

Web-based application development for the digitalization of badminton court reservation and scheduling using scrum methodology

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ABSTRACT

The primary challenge in managing badminton court reservations and scheduling lies in the absence of an integrated system that supports booking, payment flexibility, and efficient schedule management. This study addresses these issues by developing a badminton court reservation information system equipped with user registration, login, court booking, schedule management, payment reporting, and member schedule search features. System evaluation was conducted through a User Acceptance Test (UAT), which confirmed that all core features functioned effectively and met user requirements. To further assess user experience, a Mean Opinion Score (MOS) evaluation involving five respondents and ten questions was carried out, yielding an average score of 3.8 on a four-point scale, categorized as very good. Respondents indicated that the system is easy to use, offers intuitive navigation, has an attractive interface, and provides stable performance while accelerating the booking process. These findings demonstrate that the system is both functionally reliable and well-received by users, thereby contributing to improved administrative efficiency, payment transparency, and overall user convenience.

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1. Introduction

Badminton is a very popular sport in Indonesia and is enjoyed by people from various backgrounds, including students, workers, and sports communities. The high level of public enthusiasm for this sport has directly impacted the increasing demand for court facilities that are easily accessible, fast, and guaranteed to be available. However, in practice, badminton court rental management is still largely manual. Schedule recording, booking confirmation, and transaction reporting are generally carried out conventionally, which often presents a number of challenges. Problems arising from this manual method include frequent schedule conflicts or double bookings, delays in payment confirmations, and difficulties for managers in preparing accurate and structured financial reports. This situation not only complicates the administrator's work but also impacts the user experience for court reservations (Ghosh et al., 2025; N PG Scholar & Kiran Assistant Professor, 2023). With the advancement of information technology, web-based information systems are considered a suitable solution, as they can integrate booking, payment, and schedule management processes into a single, integrated platform (Andhika Febriansyah & Fira Waluyo, 2023; Woodcock, 2022; Zhao et al., 2017). Several previous studies have demonstrated the

effectiveness of web-based information systems in supporting court rental management across various domains. In the sports domain, several studies have demonstrated that digitizing reservations can minimize double bookings, standardize transaction flows, and facilitate payment reconciliation (Faris et al., 2025). For instance, a case study on badminton court rentals at Graha Pancasila Pandeglang implemented a reservation system using the Laravel framework, resulting in an interactive dashboard for efficient court management (Winata et al., 2025). Not only in Indonesia, research by (Xin Woei et al., 2023) in Malaysia also demonstrated that an Agile approach to developing a badminton court reservation system proved effective in improving the quality of user service. Other studies confirmed the effectiveness of information systems in managing sports arena rentals in real time (Nazare et al., 2023; Talath et al., 2025).

The effectiveness of booking systems isn't limited to sports. In the transportation sector, web-based and IoT-based parking reservation systems have been shown to reduce slot-finding congestion and increase utilization (Aswath et al., 2025). In libraries, the development of calendar-based study room reservation systems has reduced staff burden and increased usage regularity (Atkinson & Lee, 2018; Xuan, 2021). In coworking spaces, online booking platforms improve user experience while supporting capacity management (Howell, 2022; Selvaraja, 2020). Meanwhile, in the hotel and hospitality industry, research has highlighted user behavior in online booking, emphasizing the importance of real-time availability, secure payment systems, and user-friendly interfaces (Gao & Bi, 2021; Nsama & neene, 2021). Even in the restaurant sector, digital table reservation systems have been identified as being able to reduce no-shows and increase customer satisfaction, and similar benefits have also been observed in the context of dentist appointments, where online booking platforms help minimize missed visits and improve overall patient experience (Ma et al., 2020; Sutjiadi et al., 2025). Cross-sector empirical evidence shows that digitizing reservation systems consistently delivers positive impacts in the form of increased efficiency, recording accuracy, and a better user experience (Ao et al., 2024). In line with these findings, this study designs and implements a web-based Badminton Court Reservation Information System using the CodeIgniter framework and the Scrum software development method. This system is designed with several key contributions, including preventing double bookings, providing payment flexibility, improving reporting accuracy, and providing a more consistent and standardized user experience.

