Modeling an Information System for a Basketball Club

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Abstract

The administrative management of a basketball club, even of small size, presents several challenges, with one of the most critical being the efficient organization of all generated information and documentation. In order to meet all the requirements surrounding sports management, the use of information systems in sports is indispensable for the success of an organization. This research involves modeling an information system in the form of a web application for the administrative content management of a sports club, ensuring the efficient organization and availability of all its information. This activity includes identifying the necessary resources and investment, developing a prototype, and evaluating potential impacts.

Keywords: Modeling, Information System, Sports Management, Administrative Management, Sports Services, Basketball

Título: Modelação de um Sistema de Informação de um Clube de Basquetebol

Resumo: A gestão administrativa de um clube de basquetebol, mesmo que de pequena dimensão, apresenta vários desafios, sendo que um dos mais críticos é a organização eficiente de toda a informação e documentação gerada. De forma a responder a todas as exigências que rodeiam a gestão desportiva, o uso de sistemas de informação no desporto é indispensável para o sucesso de uma organização. Esta investigação passa por efetuar a modelação de um sistema de informação, em forma de aplicação web, para gestão do conteúdo administrativo de um clube desportivo, de modo a garantir a organização e disponibilização de toda a sua informação de forma eficiente. Esta atividade deverá compreender a identificação dos recursos e investimento necessários, o desenvolvimento de um protótipo e a avaliação dos potenciais impactos.

Palavras-chave: Modelação, Sistema de Informação, Gestão Desportiva, Gestão Administrativa, Serviços Desportivos, Basquetebol

1. Introduction

The increase in sports practice over the past years has required sports organizations to change their mode of operation in order to maintain a growing performance [1]. The success of a sports club always depends on the quality of its management, which needs to possess tools that help overcome new challenges and achieve the initially set specific goals. With the growth of new information technologies, the use of software tools provides easy access to information and its data analysis, assisting the decision-making process of sports entities [2] in order to improve their effectiveness and efficiency [3].

A niche to explore emerges from the intersection of sports management and information systems. Small and medium-sized sports institutions and organizations face difficulties defining processes and performing functions that enhance sports management efficiency - a complex and demanding task that requires special care in organizing and treating information. Through the use of an information system, the support provided to management in forecasting, organizing, coordinating, training, and controlling information can improve the quality of decision-making at all levels of sports organization management.

The following research proposes the modeling of an information system for the administrative management of a basketball club, where the impact is measured through a case study on the 'Odivelas Basket Clube'. The case study focuses on a no-profit organization since they face even more challenges as they only have a single purpose - to achieve an effective performance of their mission - and they represent the highest percentage in the Portuguese sports paradigm. This research will be conducted in two stages. In the first stage, an assessment of the current system ("AS-IS") will be made, and in the second stage, a new information system will be proposed ("TO-BE"). During these stages, various phases of the Case Study methodology will be followed. For the development of the proposed information system, the CRUD/AD method will be used [4].

2. Use Case

2.1. Research Context

The administrative management of a basketball club, even if it is of small size, presents several challenges, with one of the most critical being the efficient organization of all the generated information and documentation. At the beginning of the sports season, each club needs to submit official documentation to the Portuguese Basketball Federation (FPB). These documents should include all the information related to the club's establishment - data regarding athletes and their guardians, coaches, and administration. This process faces several obstacles, from the difficulty of obtaining the documents (usually there is no single channel to do so), managing poorly filled-out documents (which requires their return and repetition of the process), to organizing all the information generated with this documentation. The problem arises from the difficulty faced by small-sized sports clubs in effectively managing all these administrative issues and ensuring the efficient organization and availability of all their information.

2.2. Objectives

The objective of this research is to model an information system in the form of a web application for the management of administrative content in a sports club. This activity should encompass the identification of necessary resources and investment, the development of a prototype, and the evaluation of potential impacts. Achieving the objective should generate knowledge at various levels by understanding the main shortcomings in the administrative management process of a club, how the use of technology can help address these shortcomings, the required resources to invest in such a solution, and the potential impacts resulting from doing so. The intention is for this knowledge to be used in the future, with the broader purpose of guiding clubs toward simpler and more organized management.

