



Placement Report: Breda Guardians

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Abstract

This report details the initiatives undertaken during my internship at Breda Guardians to enhance the organisation's data management, research infrastructure, and community engagement. The primary objective was to establish a sustainable framework for data collection, analysis, and stakeholder reporting, addressing key operational challenges. Central to this effort was the implementation of a server infrastructure supported by an AI grant, enabling automated data tracking and integration with platforms such as *GameBooker*. Additional projects included analysing attendance and Discord community data, refining ethical practices for research, and creating strategies for effective stakeholder engagement. The outcomes highlighted significant improvements in operational efficiency, stakeholder communication, and data utilisation, laying the foundation for future growth. These findings demonstrate the value of structured research practices and innovative technologies in advancing Breda Guardians' mission to strengthen the gaming and esports community in Breda.

1 Project Description

During my internship at Breda Guardians, I was involved in several high-impact projects that aligned with my role as a Research Manager. One of the most significant initiatives I contributed to was the project titled **“Enhancing Esports Team Performance Using Game Analytics, Communication, and Physiology”** Heijligers et al., 2024. This project sought to explore the integration of cutting-edge game analytics, communication strategies, and physiological data to optimize the performance of esports teams.

As part of this initiative, I played a key role in evaluating the effectiveness of the AI system under development, ensuring that it met the practical needs of the esports teams it was designed to support. While I wasn’t directly involved in the technical development of the AI solution, my contributions were crucial in providing feedback from the user’s perspective, ensuring the system would be both functional and user-friendly. I collaborated closely with other team members, including Thomas Pichardo, Maikel Boezer, Mauro van Hulst, Vincent van der Beek, and Imani Senior, who were responsible for the technical aspects of the project.

Furthermore, I was tasked with overseeing the ethical aspects of the research. This involved drafting the *Information Letter for Participants* A.2 and the *Consent Form* A.1, which ensured that all data collected during the research adhered to ethical guidelines and participants were fully informed of their rights. These documents were essential for securing the trust of the participants and for maintaining the integrity of the research process.

Alongside the core responsibilities of this project, I was involved in various side activities aimed at expanding my understanding of the esports industry and the broader scope of emerging technologies. One such activity was my participation in the preparation for the *Breda Esports Conference*¹, an event designed to showcase opportunities in esports and provide valuable insights from leading Dutch experts. During the conference, I actively contributed to the organisation and facilitation of an esports research roundtable.

This roundtable, hosted by our colleagues Ekaterina Uzunova and Dr. Bram Heijligers, in collaboration with Breda Guardians and students from Breda University of Applied Sciences’ Data Science & AI programme, served as a platform to present the ongoing *Enhancing Esports Team Performance* project. This initiative focuses on developing a multimodal data science toolkit to assess player and team performance.

During the discussion, participants of the conference were invited to provide feedback on the toolkit. Additionally, the roundtable encouraged brainstorming on several key topics, including:

1. Identifying key performance indicators (KPIs) for esports teams.
2. Strategies for scaling up esports research innovations to professional teams.
3. Exploring the added value of esports research for both the esports industry and broader societal impacts.

¹<https://www.bredaesportsconferentie.nl/>



This collaborative and interactive approach offered invaluable insights into the professional esports ecosystem, highlighting the practical implications of ongoing research while fostering meaningful dialogue with industry stakeholders. Heijligers, 2025

In addition to the conference, I attended the *DIGIREAL* lunch meeting hosted by Uzunova, 2024, where I was introduced to the latest academic advancements in technologies related to competitive gaming. This meeting provided an excellent opportunity to explore cutting-edge innovations and their potential applications in the esports industry.

These experiences enriched my perspective on the intersection of esports, technology, and research, equipping me with a more holistic understanding of the field.

Beyond my involvement in the esports performance project, I identified significant gaps in the operational infrastructure of Breda Guardians. One such gap was the lack of a dedicated server, which became particularly evident during the course of the *Enhancing Esports Team Performance* project. This insight led me to propose the acquisition of the organization's first server to meet the growing needs for data storage, website hosting, and support for *The Hive*, a local esports facility that serves as a hub for gaming activities.

To secure the necessary funding, I authored the **BUas AI Grant Proposal A.3**, which outlined the organization's need for enhanced infrastructure to support its projects. I carefully evaluated three potential server solutions—assembling a Raspberry Pi cluster, renting a third-party server, and using an ASUS NUC 14 Pro with HDD Bay. After considering the pros and cons of each option, I ultimately recommended the ASUS NUC 14 Pro due to its excellent balance of performance, scalability, and cost-effectiveness. This proposal was instrumental in securing the AI Grant and allowed Breda Guardians to invest in the infrastructure needed for future research and operations.

In another project aimed at improving operational efficiency, I developed a Python Flask application called *GameBooker*. This application was designed to address the challenges related to attendance tracking and gaming statistics at *The Hive*. Prior to the development of *GameBooker*, the organization used a rudimentary system based on QR codes linked to a Google Form. This approach proved inefficient, lacked enforcement, and led to inaccurate data collection. By streamlining the process with *GameBooker*, I was able to improve data accuracy, ensure real-time reporting, and enhance the overall user experience for attendees.

The first phase of the project involved gathering and processing historical data that had been collected through the previous Google Form system. This data was stored in an Excel file and then converted into a CSV format for further manipulation. Using the *Pandas* library, I pre-processed the data, ensuring that all entries were valid and standardized before inserting them into the new *GameBooker* database.

In addition to these core contributions, I was tasked with analyzing data from *The Hive* and the associated Discord server to gain insights into the organization's growth and community engagement. This analysis was critical for demonstrating the impact of Breda Guardians to stakeholders, such as the Municipality of Breda, and was also important for shaping future strategies. For example, reaching 500 members on the Discord server unlocked various benefits, including improved visibility and additional engagement tools, which represented an important milestone for the organization.



The data collected via Google Forms needed extensive cleaning and validation before it could be used effectively. The pre-processing phase involved removing irrelevant columns, correcting formatting inconsistencies, and standardizing critical fields like student numbers and email addresses. This cleaned data was then mapped to the *GameBooker* database, ensuring consistency and accuracy. The system was designed to handle user requests in real-time, allowing users to check availability for devices at *The Hive* and confirm their reservations through a simple and efficient web interface.

Looking ahead, the *GameBooker* system should undergo further improvements. As Breda Guardians plans to upgrade its infrastructure with a dedicated server, additional features will be integrated, such as a card-reader system for automated check-in. This will allow users to scan their student IDs to gain access to the gaming stations, streamlining the check-in process and enhancing security. Moreover, advanced data analytics capabilities will be incorporated to provide deeper insights into usage patterns, peak times, and user demographics, further empowering the organization to make data-driven decisions.

Through my internship at Breda Guardians, I gained valuable experience in data management, AI systems, and research infrastructure. I learned the importance of ethical data collection, cross-functional collaboration, and the role of data analytics in enhancing the operations of a research-driven organization.



