**CHAPTER THREE**

**SYSTEM DESIGN AND METHODOLOGY/RESEARCH METHODOLOGY**

* 1. **Research Approach**

In the system planning phase, incorporating qualitative research approaches, such as interviews and case studies, can be invaluable for gaining a deeper understanding of user needs, requirements, and potential challenges. Here's how the qualitative research approach can be applied during the system planning phase:

The research employs a multifaceted approach to comprehensively investigate and understand the current challenges and dynamics of the Student Disciplinary Committee (SDC) and its processes:

**1. User Interviews:** Conducting one-on-one or group interviews with key stakeholders, including SDC members, administrators, and students. This aims to gather qualitative insights into existing challenges, expectations for a new system, and specific desired features. The benefits include in-depth exploration of individual experiences and perspectives, offering nuanced information.

**2. Focus Groups:** This involves organizing focus group sessions with committee members, administrators, and students to encourage group discussions on disciplinary procedures. The purpose is to uncover shared opinions, identify common pain points, and stimulate group dynamics for new insights. The collaborative environment of focus groups allows participants to build upon each other's ideas, generating a comprehensive understanding of the issues.

**3. Case Studies:** The objective is to analyze existing disciplinary cases through a detailed case study approach. This aims to identify patterns, bottlenecks, and variations in the current processes, including the lifecycle of a case. The benefits of case studies lie in providing a real-world context, helping the project team uncover intricacies and make informed decisions during planning.

**4. Observations:** Firsthand observation of current disciplinary proceedings to understand day-to-day operations, interactions, and challenges faced by committee members and stakeholders. Observations offer a holistic perspective, revealing aspects of the process that might not be explicitly communicated during interviews or focus groups.

**5. Document Analysis:** Reviewing existing documents, reports, and records related to disciplinary cases. This aims to understand the paperwork involved, the nature of documentation, and potential areas for improvement. Document analysis can reveal inefficiencies or gaps in the current documentation process, informing the planning of a more streamlined system.

* 1. **Research Questions and Hypothesis**

1. How does the current paper-based approach to managing disciplinary affairs by the Student Disciplinary Committee (SDC) impact the efficiency and effectiveness of the disciplinary process within the university?

2. What are the specific challenges and limitations faced by the SDC in the existing manual system, particularly in terms of transparency, communication, and responsiveness?

3. How can the implementation of the proposed Student Disciplinary Committee (SDC) Application address the identified challenges and improve the overall management of disciplinary cases?

4. What are the expectations and preferences of key stakeholders, including SDC members, administrators, and students, regarding the features and functionalities of a technologically-driven solution for disciplinary processes?

5. How do user-centered design principles, agile methodology, and transparency and accountability theories contribute to the development and successful implementation of the SDC Application?

6. What impact is anticipated from the deployment of the SDC Application on the efficiency, transparency, and fairness of the university's disciplinary processes, and how can this impact be measured and evaluated?

7. In what ways does the SDC Application align with or diverge from existing technological frameworks and theories in the field of educational technology and disciplinary management?

* 1. **Research Design**

The research design for the SDC Application aligns more closely with the exploratory research design. This choice is motivated by the project's goal of understanding and discovering new aspects of software development, specifically in the context of enhancing the management of disciplinary cases within the university setting. The emphasis is on gaining insights, uncovering patterns, and informing the development of an innovative technological solution. The exploratory research design allows for flexibility and adaptability in exploring various dimensions of the disciplinary process and understanding the diverse perspectives of stakeholders.

* 1. **Software Development Methodology**

The selected software development methodology for this project is Agile. The Agile methodology is well-suited for the development of the Student Disciplinary Committee (SDC) Application as it emphasizes flexibility, iterative development, and continuous feedback, aligning with the exploratory nature of the research goals.

Adaptation of Agile Methodology to Specific Research Goals:

1. **Iterative Development:** The Agile methodology's iterative approach allows for the continuous refinement of the SDC Application based on evolving insights. Regular feedback from stakeholders, including committee members, administrators, and students, will be incorporated to ensure that the application aligns with their expectations and effectively addresses the identified challenges.