While several previous studies have examined badminton court reservation systems, there is still ample room for innovation, particularly regarding the integration of data management features, financial reporting, and improving the user experience. Building on this research gap, this study focuses on developing a web-based badminton court reservation information system using the CodeIgniter framework and the Scrum software development method. The system is designed with several key contributions, including preventing double bookings, providing payment flexibility, improving reporting accuracy, and delivering a more standardized user experience. Furthermore, the growing trend of sports digitization in Indonesia is supported by the high national internet penetration rate, which in 2025 reached 80.66 percent of the population according to APJII, along with the widespread adoption of smartphones and cashless payment systems, creating a favorable ecosystem for implementing web-based solutions. In addition, shifting user behavior toward real-time access, transparent scheduling, and contactless transactions further reinforces the urgency of an integrated platform for booking, payment, and reporting. These external factors collectively indicate that the proposed system is not only a response to operational inefficiencies but also a strategic alignment with broader socio-technical trends, providing a strong foundation for long-term adoption and sustainable benefits for both managers and users (Kammrath Betancor et al., 2025).

2. Method

This study uses the Scrum software development method, which is one of the frameworks of the Agile methodology. Scrum was chosen because it is iterative and adaptive, allowing it to accommodate user needs through incremental development with continuous evaluation (Pohl & Hof, 2015). The Scrum method in this study is illustrated in Figure 1. The development process of the badminton court reservation application began with the identification of user needs, which involved analyzing the requirements of both field managers and users. Field managers required a system that could streamline

booking management, scheduling, financial reporting, and monitoring of membership package usage, while users expected convenient online registration, login, and booking services.

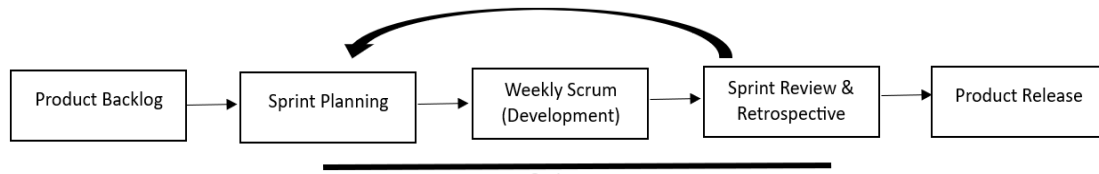


Figure 1 Scrum method (Ng, 2017)

Based on the results of this needs assessment, a product backlog was formulated that outlined essential features such as user registration and authentication, booking transactions with booking code recording, schedule management through daily and hourly tables, revenue reporting with export capabilities to Excel or PDF, reports on remaining membership package usage, and comprehensive management of data related to fields, members, packages, sessions, news, banners, and accounts. Subsequently, the product backlog was refined through sprint planning, in which features were prioritized and allocated into several sprints. For instance, Sprint 1 focused on the implementation of registration, login, and booking modules; Sprint 2 concentrated on schedule and member management modules; Sprint 3 covered reporting modules for income and membership package usage; and Sprint 4 completed the development with additional modules such as news, banners, accounts, and overall system integration. The Scrum phases in the development of the badminton court reservation application can be seen in Table 1.

Table 1 Scrum phases in developing the badminton court reservation system

Sprint	Developed Modules/Features	Implementation Description
Sprint 1	Registration & Login, Field Reservation	Users can register an account, log in, and make field reservations with a unique booking code.
Sprint 2	Schedule & Member Management	Admins can set field availability schedules in the form of daily hourly tables and manage member data.
Sprint 3	Income Report & Remaining Package Report	The system provides transaction income reports (with Excel/PDF export) and member package usage reports (remaining 1x).
Sprint 4	Additional Modules (News, Banner, Account) & System Integration	Admins can add news information, promotional banners, and manage payment accounts. All modules are integrated into one system.