2 Organisation Information

2.1 Organisation Description

Breda Guardians is a local esports community based in Breda, dedicated to bringing together gamers from the region. As part of Breda University of Applied Sciences, the organisation operates from its facility, "The Hive", located on the BUas campus. Their mission is to foster a thriving community for gamers and aspiring semi-professional esports players within Breda and its surrounding areas. Looking ahead, there is potential for broader national collaboration, as TeamNL—the Dutch national sports organisation—is exploring opportunities to integrate Breda Guardians into the national esports ecosystem.

2.2 History of the Organisation

Founded as an initiative within Breda University of Applied Sciences, Breda Guardians was created to advance esports and offer a structured platform for gamers. What began as a small community has become a prominent esports organisation, complete with its state-of-the-art facility, "The Hive". This remarkable growth has been fuelled by the rising popularity of esports and the strong support provided by BUas's infrastructure.

2.3 Structure of the Organisation

The work culture at Breda Guardians is characterised by a relaxed but productive environment. Employees are highly focused on delivering results, but they also value the balance between work and home, frequently taking breaks to participate in team activities such as gaming. While there is no rigid hierarchy (Figure 1), the organisation is led by Ruben Been as CEO and Liedewei Ratgers as COO, both of whom maintain an approachable leadership style that encourages open communication. Ekaterina Uzunova, as Project Manager and Research Advisor, provides guidance on the research project. Asrin oversees event organisation, Zoe manages the community, and I handle the research department.



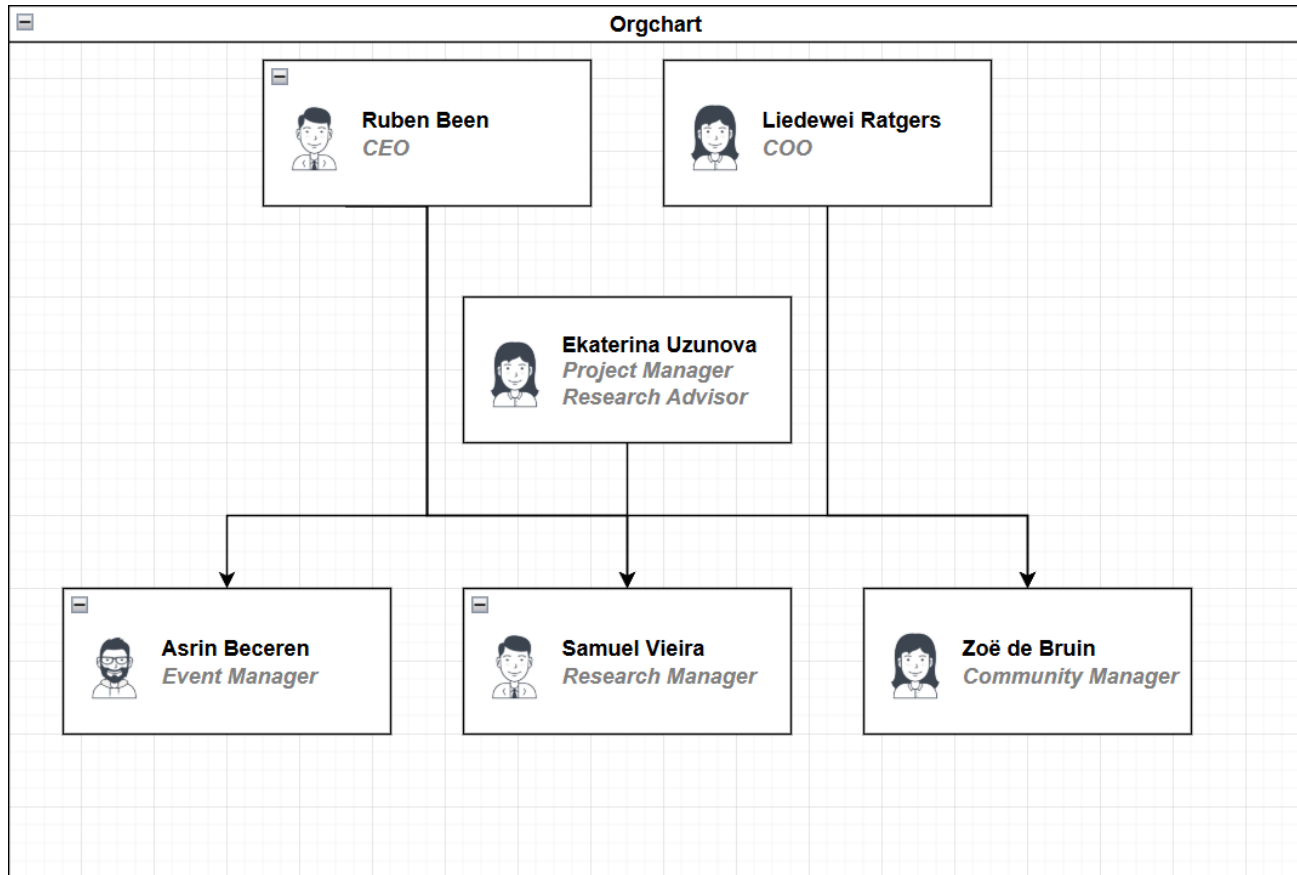


Figure 1: Breda Guardians' Organisational Chart

Meetings within the organisation are informal, which promotes active participation from all team members and ensures that everyone's voice is heard. A key aspect of the culture is open to both giving and receiving feedback, contributing to an atmosphere of continuous learning and improvement. Although communication occurs primarily through WhatsApp, email is used for more formal or official matters.

As the sole member of the Research department, I currently do not follow a formal framework for task management. Instead, I prioritise my workload through a to-do list system, ensuring that tasks are completed in a timely and organised manner.

3 Ethical Considerations

Breda Guardians places a strong emphasis on ethical considerations in its operations, ensuring that all projects and activities align with established ethical frameworks and best practices. The organisation's commitment to ethical standards is particularly evident in its handling of data, adherence to transparency, and its focus on promoting inclusivity within the gaming and esports community.

3.1 Policies and Guidelines for Data Handling

While Breda Guardians does not have a formalised set of internal policies for data governance, ethical principles are embedded in the way data is managed and processed. The organisation collects data primarily through forms and digital tools such as Google Forms, and efforts are made to handle this data responsibly. For instance, during the internship, all collected data was pre-processed to ensure accuracy and relevance, while unnecessary or sensitive information was removed or anonymised to protect individual privacy.

To further ensure compliance with ethical standards, documentation such as an *Information Letter for Participants* and a *Consent Form* was created for projects involving participant data. These documents outlined the purpose of data collection, how the data would be used, and the participants' rights, ensuring transparency and informed consent. This approach minimised the risk of misuse and established trust between the organisation and its stakeholders.

3.2 Handling Confidential Data

Breda Guardians does not typically handle highly sensitive or confidential data, but when such information is collected, it is treated with the utmost care. For example, when processing data from The Hive, steps were taken to validate and clean the data, ensuring that no unnecessary personal information was retained. Phone numbers and other potentially sensitive data were segregated into distinct columns, enabling controlled access and ensuring that only essential data was utilised for analysis.