2. **User-Centered Design (UCD):** The principles of User-Centered Design are integral to Agile. The Agile approach allows for the incorporation of feedback from users at every stage of development. Regular usability testing and user feedback sessions will be conducted to ensure that the application's user interface and functionalities are intuitive and user-friendly.

3. **Collaborative Environment:** Agile promotes collaboration among cross-functional teams. In the case of the SDC Application, collaboration between developers, designers, and end-users (committee members and students) is crucial. Agile ceremonies like sprint planning, daily stand-ups, and sprint reviews will facilitate continuous communication and collaboration.

4. **Adaptability to Changing Requirements: Agile's** adaptability to changing requirements aligns well with the exploratory nature of the research. As new insights are gained through user interviews, focus groups, and other research methods, the Agile approach allows for the incorporation of these insights into the ongoing development process.

5. **Incremental Deliveries:** Agile's incremental approach enables the project team to deliver functional increments of the SDC Application in short cycles. This allows stakeholders to see tangible progress regularly, providing opportunities for feedback and adjustments.

* 1. **Data Collection Methods**

**Interview Protocol:**

Objective: The objective of the interviews is to gather qualitative insights into the challenges faced by the Student Disciplinary Committee (SDC) and stakeholders' expectations from the new SDC Application.

**Protocol:**

1. Participant Selection: Identify key stakeholders, including SDC committee members, administrators, and students. Ensure diverse representation to capture various perspectives.

2. Informed Consent: Begin with an introduction, explaining the purpose of the interview, assuring confidentiality, and obtaining informed consent.

3. Open-Ended Questions: Use open-ended questions to encourage participants to share their experiences and perspectives freely. Example questions may include:

- What challenges do you currently face in the disciplinary process?

- What features do you believe would enhance the effectiveness of the SDC Application?

4. Follow-up Probes: Use follow-up questions to delve deeper into specific issues raised by participants.

5. Recording: With participants' consent, record the interviews to ensure accurate capture of responses.

**Sampling Strategy:**

Objective: The sampling strategy aims to ensure representation from diverse perspectives within the university community.

**Strategy:**

1. Purposeful Sampling: Select participants purposefully based on their roles in the disciplinary process. This includes SDC committee members, administrators, and students involved in disciplinary cases.

2. Diversity: Ensure diversity in terms of gender, academic disciplines, and experiences to capture a comprehensive range of perspectives.

3. Saturation: Continue sampling until data saturation is reached, where new interviews provide limited additional insights.

**Transcription and Analysis:**

Objective: The transcription and analysis process aims to identify common themes, challenges, and expectations from the SDC Application.

**Process:**

1. Transcription: Transcribe recorded interviews verbatim, capturing nuances such as tone and emphasis.

2. Coding: Utilize thematic coding to identify recurring patterns and themes within the transcripts.

3. Categorization: Group codes into categories representing broader themes, such as "Challenges in Current Process" or "Desired Features."

4. Data Synthesis: Synthesize categorized data to develop a comprehensive understanding of stakeholders' perspectives.

5. Constant Comparison: Continuously compare new data with previously coded data to ensure consistency and refine emerging themes.

**Software:** Utilize qualitative data analysis software, such as NVivo or Dedoose, to facilitate efficient coding and analysis.

This interview protocol, sampling strategy, and analysis approach are designed to ensure a rich and diverse dataset, facilitating a comprehensive understanding of stakeholders' perspectives and informing the development of the SDC Application.

* 1. **Ethical Considerations**

Ethical considerations in this research are paramount, especially concerning participant privacy, informed consent, and data security. To address these concerns, strict adherence to ethical guidelines will be maintained throughout the study. Participant privacy will be safeguarded by anonymizing all data collected, ensuring that no personally identifiable information is disclosed in any publication or presentation. Informed consent will be obtained from all participants, clearly explaining the research purpose, procedures, and potential risks, and participants will be given the choice to withdraw from the study at any point without consequences. Additionally, explicit permission will be sought for the use of any direct quotes or identifiable information in publications. Data security measures will include the use of secure storage and backup systems to prevent unauthorized access, and all digital and physical research data will be protected with encryption and access controls. The research will strictly adhere to institutional review board (IRB) guidelines and ethical standards to ensure the highest level of ethical conduct throughout the entire research process.