Based on Table 1, system development was carried out in stages over several sprints. In Sprint 1, the focus of development was directed at implementing the registration, login, and field reservation modules. This stage laid the foundation for the system, allowing users to authenticate and make field reservations with unique booking codes. Furthermore, in Sprint 2, the schedule and member management modules were developed. Admins can manage field availability in the form of a daily, hourly schedule table, while also managing member data. This feature is crucial to ensure there are no scheduling conflicts and to simplify user data management. In Sprint 3, the system was expanded with the addition of income reporting and package balance reporting modules. Income reporting allows admins to monitor financial transactions more accurately, complete with export features to Excel or PDF. Meanwhile, package balance reporting helps managers and members monitor package usage (e.g., "1x balance remaining"). Then, in Sprint 4, development focused on additional modules, such as news, promotional banners, and accounts. These modules support additional information needs and simplify payment account management. At this stage, all modules were integrated to ensure the system runs smoothly. The final stage was testing and refining the system through User Acceptance Testing (UAT) (Liskin et al., 2012) and Mean Opinion Score (MOS) (Yu et al., 2024). At this stage, users (admins and members) were directly involved to assess the system's suitability to their needs and ease of use. The UAT and MOS results showed that all main modules functioned well, with a high level of user satisfaction.

Table 2 User acceptance test plan for the badminton court reservation system

No	Test Scenarios	Test Case	Expected Result	Status
1	Registration & Login	Admin or members create accounts and perform valid or invalid logins	Login successful/failed	Pass/Failed
2	Field Reservation	Admin or members book fields based on available schedules	Reservation successful & booking code generated	Pass/Failed
3	Schedule Management	Admin adds/changes field schedule	The schedule appears in table form and does not clash	Pass/Failed
4	Payment Status	Admin changes the status from DP to paid	Saved status & updated financial reports	Pass/Failed
5	Income Report	Admin filters transactions and exports to excel/pdf	The file matches the selected data filter, ensuring valid output	Pass/Failed
6	Remaining Playing Schedule	Admin checks the remaining quota of the member	Displays members with their remaining play quotas (1x - 4x)	Pass/Failed
7	Data Management	Admin manages field, member, session, package, and order data	Data is saved & displayed in table form	Pass/Failed

3. Results and Discussions

The system requirements analysis was conducted through interviews with badminton court managers and direct observation of the manual rental process. The analysis identified several key issues in court rental management: frequent double bookings, manual payment recording that is prone to errors, and poorly documented member package revenue and monitoring reports. Based on these issues, system requirements were identified, covering two types of users: the administrator, responsible for managing court data, packages, members, schedules, payments, and reports. The second is the member, responsible for registering, logging in, and reservation courts. A more detailed list of system user requirements is shown in Table 3.

Table 3 User requirements specification for the badminton court reservation system

No	System User Needs	Code
1	Admin can manage master data (field, package, session, member, schedule, reservation)	UR-A-01
2	Admin can record and update payment status	UR-A-02
3	Admin can display income reports per period	UR-A-03
4	Admin can monitor field schedules on a daily/hourly basis	UR-A-04
5	Members can register an account	UR-M-01
6	Members can book the field according to the available schedule	UR-M-02
7	Members can view reservation status and remaining package quota	UR-M-03

Based on the results of identifying user needs, the functional system requirements is summarized in Table 4. Meanwhile, the non-functional requirements specifications are described in Table 5.

Table 4 Functional requirements of the badminton court reservation system

Code	Functional Requirements	Description
FR-01	Registration & Login	The system provides new account registration and login with access rights restrictions (admin/member).
FR-02	Field Reservation	Members can make field reservations, the system generates a unique booking code, and prevents double bookings.
FR-03	Schedule Management	Admin can add, change and delete field availability schedules displayed in the table.
FR-04	Payment Status	The system records the payment status (order, down payment, paid, cancelled) and updates it automatically on the report.
FR-05	Income Report	The system displays transaction reports per period and provides export to Excel/PDF.
FR-06	Remaining Playing Schedule	The system automatically updates and deducts members' remaining package quotas after each session.

Code	Functional Requirements	Description
FR-07	Master Data Management	Admin manages master data (fields, members, packages, sessions, accounts, news, banners).