The organisation does not currently operate under formal data protection certifications, such as GDPR compliance frameworks, but it adheres to general ethical guidelines, prioritising the security and privacy of all data it collects.

3.3 Ethical Considerations in Products and Services

Breda Guardians' initiatives, including The Hive and its gaming events, are designed to foster community engagement and inclusivity. Ethical considerations are integral to these offerings. For example, The Hive's live-tracking system was developed to transparently monitor attendance and engagement while respecting the privacy of its users. No excessive or intrusive data is collected, ensuring that the system aligns with ethical best practices.



When promoting its Discord server and other community tools, the organisation ensures that participants' data and interactions are used solely to enhance community growth and are not exploited for commercial purposes. Any partnerships or sponsorships entered into are evaluated to ensure alignment with the organisation's values of fairness and inclusivity.

3.4 Explainable AI and Transparency

Although Breda Guardians is not directly involved in the development of AI systems, the organisation is aware of the importance of explainability and transparency when incorporating technology into its operations. In collaborations where AI is used, such as the esports performance project, ethical oversight ensured that data collection and analysis were conducted responsibly. Measures were implemented to ensure that any AI-driven outcomes were interpretable and aligned with the intended goals.

For instance, in the esports project, ethical considerations were crucial in drafting participant documentation and ensuring the data used for AI training adhered to privacy standards. While the AI solution itself was developed by a partner organisation, Breda Guardians actively provided feedback to ensure it met ethical and practical requirements.

4 Methodology

4.1 AI Grant Proposal

During my internship, I also authored several proposals, including one for the **AI Proposal BUas AI Grant**. I identified a need for local infrastructure at Breda Guardians, which was highlighted during the development of the *Enhancing Esports Team Performance* project. I proposed acquiring the organisation's first server to address the need for secure data storage, facilitate website hosting, and support a new sign-up system for *The Hive*, an esports facility.

To evaluate the most appropriate server solution, I considered three options:

- **Option 1: Assembling a Raspberry Pi Cluster**
 - **Pros:** Low cost, energy-efficient, scalable
 - **Cons:** Increased configuration complexity, limited computational power, and storage capacity
- **Option 2: Renting a Third-Party Server**
 - **Pros:** Immediate availability, scalability, professional support
 - **Cons:** Recurring costs, limited control, reliance on external providers
- **Option 3: Using an ASUS NUC 14 Pro with HDD Bay (recommended solution)**
 - **Pros:** High performance, expandable storage, full control over configuration
 - **Cons:** Higher initial cost

I ultimately recommended the ASUS NUC 14 Pro, which struck a balance between performance, scalability, and cost-effectiveness, and aligned with Breda Guardians' long-term goals. This proposal contributed to the team's success in securing the AI Grant.

4.2 GameBooker: Attendance and Game Tracking System

Breda Guardians faced a significant challenge at the beginning of the internship due to the absence of an efficient system for tracking attendance, the number of visitors, and the types of games played at *The Hive*. Prior to this project, the organization used a basic QR code system linked to a Google Form, where attendees would input their details to receive a passcode for computer access. However, this method presented multiple limitations, notably the lack of enforcement, leading to discrepancies between actual attendance and the data collected. Furthermore, the inconsistent data collection process hindered the organization's ability to demonstrate its impact to stakeholders, such as the Municipality of Breda, which is essential for securing continued support and funding.



To address these challenges, I developed *GameBooker*, a Python Flask application designed to streamline the attendance tracking process while integrating with the future Breda Guardians website. The aim was to improve data accuracy, provide real-time information, and ensure a more reliable and secure tracking system.

4.2.1 Data Collection and Conversion

The first step in the development process involved gathering and processing the historical data collected via the Google Form. This data was stored in an Excel file, which was then converted into a CSV format for easier manipulation. Using the *Pandas* library, the CSV file was read into a *DataFrame* (Figure 2) for further preprocessing.

```
attendance_df = pd.read_csv(  
    | "data\Sign up form for Esports room (Antwoorden) - Formulierreacties 1.csv"  
    | )  
✓ 0.0s
```

Figure 2: Importing CSV to DataFrame

4.2.2 Data Preprocessing

Once the data was loaded, I performed several preprocessing steps to ensure the dataset's consistency and structure before insertion into the database. The first task was to remove unnecessary columns that did not align with the database schema, such as extraneous fields generated by the Google Forms system (Figure 3). This streamlined the dataset, retaining only the relevant data for integration into the *GameBooker* database.

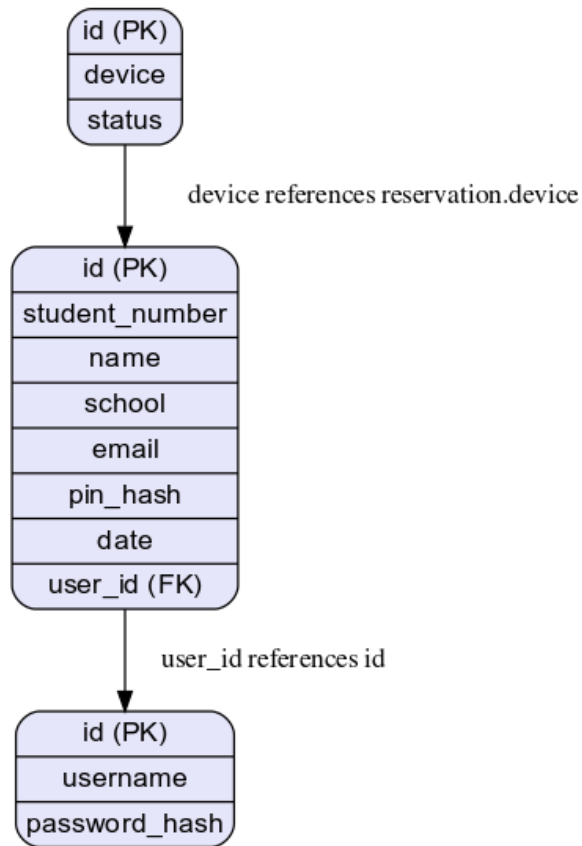


Figure 3: Database Schema

A key focus of this step was the validation and standardization of critical fields, including student numbers and email addresses. The student numbers were especially challenging due to varying formats. Some were formatted correctly, while others contained non-numeric characters or incomplete information. A custom function was implemented to standardize these entries by removing non-numeric characters and checking for correct formatting. Similarly, email addresses were validated to ensure proper formatting, eliminating invalid entries to maintain the integrity of the data (Figure 4).

```
def process_student_number(number):  
    if pd.isna(number):  
        return 'N/A', 'N/A'  
  
    # Remove any non-digit characters for processing  
    cleaned_number = re.sub(r'\D', '', str(number))  
  
    # Check if the cleaned number is exactly 6 digits  
    if len(cleaned_number) == 6:  
        return cleaned_number, 'N/A'  
    else:  
        # Check if the original number is a phone number  
        if re.match(r'^\+|\d{10}$', str(number)):  
            return 'N/A', number  
        else:  
            return 'N/A', 'N/A'
```

Figure 4: Student Numbers Preprocessing

4.2.3 Mapping Data to the Database

After preprocessing, I mapped the cleaned data to the SQLAlchemy models, which had been designed to align with the *GameBooker* database schema (Figure 3). Each row of the DataFrame was translated into a *Reservation* model instance, with attributes such as name, school, email, device, student number, and date of visit being accurately mapped. The data was then inserted into the database using SQLAlchemy's session management.