3. AS-IS System

3.1. Research Context

The Odivelas Basket Clube (OBC) is a club dedicated exclusively to the practice of basketball, founded on June 1, 2009 - International Children's Day - a date that reinforces the importance of youth development in the club. With just over a century of existence, the club currently has over 200 registered athletes, competing in all age groups and both genders, and is increasingly making a name for itself in the Lisbon district basketball scene and in the enriching development of sports in the municipality of Odivelas. The surrounding community forms the foundation that supports the club, as it is based on a family and volunteer basis, aiming to provide leisure and social interaction. Odivelas Basket Clube is a non-profit organization and, as such, all its members perform their functions on a part-time basis, with no full-time employees. The relatively simple structure reinforces the importance and dependence of each club member for the smooth operation of sports activities. The section leaders are club employees (parents of athletes who voluntarily take on the role) who are responsible for all the paperwork related to the collection of official documents and their submission to the Portuguese Basketball Federation, equipment management, management of official game documents, etc. Each team has at least one coach and one section leader responsible for their respective age group.

3.2. System Narrative

At the beginning of each sports season, it is necessary to submit official documentation to the Portuguese Basketball Federation. These documents should include all the information related to the club's establishment - data regarding athletes and their guardians, coaches, and administration. There are three types of documents: those to be filled out exclusively by the club, those to be filled out by both the club and coaches and those to be filled out by both the club and guardians.

The registration documents are intended for athletes who wish to make their first registration as basketball players or for athletes who wish to renew their player status (requiring an annual update of their data). The process of filling out documents faces several obstacles, from the difficulty of obtaining them (there is no single channel to do so) to managing poorly filled-out documents (which requires their return and repetition of the process) and organizing all the information generated with this documentation.

- There are approximately 200 athletes in Odivelas Basket Clube who need to be registered with the Portuguese Basketball Federation to be eligible to compete.

- For the registration of each athlete, the completion and submission of seven official documents are required.

- For underage athletes, their respective guardians are responsible for filling out the documents.

- The documents must be submitted to the section leaders of the respective age groups who are in charge of submitting the documents to the Portuguese Basketball Federation.

- The club's accounting requires the creation of documents to record all its activities.

- Every month, guardians are required to pay the fees for their respective athletes, as well as membership fees.

- Proof of payment of the fees needs to be provided.

- Only the management is responsible for verifying the payments and balancing the club's accounts.

3.3. Criticism of the system

The current system presents several weaknesses in terms of support, information retrieval, and retention.

Inadequate data creation

There is no single channel for document exchange among all stakeholders of the club, and information is dispersed across various communication means (e.g., emails, WhatsApp, Telegram).

The registration process begins with the guardian requesting information from the section leader, who responds by sending the necessary documentation for athlete registration. After receiving the documents, the guardian must download them, fill them out, and personally deliver them to the section leader or submit them via email or mobile application. The main reasons for delays in completing registration are poorly filled-out fields, missing information, and failure to submit documents. The first two reasons may arise from human error (e.g., lack of knowledge, misinterpretation, etc.), but they often require clarification from the section leader regarding specific field completion, which further delays the registration process. The third reason may also be due to human error (e.g., forgetfulness), but it mainly occurs when the guardian loses documents, requiring a request and resending of the documents by the section leader, further delaying the process. As long as all documents are not correctly submitted, there is a constant exchange of information between the guardian and the section leader, dispersed among personal contact, email, and mobile application, leading to information dispersal and repetition of errors in the registration process. The only payment method available in the institution is bank transfer. To confirm the payment of fees and membership dues, guardians can send

proof of payment to the section leader or president's contacts, or the club's treasury email. However, it is solely the responsibility of the management to verify the proof of payment and check the club's accounting balance, ensuring that bank transfers were successfully made. Besides the delay in payments by the guardians, the documentation related to payment proofs is also dispersed via email and mobile applications, especially when dealing with 200 athletes.