Table 5 Non-functional requirements of the badminton court reservation system

Code	Non-Functional Requirements	Description
NFR-01	Performance	Transaction response < 2 seconds.
NFR-02	Security	Login authentication, data encryption, protection from SQL Injection, XSS, and CSRF.
NFR-03	Availability & Reliability	Uptime ≥ 99% operational hours, automatic daily data backup.

During the implementation phase, a web-based badminton court reservation and scheduling management information application was designed using a relational database schema.

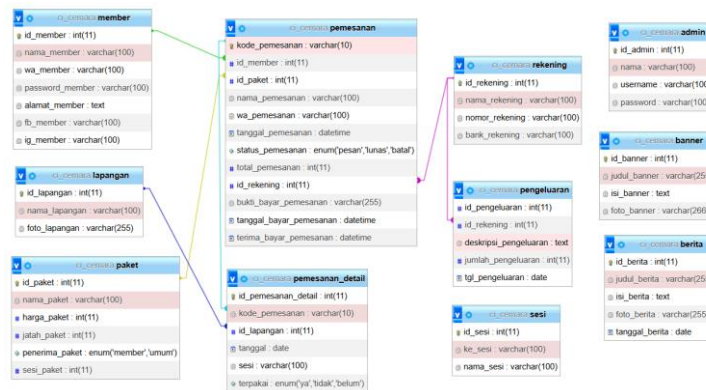


Figure 2 Relational database schema of the badminton court reservation system

This schema is designed to support the system's functional requirements, particularly in managing member data, reservations, rental packages, and financial reports. With this design, the database schema is able to accommodate the badminton court rental management needs of both users and administrators, while ensuring data integrity through clearly defined relationships between entities, as illustrated in Figure 2. Functionally, the developed system has the ability to manage master data, including field data, members, packages, sessions, bookings, news, banners, and accounts. Furthermore, the system also provides reporting features to support the decision-making process, including field usage schedules, remaining play by package (e.g., 1x, 2x, or 4x), and financial income generated from booking transactions.

The prototype of the badminton court reservation application includes key interfaces that support both admins and members. The Booking Data page (Figure 3) implements functional requirement FR-02 by displaying detailed booking transactions with unique codes, member information, package type, dates, payments, status, and total cost. The use of unique booking codes ensures the prevention of double bookings, while features for editing, viewing details, printing receipts, searching, and exporting data improve booking management efficiency. This demonstrates that the system successfully fulfills FR-02 by enabling organized, accurate, and easily manageable court reservations.

No	Kode	Member	Paket	Tgl Pesan	Tgl Bayar (*DP)	Tgl Lunas	Status	Total	Opsi
1	INMOVW	Agesta ID: 628137925474	Member	05 Sep 2025 08:43	05 Sep 2025 12:29	05 Sep 2025 08:43	Bayar	Rp 500,000	👍 🗑️
2	20885Z	Lampung Utara 2 ID: 6281022173175	Non-Member 3 jam	31 Aug 2025 13:04	31 Aug 2025 13:04	05 Sep 2025 13:09	Bayar	Rp 195,000	👍 🗑️
3	00876Z	Adit Batigola ID: 6281897023314	Non-Member 2 jam	31 Aug 2025 13:02	31 Aug 2025 13:02	05 Sep 2025 13:09	Bayar	Rp 130,000	👍 🗑️
4	27JAC9	Suhendra ID: 6281298172299	Non-Member	30 Aug 2025 13:04	30 Aug 2025 13:04	05 Sep 2025 13:10	Bayar	Rp 65,000	👍 🗑️
5	00CV8I	PB BTI ID: 6281022144255	September Cario	30 Aug 2025 13:03	30 Aug 2025 13:03	30 Aug 2025 13:03	Bayar	Rp 450,000	👍 🗑️
6	1M480F	Zuri Yodika ID: 628137922813	Pelajar	26 Aug 2025 13:03	26 Aug 2025 13:04	26 Aug 2025 13:04	Bayar	Rp 100,000	👍 🗑️

Figure 3 Order management page (admin)

Figure 4 displays the Schedule Report page, used to monitor field availability over a specific period. On this page, administrators can select a start and end date range to display a detailed field usage schedule.