* 1. **Tools & Software**

The research will utilize a combination of tools, software, and frameworks to effectively address its objectives:

1. **Figma for User Interface Design:** Figma which is a collaborative design tool, will be employed for designing the user interface of the Student Disciplinary Committee (SDC) Application. This tool allows for real-time collaboration and prototyping, ensuring a user-friendly and visually appealing design.

2. **Next.js, Tailwind CSS, and HTML for Frontend Development:** Next.js and Tailwind CSS will be used for the frontend development of the SDC Application, providing a robust and efficient framework for building responsive and scalable web applications. HTML will complement these technologies for structuring the application's frontend.

3. **TRPC (Typescript Remote Procedure Calls) for Backend Development:** TRPC, based on Typescript, will serve as the backend framework for building the SDC Application. This technology facilitates the development of type-safe APIs, enhancing the reliability and maintainability of the backend.

4. **Planetscale MySQL Serverless Database for Data Storage:** Planetscale MySQL will be employed as the database solution for the SDC Application. Its serverless architecture offers scalability and reliability for storing and managing data related to disciplinary cases.

5. **Jest for Testing:** Jest, a JavaScript testing framework, will be used to test the various components and functionalities of the SDC Application. This will ensure the application's reliability, robustness, and adherence to requirements.

6. **Vercel for Deployment:** Vercel, a serverless deployment platform, will be utilized for deploying the SDC Application. It provides a scalable and efficient hosting solution for web applications, ensuring accessibility and responsiveness.

7. **Axiom for Production Logging:** Axiom will be integrated for production logging in the SDC Application, enabling efficient monitoring and diagnostics, ensuring a robust and secure user authentication system.

These tools and frameworks are carefully chosen to align with the research goals, promoting efficiency, scalability, and the successful development and deployment of the Student Disciplinary Committee Application.

* 1. **Research Timeline**

Below is a timeline following the Agile methodology for the specified phases of this research. Note that the phases may overlap due to the application of Agile in the software development life cycle of the SDC Application:

**October 28, 2023 - June 28, 2024:**

**Data Collection:**

- Conduct initial literature review and refine research questions.

- Develop interview protocol and sampling strategy.

- Begin participant recruitment and conduct initial interviews.

- Simultaneously start collecting relevant documents and observational data.

- Refine data collected as things change.

- Validate findings through member checking.

**Design:**

- Develop a draft design for the Student Disciplinary Committee (SDC) Application.

- Iterate on the SDC Application design based on initial feedback.

- Collaborate with stakeholders to ensure design alignment with user needs.

**Implementation:**

- Begin coding the application based on the finalized design.

- Continue coding and develop key features of the SDC Application.

- Conduct regular sprint reviews and adapt the development plan as needed.

- Integrate user feedback.

**Testing:**

- Testing of application features.

- Integrating Github Actions to ensure peak product quality

**Deploy:**

- Deploy the SDC Application for a trial period.

**Reviewing:**

- Review application functionalities and make necessary adjustments.

- Monitoring the applications core web vitals to ensure the application is optimized and up to the required crux standard.

- Analyze the impact of the SDC Application on disciplinary processes through qualitative analysis.

- Work with vercels axiom.co integration to properly analyze applications activities.

* 1. **Data Analysis/Evaluation Plan**

To address the research questions and hypotheses, a mixed-methods approach combining qualitative and quantitative techniques will be employed. The data analysis plan is outlined as follows:

**Quantitative:**

- Survey data analysis using descriptive statistics to measure perceived efficiency and effectiveness.

- Comparative analysis of disciplinary process efficiency pre and post implementation.

- Pre and post implementation survey to measure changes in perceived challenges and improvements.

**Qualitative:**

- Thematic analysis of interview and focus group transcripts, identifying common challenges related to transparency, communication, and responsiveness.