Information fragmentation (official documents, payment receipts, etc.) exists across several platforms highly susceptible to data loss (e.g., emails, paper, cloud-based files - Excel, Word, PDF). After completing a registration, the section leader may have documents related to an athlete dispersed across multiple platforms - paper, email, or mobile application. Similarly, after sending proof of payment, it may be dispersed in two platforms - email or mobile application. Many of these documents remain "stored" in respective conversations and emails, leading to disorganization, hindered access to information, and frequent document loss.

Lack of information structuring and replication. After a guardian makes a fee payment, they must send the corresponding proof to the club's treasury. This process can be done directly by sending the proof via email or mobile application to the president or treasury or indirectly by using the section leader as an intermediary who will subsequently deliver the proof to the management. The management has various shared files in the cloud used to reconcile payments and registrations (e.g., 'Registered athletes file', 'Paid fees file', 'Paid membership dues file', etc.). Whenever an athlete is registered or a payment is made, the respective files are manually updated. As there is more than one member of the management responsible for updating financial reconciliations and registrations, many documents end up having multiple versions, making it difficult to have an aggregated and unified view of the information.

Excessive data exchanged between stakeholders

High turnover of organization employees (directors, coaches, section leaders) without proper information support to prevent data loss. It is common for section leaders of respective age groups to change every two years, as section leaders generally represent their roles in the age group where their child is involved. Consequently, several documents are in the possession of each section leader of the corresponding age group, and these documents are often lost when the section leader ceases their duties.

Organization restarts/resets - information is not consolidated in a single system. The dispersion and subsequent loss of documents, along with the lack of centralization of all documentation in a single location, require the collection of all official documentation for athlete registration year after year. There is no utilization of existing information, leading to recurring obstacles and delays in completing registrations. The aforementioned points indicate that the organization has a volatile structure, making it challenging to carry out various administrative processes of the club on an annual basis throughout a sports season.

Inadequate generation of information
All data collected by the club does not generate "Information" that represents value for the institution. The athlete data collected is solely for the purpose of annual registrations and does not reflect the club's information about its athletes. In addition to registration data, other valuable information that is not stored and analyzed is lost throughout the season. Assigning meaning to the obtained data would provide insights into various areas of the club, such as efficient scheduling and allocation of facilities for teams (management), adjustment of fees/payment deadlines (finance), timely promotion of recruitment events (marketing), etc. The lack of a centralized repository for data aggregation prevents the analysis of data for the creation of meaningful information in the future.

4. TO-BE System

The main systematization processes of the TO-BE system are:
i) Simplification of the registration process: The system will allow the registration process to be carried out solely by the guardians and the system itself, eliminating the need for a section leader. The system will automatically generate the necessary documents for registration, reducing the risk of errors and the time spent on this task.

ii) Centralized storage of information: The system will store all relevant information, including registration data, proof of payment, and other official documents. This will prevent information duplication and data loss.

iii) Process automation: The system will send payment reminders, notify the management about new payment proofs, and allow data analysis to improve club management.

iv) Reduction of section leader’s workload: The system will reduce the excessive tasks assigned to section leaders and prevent issues related to staff turnover due to document dispersion.

4.1. CRUD/AD Methodology
The CRUD/AD methodology is a framework that aims to ensure coherence and consistency throughout the Enterprise Architecture - the process of managing businesses that focuses on the analysis, design, planning, and implementation of long-term organizational strategies and structures to achieve specific business objectives. The methodology utilizes two tools: the CRUD Matrix and Axiomatic Design [4].

The CRUD Matrix is a popular tool used to analyze the relationships between applications and data classes in the Enterprise Architecture. It is a table that represents four basic operations: Create, Read, Update, and Delete. These operations are mapped to the data classes of the Enterprise Architecture so that they can be easily understood and efficiently managed. Axiomatic Design is a systematic approach to designing complex systems that aims to create an independent design that meets all functional requirements while minimizing the information content of the design.

