified. Examining these universities’ purposes for introducing seat reservation management systems reveals five categories of stated objectives: “improving library seat utilization,” “solving the library seat occupation problem,” “creating a harmonious and civilized learning environment,” “protecting readers’ equal rights to use library reading seats,” and “improving library informatization levels.” Except for the fifth category, the other four can be understood as addressing the seat occupation problem. Among them, improving seat utilization aims to solve resource waste during seat occupation;

protecting equal usage rights aims to solve distribution inequity during seat occupation; and creating a harmonious environment aims to solve conflicts arising from seat scrambling and usage disputes. Fairness, efficiency, and harmony are three values in seat usage and represent the effects pursued by seat reservation management systems. Value realization depends on whether the system can eliminate the harms caused by seat occupation.

## 4.2 Classification of Seat Occupation

Seat occupation is common in many universities, taking various forms as an expression of the first-come, first-served allocation rule. Seat occupation behaviors can be categorized into: (1) readers occupying seats without actual use or without use for a period; (2) readers occupying seats for others without actual use or without use for a period; (3) readers temporarily or permanently leaving while using seats; and (4) readers permanently occupying specific seats. These four behaviors can all be termed “seat occupation,” but they have different natures. The first three refer to a state where the intention to occupy and actual seat usage are not synchronized, while the fourth involves readers excluding others from seat use through occupation. The first three primarily involve resource waste, while the fourth concerns readers’ equal rights to use seats. The fourth behavior mainly infringes on other readers’ equal usage rights; whether it causes resource waste requires case-by-case analysis. In some postgraduate entrance exam seat occupation cases, these seats often receive full use. The first three behaviors also include exclusivity, but this exclusivity is temporary and insufficient to completely exclude others’ use, as seats become equally available to all readers again after the occupation ends or the next day. This appears to be merely a difference in degree, but when determining the nature of public goods, there is no absolute distinction between competitiveness and non-competitiveness or exclusivity and non-exclusivity, but rather differences in degree [16]. Based on this, the exclusivity of the fourth behavior changes the nature of seats and fundamentally distinguishes it from the first three. All four behaviors can cause disputes among readers and disrupt the library’s harmonious environment.

## 4.3 Functional Assessment

- (1) The effectiveness of seat reservation management systems first depends on the formation of the seat occupation problem. The seat occupation problem refers to seat occupation behaviors causing sufficient damage to fairness, efficiency, harmony, and other values that they require governance. When seat resource supply far exceeds demand, none of the four seat occupation behaviors cause resource waste or damage fairness and harmony. Even if the fourth behavior changes seat nature, it does not necessarily trigger library governance, as all governance incurs costs. As rights are “priced,” the cost of achieving justice must be controlled within certain limits [8]. Solving the seat occupation problem through seat reservation management systems is no exception; the cost of maintaining order

cannot exceed the damage caused by disorder. Otherwise, introducing the system itself constitutes resource waste.

- (2) Seat reservation management systems help reduce waiting time costs and eliminate safety hazards from seat scrambling. Compared with first-come, first-served, reserved seat selection transforms readers' waiting time costs—readers only need internet access to obtain seat priority or usage rights, significantly reducing allocation costs. Simultaneously, because the system handles seat allocation, readers need not act personally, eliminating safety hazards from seat scrambling and enhancing the library's harmony value. Notably, when both first-come, first-served and reserved seat selection operate concurrently, all parties must reasonably share adjudication and enforcement costs. Otherwise, even if readers reserve seats online, they still incur substantial waiting time costs and safety risks to prevent seat occupation by first-come, first-served users.
- (3) Regarding the first three seat occupation behaviors, the degree of system functionality realization requires specific analysis. Practice proves that seat occupation is difficult to solve under first-come, first-served. Under reserved seat selection, seat usage rights must be obtained through the system, eliminating the second occupation behavior. The effectiveness in governing the first and third behaviors depends on the temporary absence function. Currently, some systems do not mandate use of the temporary absence function, resulting in limited effectiveness in addressing the first and third behaviors. Tsinghua University integrates its seat reservation system with access control, effectively detecting violations when readers leave the library (including the first and third behaviors) [17]. Effective temporary absence functionality can solve resource waste from the first behavior but only partially mitigates damage from the third. Wang Shouhong notes that seat reservation management systems are ineffective for in-library seat occupation and suggests further measures (such as infrared sensors on seats), but these create additional problems (e.g., potential reader conflicts, disruption of relaxed learning environments) [18]. Infrared sensors also cannot completely eliminate in-library seat occupation, as they cannot identify readers or detect speculative behavior. Similar technologies include pressure sensors and video surveillance. Technically, eliminating in-library seat occupation is possible, but the cost problems from technical solutions are difficult to overcome in practice.
- (4) Regarding the fourth behavior, seat reservation management systems are basically powerless, as permanent seat occupation results from library authorization, acquiescence, or inaction. Once the library cancels authorization or strictly enforces institutional rules, permanent seat occupation disappears. Attempting to solve permanent seat occupation through reserved seat selection would shift enforcement and supervision costs from the library to readers, who lack incentives for this activity. Therefore, the system cannot eliminate the fourth seat occupation behavior.