- In-depth interviews and focus groups, employing thematic analysis to identify and categorize stakeholder expectations and preferences.

- Content analysis of design documents and stakeholder feedback, examining how user-centered design and agile methodology contribute to the application's development.

- Comparative analysis of the SDC Application features against existing technological frameworks in educational technology and disciplinary management.

- Content analysis of system usage data and participant feedback.

- Thematic analysis of participant feedback on the impact.

**Data Integration:**

- Integrating findings from quantitative surveys and qualitative analyses to provide a comprehensive understanding.

* 1. **Validity and Reliability**

**Quantitative Research (Surveys, Data Analysis):**

1. **Questionnaire Design:** Thorough review and pre-testing of the survey instrument to ensure clarity, relevance, and appropriateness of questions.

2. **Pilot Testing:** Conducting a pilot survey with a small sample to identify and address potential issues with question wording or response categories.

3. **Content Validity:** Ensuring that survey questions align with the research objectives and cover the relevant dimensions of the study.

4. **Reliability Measures:** Employing established reliability measures, such as internal consistency analysis (Cronbach's alpha), to assess the reliability of survey constructs.

5. **Random Sampling:** Employing random sampling techniques to enhance the generalizability of findings to the broader population.

6. **Data Verification:** Implementing double-entry verification for data accuracy and consistency.

**Qualitative Research (Interviews, Focus Groups, Thematic Analysis):**

1. **Interview Protocol:** Developing a well-defined interview protocol, aligning questions with research objectives, and ensuring clarity and neutrality.

2. **Prolonged Engagement:** Establishing prolonged engagement with the research context to build trust and rapport with participants, enhancing the depth of qualitative data.

3. **Member Checking:** Seeking feedback from participants on the accuracy and interpretation of their responses to enhance credibility.

4. **Peer Debriefing:** Regular debriefing sessions with a research team or peers to discuss emerging themes, interpretations, and potential biases.

5. **Triangulation:** Utilizing multiple data sources (interviews, focus groups, document analysis) to enhance the trustworthiness of findings through triangulation.

6. **Thematic Analysis Reliability:** Employing inter-coder reliability measures for consistency among researchers involved in thematic analysis.

**Overall Strategies:**

1. **Researcher Reflexivity:** Acknowledging and documenting the researcher's potential biases and perspectives to enhance transparency.

2. **Clear Documentation:** Maintaining clear and comprehensive documentation of research processes, decisions, and changes.

**Ethical Considerations:**

1. **Informed Consent:** Making sure participants are fully informed about the study's purpose, and procedures.

2. **Confidentiality:** Protecting participant confidentiality through anonymization and secure data storage.

* 1. **Data Presentation**

1. **Textual Presentation:**

Clear and detailed textual descriptions will accompany the presentation of each research finding, providing context, interpretations, and implications. Organizing findings in a structured format, with sections and subsections corresponding to each research question or objective.

2. **Tables:**

Using tables to present summarized quantitative data, key metrics, or comparisons. This should facilitate transparency and allow readers delve into specific aspects of the findings.

3. **Charts and Graphs:**

Utilizing charts and graphs (e.g., bar charts, line graphs) for visual representation of quantitative trends, patterns, or comparisons.

* 1. **Research Methodology for Software Development**

**Project Objectives and Research Questions:**

1. **Impact of Current System:**

- Question: How does the existing paper-based approach within the Student Disciplinary Committee impact the efficiency and effectiveness of the university's disciplinary process?

- Objective: Gain firsthand insight into the challenges and inefficiencies of the current system through active participation in SDC events.

2. **Challenges and Limitations:**

- Question: What are the specific challenges and limitations faced by the SDC in the manual system, particularly related to transparency, communication, and responsiveness?

- Objective: Identify areas for improvement by understanding the practical challenges faced by the committee in the current manual system.

3. **Implementation Impact:**

- Question: How can the proposed SDC Application address the identified challenges and enhance the overall management of disciplinary cases?