The CRUD/AD framework has three layers of enterprise architecture associated with UML diagrams. The first layer depicts the sequence of activities in Business/Process Architecture. The second layer describes the list of applications and the data diagram, while the CRUD Matrix combines applications and data items from the Information Systems Architecture. Finally, the third layer illustrates the Technological Architecture of the infrastructure. The CRUD/AD methodology is an iterative procedure and should be repeated until a satisfactory level of alignment is achieved [4].

4.2. CRUD Matrix Use Cases vs. Classes

The CRUD matrix, as represented in Table 1, allows for the cross-referencing of data information (data classes) with applications (use cases). It is important to note that the CRUD counters adhere to the 1N11 form, validating the coherence of the matrix and ensuring consistency between the functional definitions and the data inherent in the proposed solution.

Table 1. CRUD Use-cases vs. Classes

Use Case \ Classes	**RC FPB**	**RA FPB**	**RA OBC**	**RM OBC**	**RMP**	**RMP**	**Coach**	**Guardian**	**Athlete**
Register CoachFPB	CRUD								
Register AthleteFPB		CRUD							
Register AthleteOBC			CRUD						
Register MemberOBC				CRUD					
Manage Membership Payments					CRUD				
Manage Monthly Payments						CRUD			
Manage Coach Data							CRUD		
Manage Guardian Data								CRUD	
Manage Athlete Data									CRUD
Consult Registrations	R	R	R	R					
Consult Payments					R	R			
CRUD Counters	1211	1211	1211	1211	1211	1211	1111	1111	1111

The CRUD-AD methodology can be easily integrated with other methodologies and tools, such as the Unified Modeling Language (UML), for information system analysis and design. This allows CRUD-AD to be used in conjunction with existing approaches, providing a more comprehensive and coherent view of the system. The theory of Axiomatic Design provides a systematic approach to information system design. By applying the principles of Axiomatic Design, it is possible to simplify the design of the CRUD matrix by identifying the appropriate relationships between functional requirements and design parameters. This leads to a more efficient and consistent design of the information system.

The integration with other methodologies and the simplification of design are two of the main advantages of using the CRUD-AD methodology. These advantages contribute to the development of efficient, flexible, and business-aligned information systems.

5. Interface

5.1. Parent/Guardian Profile

The Parent/Guardian profile is divided into three main areas: Athlete, Registrations, and Payments. The registration area includes the following functionalities: Register Athlete (First Registration), Revalidate Registration, Register as a Member, and Cancel Registration. When selecting the "Register Athlete (First Registration)" functionality, the user will be taken to the page with the form for the first registration. After filling out the form, the system will automatically populate the official Word documents with the form data and download them. At the same time, the user will be redirected to the Athlete/Registration Process page, as shown in Figure 1, where they only need to print the documents, sign them, scan them, and upload them back to the system. Another functionality of the system is to revalidate an athlete's registration. In the following sports seasons after the first registration, the user only needs to access "Revalidate Registration," where they will be presented with a form identical to the first registration, with the difference that this form is already fully filled out with the previously provided data. Therefore, it is only necessary for the user to confirm that the data remains up to date. This functionality addresses one of the main constraints identified at the beginning of the case study: the constant filling out of annual documents with the same information.

Figure 1. Registration Process.

The payment area includes the following functionalities: Monthly Fee Payment and Membership Fee Payment. When accessing the monthly fees section, the user will be directed to the payment page for the athlete's 10 monthly fees. It is possible to review the paid fees and those that are still due.

- As the end of each month approaches, each guardian will be notified by the system about the upcoming deadline for payment of their athlete's monthly fee and membership fees;
- Each payment receipt will have a designated location for uploading.

5.2. Administrator Profile

The administrator profile is divided into two main areas:

Athletes - an area for accessing information on registered athletes across all age groups. The list of athletes can be filtered by "Age Group" and "Gender." By selecting a specific athlete, it is also possible to access their personal data and check the current status of their registration process.

Monthly Fees - an area for accessing information on athletes' monthly fee payments and members' membership fee payments. Figure 2 represents the monthly fees of all club athletes. This list can be filtered by "Age Group," "Gender," "Athlete," "Month," and "Payment." Through this functionality, a detailed query can be performed to determine if a particular athlete's fees are up to date.