4.2.4 Data Validation and Integrity Checks

Once the data was successfully inserted into the database, I conducted several validation checks to ensure data consistency and accuracy. Using SQLAlchemy queries, I examined the records for missing or inconsistent entries and ensured that all fields were correctly populated. This validation step was critical in providing confidence that the system could accurately track and report attendance in real time.

4.2.5 User Interaction and Real-Time Updates

At this stage, the system was capable of managing user requests, recording device reservations, and displaying real-time availability (Figure 5). The website interface allowed users to easily check device availability at *The Hive* and provided them with the ability to fill out the required form to confirm their reservations. A time-based check (using the current date and time) was implemented to automatically update the availability status of devices, ensuring that reservations were accurately reflected in the database.



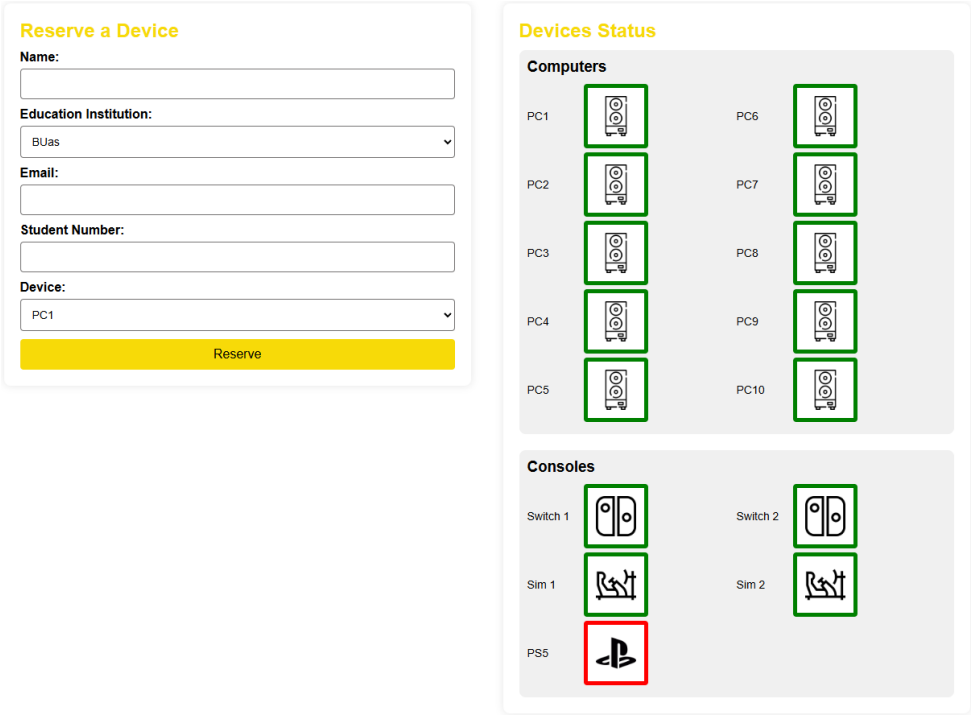


Figure 5: Live Reservations

4.2.6 Future Enhancements

Looking forward, *GameBooker* is expected to undergo significant improvements. As *Breda Guardians* prepares to upgrade its infrastructure by acquiring a dedicated server, the system will be enhanced with additional features, such as a card-reader system for check-in. This feature will allow users to scan their student IDs to gain access to the computers, eliminating the need for manual form submissions and further improving the efficiency of the check-in process.

Integrating the card-reader system will also provide a more secure method of verifying users, linking their attendance directly to their identity. This will help eliminate potential errors associated with user self-registration, further ensuring the accuracy and reliability of the collected data.

Additionally, I plan to implement advanced data analytics capabilities to offer detailed insights into usage patterns. By analysing the data collected over time, the system can generate reports on peak usage times, popular games, and demographic information about attendees. This will provide *Breda Guardians* with actionable insights to inform strategic decisions, such as event scheduling, device allocation, and future investments (Figure 6).

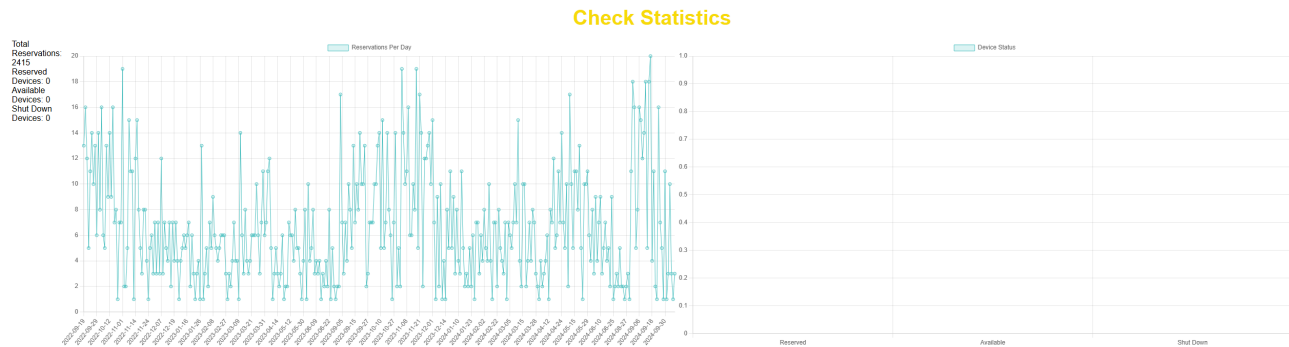


Figure 6: Future Enhancements to GameBooker

4.3 Discord and *The Hive* Data Analysis

One of the smaller but significant projects I worked on during my internship at Breda Guardians was analysing the data collected up to that point. This data consisted of entries to *The Hive* and the member count of the Discord server. These datasets provided critical insights into the organisation's reach and engagement with the community.

At the beginning of my internship, we were informed that reaching 500 members on the Discord server would unlock certain benefits offered by Discord, such as improved server visibility and additional tools to enhance community engagement. This milestone was not just an organisational goal; it represented a tangible indicator of growth and success that could be shared with stakeholders, such as the Municipality of Breda, to demonstrate our progress.

The entries to *The Hive* were equally important as they reflected real-world interactions and participation in Breda Guardians' initiatives. This data served as evidence of the organisation's contribution to fostering a thriving gaming and esports community within Breda. Accurate tracking of these numbers was crucial for reinforcing the organisation's credibility and securing continued support from the Municipality. By showcasing how many individuals were actively engaging with *The Hive*, we could substantiate claims about the impact and relevance of Breda Guardians in the local esports landscape.