Laporan Jadwal

Mulai: 31/08/2025 Selesai: 05/09/2025

Tanggal	07.30-08.30	08.30-09.30	09.30-10.30	10.30-11.00	11.00-12.00	12.00-13.00	13.00-14.00	14.00-15.00	15.00-16.00	16.00-17.00	17.00-18.00	18.00-19.30	19.30-20.30	20.30-21.30	21.30-22.30
31 Aug 2025	PB BTI	PB BTI	PB BTI	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong
01 Sep 2025	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong
02 Sep 2025	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong
03 Sep 2025	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong
04 Sep 2025	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong
05 Sep 2025	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Kosong	Agesta	Agesta	Agesta	Kosong	Kosong	Kosong	Kosong

Data Pemesanan

Kode: INMOVW
 Tgl Lunas: 05 Sep 2025 08:43
 Total: Rp. 500,000

Member

Nama: Agesta
 No HP: 628137925474
 Paket: Member
 Jatah: 4x
 Jumlah Sesi: 3

Rincian Pemesanan

Lapangan	Tanggal	Sesi	Status Terpakai	Opsi
Court 1	05 Sep 2025	15.00-16.00, 16.00-17.00, 17.00-18.00	Bayar	👍 🗑️
Court 1	19 Sep 2025	16.00-18.00, 18.00-17.00, 17.00-18.00	Bayar	👍 🗑️
Court 1	12 Sep 2025	16.00-18.00, 18.00-17.00, 17.00-18.00	Bayar	👍 🗑️
Court 1	26 Sep 2025	15.00-16.00, 16.00-17.00, 17.00-18.00	Bayar	👍 🗑️

Figure 4 Schedule management page (admin)

The schedule information is presented in a matrix-style table, where rows correspond to dates and columns represent operating hours. Each cell displays the availability status and renter identity, thereby enabling administrators to monitor utilization patterns, prevent booking conflicts, and guide members in selecting optimal time slots. The implementation of this Schedule Report page fully satisfies functional requirement FR-03 by not only allowing administrators to add, modify, and delete schedules but also providing a clear and structured visualization of court availability, thereby enhancing transparency and supporting efficient time management. In parallel, the Package Usage Report page (Figure 5) addresses functional requirement FR-06 by presenting each member's remaining playing quota, complete with usage dates and automated deductions for each session utilized. The inclusion of real-time updates and data export capabilities (Excel and PDF) ensures that both administrators and members can accurately track package usage, archive records, and maintain service flexibility for recurring packages (e.g., 1X, 3X, or more). Collectively, these features strengthen operational oversight and contribute to a more transparent and user-centered management process.

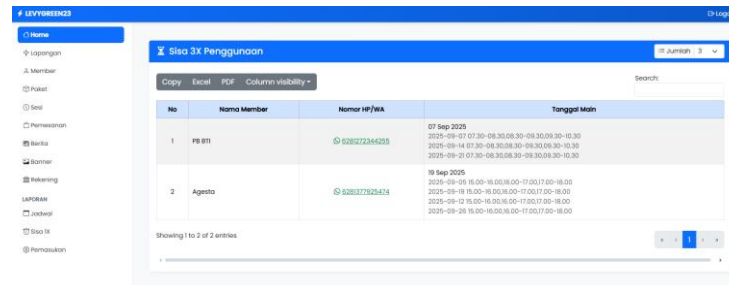


Figure 5 Remaining play schedule management (admin)

In addition to the functional testing illustrated in Table 6, this study also employs the Mean Opinion Score (MOS) method (Yu et al., 2024) to assess system quality from the end-user perspective. MOS is a widely recognized evaluation approach in both academia and industry, particularly for measuring Quality of Experience (QoE) in digital service-based systems. This measurement is conducted by asking respondents to directly experience the system’s features and then provide an assessment of several predetermined aspects using a structured questionnaire. Respondents rate each aspect on an ordinal scale from 1 to 4, where 1 indicates “very poor” and 4 indicates “very good.” The final evaluation was conducted by calculating the average score across all respondents to derive the MOS, which serves as an indicator of user acceptance and overall satisfaction. A higher MOS value reflects better perceived system quality from the user perspective.