By having access to accurate and up-to-date information on fee and membership payments, the club administration can make more informed decisions regarding financial management. The payment query area simplifies administrative processes by reducing the need for manual work to track payments and verify the status of each member or individual athlete. This saves time and resources, allowing the administrative team to focus on other important areas of the organization.

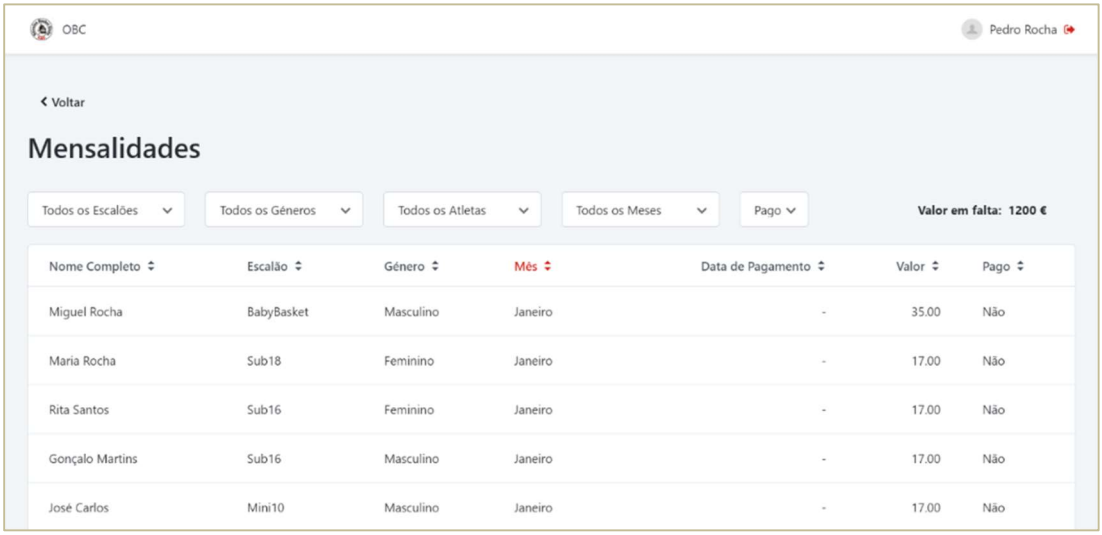

Figure 2. List of Monthly Fees.

6. Conclusion

The completion of the Case Study has provided a deeper understanding of the research topic and the challenges faced by the sports club in its administrative management. Through the assessment of the AS-IS system, weaknesses were identified, such as information dispersal across multiple communication channels, delays in athlete registration processes, and disorganization in payment methods and document management.

By implementing the TO-BE system, the identified weaknesses of the current system have been addressed. The main weakness, the athlete registration process, will be resolved by allowing guardians to fill out forms, followed by the automatic generation of all necessary documents for registration by the system. The guardians will only need to download the documents, sign them, and upload them back into the system. The system facilitates a simpler payment process with the option to upload payment receipts. All information will be aggregated in a single location, preventing data replication or loss. The implementation of the new system will alleviate the annual workload burden on the organization's administrators (section leaders) and mitigate employee turnover issues. It will enable an analysis of registration and payment processes to generate insights and optimize various areas of the club.

The CRUD/AD methodology [4] was employed throughout the project, providing a systematic framework for analyzing, designing, and implementing the system. The CRUD Matrix and Axiomatic Design ensured coherence and consistency in the Enterprise Architecture, with continuous refinement of system development.

The prototype development effectively addressed the club's issues and resulted in improved efficiency, cost reduction, streamlined processes, and enhanced information quality. It proved to be a viable solution for optimizing administrative management and resource allocation in sports clubs.

In conclusion, administrative management in sports organizations poses unique challenges, but information systems can provide promising solutions. Tailoring these solutions to the specific needs of each organization is crucial for success.

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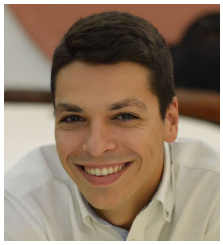

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