4.3.1 Data Pre-Processing & Insertion

Before the data could be analysed, it required thorough pre-processing to ensure its accuracy and relevance. The raw data collected from Google Forms included several unnecessary columns and inconsistencies that needed to be addressed. We began by removing irrelevant columns automatically generated by Google Forms and renaming the remaining columns to shorter, more comprehensible names (see Fig. 7).



```
df1 = df1.drop([
    "Time of visit",
    "Date of visit ",
    "Free space for comments",
    "Which game are you going to play?",
    "Unnamed: 10",
    "Unnamed: 11",
    "Unnamed: 12",
    "Unnamed: 13",
    "Unnamed: 14",
    "Unnamed: 15",
    "Unnamed: 16",
    "Unnamed: 17",
    "Unnamed: 18",
    "Unnamed: 19",
],
axis=1,
)

# Rename columns to match SQLAlchemy model
df1.rename(
    columns={
        "Full name": "name",
        "Which university are you from? (If not from a uni, please let us know from where at the \"other\" section)": "school",
        "E-mailadres": "email",
        "What PC/Console will you use?": "device",
        "Tijdstempel": "date",
    },
    inplace=True,
)
```

Figure 7: Preprocessing Steps

One of the most challenging aspects of the pre-processing phase was handling the *student number* column. Since not all attendees of *The Hive* were BUas students, some entries in this column contained phone numbers or nonsensical data. To address this, we applied a series of validation steps:

1. We filtered out entries containing non-digit characters or exceeding six digits.
2. If a phone number was detected in this field, it was moved to a newly created column specifically for phone numbers.

This process ensured that the *student number* column contained only valid and usable data (see Fig. 8 and Fig. 9).

```
def process_student_number(number):  
    if pd.isna(number):  
        return 'N/A', 'N/A'  
  
    # Remove any non-digit characters for processing  
    cleaned_number = re.sub(r'\D', '', str(number))  
  
    # Check if the cleaned number is exactly 6 digits  
    if len(cleaned_number) == 6:  
        return cleaned_number, 'N/A'  
    else:  
        # Check if the original number is a phone number  
        if re.match(r'^\+|\d{10,}$', str(number)):  
            return 'N/A', number  
        else:  
            return 'N/A', 'N/A'
```

Figure 8: Student Number Pre-Processing

	date	name	Student number	device	school	email	phone_number
0	19-9-2022 15:41:23	Jian Jin He	193099	NaN	NaN	NaN	N/A
1	19-9-2022 15:41:27	Thomas Pichardo	223834	NaN	NaN	NaN	N/A
2	19-9-2022 15:41:31	Samuel Antonio Vieira Vasconcelos	211941	NaN	NaN	NaN	N/A
3	19-9-2022 15:41:55	Juan José Gutierrez	215517	NaN	NaN	NaN	N/A
4	19-9-2022 15:42:07	Fedor Chursin	220905	NaN	NaN	NaN	N/A
...
2407	7-10-2024 16:19:02	Jack Woodley	243752	06	Buas	243752@buas.nl	N/A
2408	10-10-2024 10:36:09	Nikita Bezumovsky	N/A	09	Karazin uni Ukraine	nikita.bezumovsky@gmail.com	+380685424290
2409	10-10-2024 12:09:03	Stanisław Płoski	232416	02	Buas	stachuploski@gmail.com	N/A
2410	10-10-2024 12:27:55	Achilles Lordos	230746	03	Buas	230746@buas.nl	N/A
2411	14-10-2024 11:06:41	Imani senior	225619	04	Buas	studentsenior1999@gmail.com	N/A

2412 rows × 7 columns

Figure 9: Student Number Pre-Processing Result

In addition to validating the data, we performed other cleaning tasks, such as formatting inconsistencies in timestamps and standardising responses in categorical fields. The cleaned data was then converted into a structured format suitable for database insertion.

These pre-processing steps were essential to ensure the integrity of the data and its compatibility with the database system. The final dataset was inserted into a live tracking database created to streamline data management and facilitate real-time monitoring of both Discord and *The Hive* activity (see Fig. 10).

```
def map_df_to_model(df):
    reservations = []
    for index, row in df.iterrows():
        # Initialize date variable
        date = None

        if isinstance(row['date'], str):
            # Try parsing with different formats
            try:
                # Try with seconds
                date = datetime.strptime(row['date'], '%d-%m-%Y %H:%M:%S')
            except ValueError:
                try:
                    # Try without seconds
                    date = datetime.strptime(row['date'], '%d-%m-%Y %H:%M')
                except ValueError:
                    # Handle if neither format works
                    print(f"Failed to parse date: {row['date']}")
                    continue # Skip this row if parsing fails
            else:
                # Convert Timestamp to datetime if it's not a string
                date = row['date'].to_pydatetime()

        # Create a Reservation instance
        reservation = Reservation(
            name=row['name'],
            school=row['school'] if pd.notna(row['school']) else 'Unknown',
            email=row['email'] if pd.notna(row['email']) else 'Unknown',
            device=row['device'] if pd.notna(row['device']) else 'Unknown',
            student_number=row['Student number'] if pd.notna(row['Student number']) else 'Unknown',
            pin_hash='N/A',
            date=date
        )
        reservations.append(reservation)

    return reservations

# Insert DataFrame data into the database
reservations = map_df_to_model(df1)

try:
    session.add_all(reservations)
    session.commit()
    print("Data inserted successfully.")
except Exception as e:
    session.rollback()
    print(f"An error occurred: {e}")
finally:
    session.close()

Data inserted successfully.
```

Figure 10: Inserting Data into Database

This database not only provided a centralised repository for all collected data but also enabled more efficient analysis and reporting. By leveraging this system, Breda Guardians could better track engagement metrics, such as attendance trends and community growth, and present these insights to stakeholders in a compelling way.



5 Recommendations

As the first Research Manager at Breda Guardians, I believe I have laid a strong foundation for the organisation and this position. Thanks to the approval of the AI Grant, we secured funding to invest in a local server for Breda Guardians. To build on this progress, I offer the following recommendations for the upcoming Research Manager and the organisation.

5.1 Server Setup and Utilisation

It is essential to correctly set up and manage the new server to unlock its full potential. While its primary purpose is to support data collection for the ongoing research project, its application can be expanded to address broader organisational needs. I recommend utilising the server as a web hosting platform for Breda Guardians' digital infrastructure. This would enable the seamless integration of *GameBooker* into the organisation's official website, automating the tracking of attendees at *The Hive* and significantly reducing manual data entry efforts.

Additionally, implementing a card reader system into *GameBooker* would allow students to check in using their student cards. This enhancement would not only improve the operational efficiency of *The Hive* but also provide a streamlined and user-friendly check-in process for attendees. By automating these processes, the system would ensure more accurate and reliable data collection, which is critical for analysing attendance patterns and community engagement.

The server's potential to organise and structure collected data is invaluable. In traditional research, data management often involves labour-intensive, manual processes that are prone to error. By automating these tasks, the server would modernise the approach to data collection and analysis, providing a centralised and efficient solution. This capability is particularly valuable for presenting actionable insights to stakeholders such as the Municipality of Breda and the Breda University of Applied Sciences, who rely on this information to evaluate and support Breda Guardians' initiatives.