Table 6 User acceptance testing scenarios of the badminton court reservation system

ID	Feature	Input Data	Test Steps	Expected Results	Actual Results	Status
UAT-001	Add order data.	<ol style="list-style-type: none"> Member data. Package data. Payment account data. 	<ol style="list-style-type: none"> Login in as admin. Select the order menu. Select member. Select a game package. Select order status. Select payment account. Select payment date and payment date. Press the save button. 	<ol style="list-style-type: none"> The orderer's name and WhatsApp number are automatically filled in. The order amount is automatically filled in. The field order data is successfully saved. 	<ol style="list-style-type: none"> The orderer's name and WhatsApp number are automatically filled in. The order amount is automatically filled in. The field order data is successfully saved. 	PASS
UAT-002	Change order data details.	<ol style="list-style-type: none"> Order data. Order details data. 	<ol style="list-style-type: none"> Login in as admin. Select the booking menu. Select field data. Select the playing date. Select the playing session. Press the save button. 	<ol style="list-style-type: none"> There are no conflicting game schedules. The booking information was successfully changed. 	<ol style="list-style-type: none"> There are no conflicting game schedules. The booking information was successfully changed. 	PASS

In this study, the MOS assessment was designed in alignment with the UAT and involved five representative respondents. Each participant completed a set of ten questions addressing usability, reliability, performance, and alignment of system functionality with business requirements. This dual approach allowed the UAT to validate functional correctness, while the MOS provided both qualitative and quantitative measures of user experience, forming a robust basis for system refinement and informed decision-making regarding real-world deployment. A summary of the MOS results from all respondents is presented in Table 7.

Table 7 Summary of MOS results for the badminton court reservation system

No	Question	R1	R2	R3	R4	R5	Average
1	Is the system easy to use?	4	3	4	4	4	3.8
2	Are the menus and navigation easy to understand?	3	4	4	4	4	3.8
3	Does the system respond quickly when used?	3	4	3	4	4	3.6
4	Is the system stable and rarely experiences errors?	4	3	4	4	4	3.8
5	Does the ordering feature meet user needs?	4	4	4	3	4	3.8
6	Is the information displayed on the system accurate and clear?	4	4	3	4	4	3.8
7	Is the user interface (UI) attractive and pleasing to the eye?	3	4	3	4	4	3.6
8	Does the system help speed up the field booking business process?	4	4	4	3	4	3.8
9	Is the system easy to learn for new users?	4	3	4	4	4	3.8
10	Are you satisfied overall with this system?	4	4	3	4	4	3.8

The Mean Opinion Score (MOS) test yielded an average of 3.8 on a four-point scale, indicating very good user perception. High scores were observed in ease of use, learnability, system stability, information accuracy, and booking efficiency, confirming that the system meets its functional objectives and delivers a positive user experience. Slightly lower scores in responsiveness and interface attractiveness (3.6) indicate potential for improvement in performance and visual design. Integrating additional features such as automated notifications and online payment gateways can further enhance user satisfaction by providing real-time updates and streamlining the booking process. For facility managers, these features improve operational efficiency by reducing administrative workload, accelerating payment reconciliation, and enabling data-driven monitoring, supporting sustained user engagement and long-term adoption.

4. Conclusions

The application resolves unintegrated booking, payment, and scheduling services. UAT results confirmed that all core features functioned successfully with PASS status, while MOS evaluation yielded an average score of 3.8 out of 4, indicating very good user acceptance. Respondents appreciated its ease of use, intuitive navigation, attractive interface, stable performance, and efficiency in accelerating the booking process. The application enhances administrative efficiency, payment transparency, and overall user convenience. Considering the slightly lower scores for system responsiveness and interface attractiveness, the most urgent priority for further development is improving technical aspects, particularly system performance, security, and integration with online payment gateways. Service-related features such as automated notifications and personalization may follow as secondary priorities to maximize user engagement once the core system performance is fully optimized. For sustainable adoption, sports facility managers should continue improving responsiveness and interface design, provide regular user training, gather feedback for iterative enhancement, and utilize system data to optimize court usage and support data driven decision-making.

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