## 5 Approaches to Improving the Seat Reservation Management System

Analysis of the reasons for low usage rates in practice shows that the current usage status relates to both cost allocation and functional expectations. Therefore, comprehensive and systematic measures are needed for institutional improvement.

### 5.1 Unifying Seat Resource Allocation Rules

Adopting unified seat resource allocation rules—that is, allowing seat selection and use only through the reservation system—eliminates readers' rule-selection costs. Whether first-come, first-served, reserved seat selection, or other allocation rules, none can permanently solve seat occupation and scrambling problems. When resources are sufficiently scarce, readers without seats will resort to other rules to justify their occupation and scrambling behaviors. From this perspective, these allocation methods have no inherent superiority; what matters is reaching consensus among people to adopt the same behavioral rules.

### 5.2 Improving System Design

Improving the seat reservation management system's institutional design involves adjusting cost allocation during seat usage to change existing arrangements: on one hand, reducing readers' costs for using the system; on the other hand, increasing costs for seat occupation (such as implementing stricter credit point systems). Simultaneously, adjudication, enforcement, and supervision costs should be allocated to the library.

Yan Wei argues that certain conditions produce specific institutional arrangements that are effective under those conditions; forcibly changing arrangements without altering conditions only reduces efficiency, suggesting that coercive measures should not be used to solve seat occupation [19]. If the condition refers to tense seat supply-demand relations, this means usage rates and seat occupation problems can be improved without changing supply-demand relations, though possibly at the cost of efficiency. When efficiency conflicts with fairness and harmony, sacrificing some efficiency for fairness and harmony is acceptable, as equality is a fundamental principle of readers' rights protection [20]. To prevent excessive efficiency loss, coordination at the university level is necessary to ease seat resource supply-demand tensions. Improving supply-demand relations can proceed in two ways: increasing resources and reducing demand. Regarding demand reduction, one approach involves changing university examination scheduling systems [21]; another involves targeted reduction of seat demand based on different seat occupation behaviors. Specifically, seat occupation includes two aspects: readers' control over seats and their handling of personal belongings. Chen Ying notes that 63% of readers occupy seats because they find it inconvenient to carry heavy bags when leaving temporarily [22]. Therefore, when seat occupation stems from personal belongings management, creating

temporary public storage spaces can reduce this portion of seat demand. Regarding resource increases, objectively increasing seats is difficult as it requires substantial university funding. However, even without objectively increasing resources, supply-demand tensions can be eased. From the perspective of reader needs, seats can be categorized as undifferentiated or differentiated, with differentiated seats meeting personalized needs (e.g., seats with power outlets). From this angle, maximizing undifferentiation of seat resources across campus can distribute readers more evenly across the library or other school areas, relatively easing library seat supply-demand tensions.

### 5.3 Combining System Management with Human Management

Seat reservation management systems must be combined with human management; it cannot be assumed that information-based management can completely replace human management. This requires library staff to fulfill their duties, strictly enforce library regulations, and increase the opportunity costs of seat occupation, making it “unaffordable” for readers.

Human management plays a key role in realizing system functions. For example, library staff can “enforce” rules by clearing occupied items to optimize the usage environment for the seat reservation management system. Enforcement standardization must be ensured, such as by attaching cleanup notices to violation seats that record the reason for cleanup, cleanup time, item inventory, methods for retrieving cleared items, consequences for not retrieving items within the time limit, and penalties for repeated violations, finally signed by the responsible staff member and witnessed and signed by a nearby reader to enhance enforcement standardization and reduce potential risks or losses. Such enforcement not only warns and penalizes occupying readers but also educates other readers about the rules, serving as a strong demonstration effect.

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**Abstract:** [Purpose/Significance] Current research on academic library seat reservation and management systems assumes these systems will be widely adopted, yet this is not necessarily true in practice. This study examines the actual usage effectiveness of seat reservation management systems, analyzes the causes of their usage patterns, and proposes approaches for improving the seat reservation management system.

[Method/Process] Using empirical analysis and economic analysis methods, this paper collects usage statistics from the seat reservation management system at Jilin University's Dingxin Library to describe its usage effectiveness. By examining the costs of rule selection, allocation, adjudication, enforcement, and supervision within the seat reservation management system, we analyze the causes behind the current usage status.

[Result/Conclusion] In practice, the number of users of seat reservation management systems is relatively low. This phenomenon results from a game between two seat resource allocation rules: "first-come, first-served" and "reserved seat selection." Due to unreasonable cost allocation during the processes of rule selection, allocation, adjudication, enforcement, and supervision, readers lack incentives to use the system. The degree of system functionality realization also affects reader usage. Academic libraries introduce seat reservation management systems primarily to solve the seat occupation problem, but the system's effectiveness varies across four different types of seat occupation behaviors. To improve the seat reservation management system, comprehensive and systematic measures are needed, including unifying seat resource allocation rules, optimizing system design, and effectively combining system management with human management.

**Keywords:** academic library; seat reservation and management system; usage status; cost

*Note: Figure translations are in progress. See original paper for figures.*

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