Moreover, the server would enable Breda Guardians to store, process, and analyse data in a scalable and secure environment. This infrastructure could also support future research and development projects, further establishing the organisation as a leader in innovation within the gaming and esports community.

5.2 Stakeholder Reporting and Engagement

Developing a comprehensive presentation or report on Breda Guardians' impact and growth since the opening of *The Hive* is a crucial task. This report should leverage data storytelling techniques to present key metrics in an engaging and accessible way, highlighting the organisation's achievements and its role in fostering the gaming and esports community within the Municipality of Breda.

Sharing these insights with key stakeholders, including Breda University of Applied Sciences and Gemeente Breda, is essential. Given that Gemeente Breda provides the majority of Breda Guardians' funding for community development, such presentations can strengthen these partnerships and ensure



continued support for future initiatives. For instance, presenting compelling data on attendance figures, community engagement, and project outcomes would help reinforce the value of *The Hive* as a vital community resource.

To further enhance stakeholder engagement, I recommend adopting a proactive communication strategy. This could include:

- Organising regular meetings or updates with stakeholders to keep them informed about ongoing projects and future plans.
- Providing stakeholders with tailored summaries or dashboards that highlight the specific data and insights most relevant to their interests.
- Hosting events, such as open days or stakeholder-focused workshops, where partners can directly observe the impact of Breda Guardians' initiatives and engage with the community.
- Actively seeking feedback from stakeholders to align the organisation's goals with their expectations and priorities.

By combining clear, data-driven reporting with active stakeholder engagement, Breda Guardians can solidify its reputation as a reliable and impactful organisation, ensuring sustained collaboration and support from its partners.

5.3 Embracing New Projects

I strongly encourage the next Research Manager to remain open to exploring new projects that align with Breda Guardians' mission. The organisation's strong relationship with *TeamNL*, the national sports association, represents a valuable opportunity for future collaborations. Such partnerships could bolster Breda Guardians' visibility, resources, and impact within the gaming and esports community.

Additionally, now that Breda Guardians is a member of the *Esports Research Network*, it is crucial to continue collaborating with national academic partners in the Netherlands and applying for funding together. The membership offers an excellent platform to foster future collaborations with international partners, potentially expanding the scope of research initiatives and increasing the impact of Breda Guardians' work. Furthermore, it presents opportunities to connect more deeply with industry partners, allowing for meaningful exchanges of ideas and resources that can drive esports innovation.

One project worth pursuing involves the racing simulation game *Assetto Corsa*. This game boasts a passionate developer community and offers extensive data-exporting capabilities. By performing in-depth analysis of the data generated by the game, it is possible to identify actionable insights into a driver's performance and driving style. These insights could help drivers make impactful changes that lead to better results in competitions, positioning Breda Guardians as a leader in esports innovation.



5.4 Final Remarks

Breda Guardians stands at an exciting crossroads, with significant potential to expand its impact both in research and community engagement. By following these recommendations—maximising the server’s capabilities, strengthening stakeholder relationships, and embracing new projects—the organisation can continue to thrive and grow its reputation as a pioneering force in gaming and esports.



References

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A Appendices

A.1 Consent Form

The consent form is included on the following page.



Informed Consent

Title of research project: 'Enhancing Esports Team Performance Using Game Analytics, Communication and Physiology'

I hereby declare that I have read the information letter for participants (version: September 2024). I have been given the opportunity to ask additional questions about the study. These questions have been sufficiently answered. I have had sufficient time to think about whether or not I want to participate.

I understand that participating in this study is completely voluntary and that I can withdraw my permission to participate at any time, without having to give a reason. Withdrawal of permission will not have any negative consequences for me.

I have no objection to the fact that cognitive measures will be collected.

I am aware that anonymized data about me, that are meaningful for this study, can be used for scientific purposes. The informed consent form will be stored separately from all other data. Only the researchers involved in this study (namely: Bram Heijligers, Dr. Paris Mavromoustakos Blom, Kyana van Eijndhoven, Samuel Vieira) will have access to the data enabling participant identification. Anonymous digital data will be stored on a secure location (e.g., a secure server space of Breda University of Applied Sciences, Tilburg University, and on the desktop computers of the researchers involved in this study).

I hereby declare that I confirm to the requirements for participation in this study, namely: no (history of) migraine or epilepsy and no (expected) pregnancy, and that I am not younger than 18 or older than 67.

I know that the virtual simulation that will be presented can lead to some eyestrain. There are no further risks attached to participation in this study.

I hereby voluntarily agree to participate in the study mentioned above.

Name participant:

Signature:

Date:

I, the undersigned, hereby declare that this study has been explained both verbally as in writing to the above-mentioned participant. I declare to be willing to answer any upcoming questions about the study to my ability. A possible premature ending of participation in this study will not be of influence on how the participant is treated.

Name researcher: **Bram Heijligers**

Signature: Date:

A.2 Information Letter

The Information Letter is included on the following page.



Information letter for participants

Title of research project: ‘Enhancing Esports Team Performance Using Game Analytics, Communication and Physiology.’

Dear Sir/Madam,

You have shown interest in a scientific study of Breda Guardians, the Department of Data Science & Artificial Intelligence of Breda University of Applied Sciences, the Department of Organization Studies of Tilburg University’s School of Social and Behavioural Sciences and the Department of Cognitive Science and Artificial Intelligence of Tilburg University’s School of Humanities and Digital Sciences. Before you participate in this study it is required that we obtain your written declaration stating that you have been fully briefed about the study and are willing to participate. This is called “Informed Consent.” You will get an explanation from the researchers about the design of the study, the exact nature of your participation and the possible risks. Additionally, it will be explained how the results from the study will be managed to guarantee your privacy. Please read in the text below what participation in this study entails.

Study subject and goal

This project seeks to optimize esports team performance by integrating game data analytics, team communication data, and physiological signals into an automated data collection pipeline, focusing on games like Valorant, Counter Strike: 2, and League of Legends, in order to enhance decision-making and strategic planning for the Breda Guardians esports teams (BUas), while also laying the foundation for future collaborations in the Dutch esports research field to develop a longitudinal data collection and performance assessment pipeline.

Study content and design

Data will be collected in multiple sessions (i.e. match or practise) throughout 2024 and 2025 will take about 60 minutes per session.

Test session

During this study you will play a match/practice of the game of choice in The Hive. You will play your match/practice like any other match/practice with your fellow teammates where you will be able to show your skills and level of cooperation within the team. Before the start of the actual experiment, you will have the opportunity to ask questions about any aspect of the study related to the experiment.

Cognitive measures will be collected during the study using biometric measuring devices. By agreeing to participate in this study, the data collected from the biometric measuring devices will only be used for research purposes or ameliorating the performance of Breda Guardians' esports teams, including the participants own performance.

Confidentiality personal details and access by third parties

The information collected in this study will be treated confidentially. Personal details collected during this study will be substituted by a code number. Only this number is used for study documentation and in reports or publications on this study. The person corresponding to the code number can only be retrieved by he/she who has the key to the code (i.e., the researchers Bram Heijligers, Dr. Paris Mavromoustakos Blom, Kyana van Eijndhoven, Samuel Vieira). The anonymous data will be retained for a minimum of five years.