- Objective: Evaluate the impact and effectiveness of the application in addressing identified challenges and streamlining processes.

4. **Stakeholder Expectations:**

- Question: What are the expectations and preferences of key stakeholders, including SDC members, administrators, and students, regarding the features of a technologically-driven solution?

- Objective: Inform the application design based on stakeholder expectations and preferences, ensuring alignment with user needs.

5. **Contributions of Methodologies:**

- Question: How do user-centered design principles, agile methodology, and transparency and accountability theories contribute to the development and successful implementation of the SDC Application?

- Objective: Examine the practical application and contributions of these methodologies in the context of educational technology development.

6. **Impact Measurement:**

- Question: What impact is anticipated from the deployment of the SDC Application on the efficiency, transparency, and fairness of the university's disciplinary processes, and how can this impact be measured and evaluated?

- Objective: Establish measurable criteria to assess the application's impact and effectiveness in achieving desired outcomes.

7. **Alignment with Technological Frameworks:**

- Question: In what ways does the SDC Application align with or diverge from existing technological frameworks and theories in the field of educational technology and disciplinary management?

- Objective: Situate the SDC Application within the broader technological landscape, identifying synergies and distinctive features.

* 1. **Software Development for the SDC Application**

**3.13.1 System Design and Methodology:**

The system design and methodology of the Student Disciplinary Committee (SDC) Application follow a user-centric and agile approach. The methodology involves iterative cycles, incorporating user feedback at various stages to ensure the application meets the specific needs of stakeholders. The system design focuses on modularity, scalability, and a seamless user experience. Agile principles guide the development process, allowing for adaptability to evolving requirements and ensuring the efficient implementation of features in alignment with the overarching goals.

**3.13.2 Review of Methodologies:**

Several methodologies were reviewed, including Waterfall, Scrum, Kanban, and Lean. Waterfall, while structured, was deemed too inflexible for the dynamic requirements of the educational environment. Scrum and Kanban were considered but lacked the depth needed for this comprehensive project. Lean, emphasizing efficiency and waste reduction, influenced certain aspects. However, the chosen approach aligns closely with the iterative and user-focused principles of Agile, ensuring responsiveness to user needs and continuous improvement.

**3.13.3 Adopted/Adapted Methodology:**

The adopted methodology for the SDC Application is Agile, emphasizing user collaboration, flexibility, and incremental progress. This decision stems from the need for constant stakeholder involvement, given the diverse user groups involved – SDC members, administrators, and students. Agile allows for iterative enhancements, incorporating feedback promptly. The methodology aligns seamlessly with the user-centered design principles essential for the success of an educational technology application.

**3.13.5 System Modelling:**

Three UML diagrams were instrumental in modeling the software:

1. **Use Case Diagram:** Illustrating interactions between users and the system.

2. **Activity Diagram:** Describing the workflow and sequence of activities within the application.

3. **Class Diagram:** Depicting the relationships and structure of classes, facilitating a clear understanding of the application's data model.

These UML diagrams collectively provide a comprehensive visual representation of the SDC Application, aiding in understanding its functionality, interactions, and structure.

**3.13.6 System Requirements:**

The system requirements are classified into functional and non-functional categories. Prioritization is done using the MoSCoW method, ensuring clarity on essential features. Functional requirements encompass case creation, real-time updates, document management, and secure user authentication. Non-functional requirements include data security, system responsiveness, and scalability. MoSCoW priorities guide the development process, emphasizing critical features to meet user needs effectively.

**3.13.7 Interface Design:**

The interface design of the SDC Application prioritizes a user-friendly experience. Figma is employed for design mock-ups, ensuring a visually appealing and intuitive interface. The design adheres to user-centered principles, minimizing user interactions for seamless navigation. The interface aligns with stakeholders' expectations, fostering user satisfaction.

**3.13.8 Database Schema Design:**

The database schema design is crafted using dbdiagram.io, ensuring a structured and efficient data model. It encompasses tables for users, cases, school, and other relevant entities, promoting data integrity and optimal retrieval. The design supports the application's functionality and aligns with best practices for secure and scalable database management.