No individual results will be computed. Details will be processed anonymously and on a group level for possible scientific publications or presentations.

When are you not allowed to participate in this study?

You cannot participate in this study if you have (a history of) migraine or epilepsy. Additionally, you cannot participate if you are pregnant or expect to be pregnant or if you are younger than 16.

Voluntary participation

Participation in this study is completely voluntary. You do not have to give any reason if you do not want to participate. Even if you give your permission now, you can withdraw this permission at any time without having to give a reason.

Advantages and disadvantages

Participating in this study will provide you with direct advantages. Results of the study can potentially contribute to improving player performance, decision-making and behavioural sequences of events.

What to do when you have a complaint?

If you have a complaint about the study, you can report this to one of the researchers involved in this study. Alternatively, you can report your complaint to an independent person of the Ethics Committee of Breda University.

The experimenter is Bram Heijligers. He can be contacted via e-mail heijligers.b@buas.nl. The main researcher is Bram Heijligers, and he can be contacted via e-mail: heijligers.b@buas.nl. The independent person of the Ethics Committee of Breda University is Dr. Mata Haggis, and he can be contacted via e-mail: haggis.m@buas.nl.

Administrative procedure

If you are willing to cooperate in this study, we request you to sign the document “Informed Consent” before participating in this study.

If you have any further questions, please ask the experimenter.

Kind regards,

Bram Heijligers

Paris Mavromoustakos Blom

Kyana van Eijndhoven

Samuel Vieira

A.3 AI Grant Proposal

The AI Grant Proposal is included on the following page.



Proposal LLM AI System for Esports Research

Contacts

Bram Heijligers – ASD&AI Lecturer (heijligers.b@buas.nl)

Breda Guardians (bredaguardians@buas.nl)

Ekaterina Uzunova – Project Manager & Producer, Cradle AGM (uzunova.e@buas.nl)

Proposed

Description of the Problem

Esports teams face significant challenges in optimising player performance and strategies due to a lack of funding for coaching. Additionally, traditional coaching methods are limited in their ability to process the vast amounts of data generated during gameplay. Teams need tools to analyse game logs, player behaviour, and strategic decisions efficiently, delivering actionable insights to improve outcomes in highly competitive environments. Teams risk falling behind in a rapidly evolving and data-driven esports ecosystem without these tools.

Processing gameplay data on the other hand, is limited by the ability to adequately study games on a process level; what happens from moment to moment and why. Conventionally, these descriptions are largely qualitative; gut-feeling, observations which often don't provide enough depth or resolution and any quantitative methods need to be either video-annotated or time-stamped by the game itself in some way such as scripted events. Furthermore, the large amounts of data when collected on a process level will need to be analysed in an efficient and feasible way.

However, with the advent of highly versatile and accurate video annotation this becomes possible; couple that to the structural collection of weekly esports training data and from commonly. According to the IMO system, there are 3 data streams, namingly contextual, behavioural and physiological.

What's the aim of this project?

The primary goal is to structurally develop a multi-modal AI system that analyses and annotates the context using game data; mainly audiovisual gameplay footage), player behaviour, and team strategies. That output will then be combined using traditional AI

techniques as an outcome variable for behavioural and physiological data, providing insights in why certain things occurred in the game context. Thereby, this system will enhance the performance of Breda Guardians' esports teams and act as a training bed for third year ADS&AI students. The project will require the structural, automated collection of data from esports training and match session to provide a steady stream of training data.

Intended Contribution of the Project

The project will enhance esports performance through tailored, data-driven insights for players and coaches. Thereby.

1. offering BUas students hands-on experience coaching in a data-driven way;
2. offering BUas students & staff a tool to study game analytics and experience. Thereby, taking a more quantitative approach to research and design;
3. Allow BUas to build a high-quality multi-modal dataset of contextual, behavioural and physiological data; the full-cognitive loop of human information processing;
4. developing techniques to integrate large language models and multi-modal analytics in real-world game applications.

Why are you doing this project?

This project seeks to:

- address the growing demand for innovation in esports training and insights in player and team performance;
- showcase Buas as a leader in game research and applications;
- provide practical tools for Breda Guardians to improve their competitive edge;
- provide a prototype for a data science tool which could grow to help the game development community in and around Buas to improve their competitive edge;
- contribute to scientific knowledge in esports analytics and game-research.

Services

Link with BUas Education and Services

This project aligns with several key areas of BUas' mission:

1. **Educational Excellence:** It involves BUas students in real-world applications, providing hands-on learning experiences that bridge the gap between cutting-edge research and industry.
2. **Community Support:** Enhances the performance of the Breda Guardians, a BUas-affiliated esports team, promoting institutional pride and visibility. Enhances the capabilities of BUas to do game research and provide education and support to its students, staff and the game ecosystem around Breda/
3. **Data-Driven Transformation:** Supports BUas goal to become a data-driven educational institution. By leveraging AI to analyse and utilise data for improving esports performance this project not only showcases data analytics in action but also sets a precedent for how data-driven tools can enhance decision-making and efficiency across various domains within BUas such as game, media or another form of experience design.
4. **Attracting Students:** Highlighting BUas's focus on technology can attract students to its innovative programs, positioning them as forward-thinking and appealing to tech-savvy prospects.

Engagement

Who benefits from this Project?

1. **Breda Guardians:** Improved training methods and performance through AI-driven insights
2. **Year 3 ADS&AI students** will have hands-on involvement in the project's development phases as this project will be a recurring one for the specialisation projects taught the entire academic year.
3. **Year 2 ADS&AI students** Certain tasks associated with the project, such as predictive modelling on a cleaned dataset or fine-tuning Large Language Models will be transformed into educational challenges developed by students during weeks 9 and 10 of the first block of the ADS&AI program
4. **BUas Students:** Opportunities for practical, project-based learning in AI and game development by using a data-driven toolkit to analyse experiences and esports performance
5. **Research and teaching staff:** Will benefit from the access to a data-driven toolkit to analyse experiences and esports performance.
6. **Esports Community:** Access to new methods of performance analysis and coaching, potentially influencing industry standards.

7. **BUas** showcases its commitment to educational innovation by integrating advanced AI technology.

Key Needs Addressed

- For **Players and Coaches**: Tool for analysing and improving gameplay strategies.
- For **BUas Students**: Real-world experience with cutting-edge AI technologies and contribute to technological innovations during their education. Have a competitive edge in knowledge & skills by being able to work in a data-driven manner when dealing with human factors such as behaviour and experience.
- For **BUas** as an **Institution**: Boosts reputation as innovator in AI and esports, as well as supports BUas goals to become data driven. Must demonstrate technological leadership and innovation to enhance its image and attract talented prospective students.
- **BUas Researchers**: The project contributes valuable insights into the study of esports gaming and game research, helping to solidify BUas's position as a leading game development and research institute.

Practical Value

- Esports Performance: Optimise competitive performance for the Breda Guardians with tools to analyse game data, player behaviour, and strategies, enhancing performance through data-driven insights.
- Education and Job Prospect: Offers BUas students' practical opportunities to learn and apply AI and data analytics skills in real-world esports applications, preparing them for industry challenges in the world of ADS&AI or Leisure and Events.
- Data Collection and Utilisation: Enables structural, automated data collection from gameplay, building a comprehensive dataset that includes contextual, behavioural, and physiological data for esports. Scientific contribution to esports analytics and AI applications.
- Development of AI Prototypes: Creates a prototype for a data science tool that has potential uses beyond esports, applicable to the wider game development and research community.

Impact

Advancements and Innovations

If adopted long-term, this project could:

- Establish AI-driven training as a standard in esports, game design practises and game research methodology.
- Inspire new AI applications in esports analytics and player development through providing the infrastructure and a toolkit as a backbone.
- Demonstrate BUas's commitment to cutting-edge educational innovation, enhancing its reputation as a leader in game research, AI integration, and data-driven approaches.
- Support BUas's affiliated esports team (Breda Guardians), enhancing the capabilities of students and staff, and strengthens BUas's visibility and pride within the esports community.
- Support for Data-Driven Transformation at BUas: The project aligns with BUas's goal to become a data-driven educational institution. By leveraging AI and data analytics in esports, the project demonstrates how data-driven tools can enhance decision-making and efficiency in other domains, including media and experience design.

Possible Risks

The project concerns an existing project which has a successfully automated data-collection method in place but needs more infrastructure to start collecting effectively on scale:

- The effectiveness of AI models relies on quality training data. If data collection is inconsistent or the volume is insufficient, it could lead to inaccurate insights or failed models. Therefore, the system should be intuitive and easy to use.
- Collecting detailed contextual, behavioural, and physiological data may raise privacy concerns. Improper handling of this sensitive information could lead to data breaches. Therefore, the modular system should come with a hardware setup as to be able to store data from an esports or research organisation within the organisation.
- Coaches and players may resist adopting data-driven insights if they feel it undermines their expertise or adds complexity to their routines. Having a modular system which comes with its own server makes the solution easily scalable to other esports organisations as it allows for the storage and local data analyses of matches played by the deployed toolkit.

Furthermore, the development of a multi-modal AI system involves complex integration of different data streams (contextual, behavioural, and physiological). Technical challenges may delay the project or result in inaccuracies. Robust testing and iterative development of such a toolkit is required, which can be offered by it being a recurring project in the third-year specialisation projects of ADS&AI students.

Ethical Considerations

- Privacy: Player data will be securely stored on the server of Breda Guardians or future esports organisations. Data can be accessed through the ADS&AI server for analyses according to the permission agreed upon by the organisation and the project leader.
- Bias: AI models may inherit biases present in the training data, leading to unfair or inaccurate assessments of player performance. Rigorous testing will ensure AI recommendations are fair and accurate.
- Human Interaction: Coaches and players may resist adopting data-driven insights if they feel it undermines their expertise or adds complexity to their routines. So, care is needed to design and communicate that the AI tools will complement, not replace, human coaching.

A data management plan according to BUas's regulations is in its first draft and an application for the ethics review board has been prepared.

Capability

Technical System Utilised

This project will leverage existing advancements in multi-modal AI analytics to enhance esports performance, rather than developing entirely new models from scratch. We will evaluate several pre-trained models such as Llama 3.2, Gemini and GPT4o. Firstly, we will evaluate their suitability as video annotation tools. Secondly the multi-modal capacity to integrate other behavioural, physiological and contextual data streams. Thirdly, low operating cost both financially and computationally will be prioritised.

This toolkit will be used to analyse gameplay footage, player behaviour, and strategic decisions. To tailor the system to the specific requirements of Breda Guardians and maximise its effectiveness, we will explore various training approaches such as multi-modal data integration, traditional supervised learning; and design for continuous learning, and reinforcement learning techniques to optimise the model's capacity for delivering actionable insights.

Practicality

The project will utilise both the existing BUas hardware resources available and targeted new acquisitions. The data will be collected by the esports toolkit as developed under the Growth Project which is a collaboration of BUas, Breda Guardians and Tilburg University. The data collection consists of recorded gameplay data, control input, facial expression and emotion, eye-tracking, heart-activity and electrodermal-activity. The

data collection is already being taken care of and therefore not mention in the proposal but instead [demonstrated here shortly](#), and [in length over here](#). Finally, the ADS&AI department has an existing card-scanning application which can be utilised to manage play sessions & players correctly.

The processing power of the ADS&AI server will be harnessed for computationally intensive tasks, such as multi-modal data processing and AI model training. A dedicated data collection system will be implemented to ensure automated, consistent gathering of esports training and match data. To facilitate smooth data processing and model deployment, the project will require a dedicated on-site server for local model execution and provide the data-driven insight through the dashboard and match-review tool.

We will also explore the integration of existing game analytics platforms to visualise and interpret player performance data, ensuring a cohesive approach to analysing gameplay, behaviour, and physiological data streams. Additionally, the project will investigate the potential for integrating predictive models and fine-tuning AI to enable accurate player performance forecasting, enhancing the coaching and training experience for the Breda Guardians.

Skills and Experience of Team

- Bram Heijligers (Project Lead): Lecturer Data Science & AI, PhD-candidate. Project will be part of project leaders PhD project.
- ADS&AI and Leisure and Events Students: Providing technical, organisational, communicative or managerial support under expert supervision of the Project Lead and Breda Guardians staff as interns or as part of the ADS&AI specialisation projects.

Outcomes

Showcasing Results

The outcomes will be shared via:

- Toolkit Dissemination: providing access to Breda Guardians, BUas researchers & students to the toolkit
- Presentations: Showcasing project results to the projects stakeholders (Game Lab Tilburg University, University Twente, HAN Nijmegen), esports community and internal stakeholders such as educator or researchers within BUas; primarily AGM.
- Videos: Demonstrating the AI system in action during the training sessions and by generating more marketing material with the marketing department.

- Journal articles & conference articles: find suitable venues of journals and conferences to share the findings of the research & development through technical papers and case studies.

Timeline and Funding

Proposed Timeline

Milestone	2025				2026			
	Winter	Spring	Summer	Autum	Winter	Spring	Summer	Winter
First Iteration Analytical Toolkit (descriptive modelling)								
Continue & expand Data Collection								
Tutorials, Conducting User Studies, Presentations								
LLM Annotation & Modelling (predictive modelling)								
Academic Output								

Funding Requirements

1st Priority:

- ASUS NUC 14 Pro RNUC14RVHI300002I: € 456
- 2x16GB RAM DDR5 6500Mhz: € 75
- 2x16TB Seagate Ironwolf: € 660
- Orinoco 5-Bay Enclosure: € 150
- NFC Card Reader: € 30

2nd Priority

- Credits for using OpenAI's, Google's or Meta's models: € 2000. (Meta's Llama comes in free version with good enough performance and building blocks as a back-up)

3rd Priority

- Journal fees/Conference registration and travel costs: € 3.000

Total: € 6,371