

1 TRACKING UTILITY FOR KNOWLEDGE INTEGRATION
2 AND BENCHMARKING (TUKIB): AN INTEGRATED
3 AUTOMATION SYSTEM FOR THE UNIVERSITY OF THE
4 PHILIPPINES VISAYAS REGIONAL RESEARCH CENTER

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Abstract

21 From 150 to 200 words of short, direct and complete sentences, the abstract should
22 be informative enough to serve as a substitute for reading the entire SP document
23 itself. It states the rationale and the objectives of the research. In the final Special
24 Problem document (i.e., the document you'll submit for your final defense), the
25 abstract should also contain a description of your research results, findings, and
26 contribution(s).

27 Suggested keywords based on ACM Computing Classification system can be
28 found at https://dl.acm.org/ccs/ccs_flat.cfm

29 **Keywords:** Keyword 1, keyword 2, keyword 3, keyword 4, etc.

30

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Chapter 1

Introduction

1.1 Overview of the Current State of Technology

In the era of digital transformation, efficient data management and streamlined service workflows are critical for the success of any business or institution. Perhaps one of the remarkable and known products of technology is converting paper-based or manually-operated systems to automated systems. It is irrefutable that automation greatly impacts people's lives, providing increased efficiency and productivity.

The University of the Philippines Visayas - Regional Research Center (UPV RRC) is a centralized facility that strengthens UP Visayas' research and innovation capabilities by providing researchers access to and training on advanced analytical equipment and method development. It provides several services catering to different fields of natural and physical sciences. Current practices on the service flow of the institution rely heavily on manual processes, using tools such as Google Forms and Google Sheets for service request handling, tracking, and data management. While these methods provide a foundational level of functionality, they fall short in addressing the specific needs of service flow requirements of the RRC, posing challenges not only for the staff but also for the clients. The need for a more sophisticated and integrated system led to the conceptualization of TUKIB.

The proliferation of advanced software solutions presents an opportunity to enhance operational efficiency by automating service flow tasks. However, existing systems fail to provide the specific necessities of some institutions hence, a more sophisticated software is often needed. By developing a specialized software

87 solution tailored to the unique needs of RRC, it is possible to significantly im-
88 prove productivity, data accuracy, and overall effectiveness. This project explores
89 the design and implementation of such a software solution, aiming to replace the
90 existing reliance on Google Apps with a more robust, integrated system.

91 The proposed software seeks to address several key challenges faced by the
92 institution, including the automation of repetitive tasks and the facilitation of
93 seamless communication among team members. By making use of modern tech-
94 nologies and best practices in software development, this research aims to provide
95 a practical, scalable solution that can be adapted to various research environments.

96 1.2 Problem Statement

97 The UPV Regional Research Center (RRC) currently relies on a manual service
98 workflow for handling client requests, managing laboratory services, and tracking
99 research-related activities. This process, which depends on Google Forms and
100 Sheets, lacks automation, leading to inefficiencies such as delays in service re-
101 quests, difficulty in tracking progress, and limited scalability as the demand for
102 RRC services grows. Furthermore, the absence of a centralized system makes it
103 challenging for staff to manage and monitor multiple services and for clients to
104 access real-time information about their requests.

105 To address these issues, a comprehensive and integrated workflow automation
106 system, named TUKIB, is necessary. The system aims to automate service re-
107 quests, improve data management, enhance communication between RRC staff
108 and clients, and streamline overall operations. With automation, the center can
109 improve the efficiency, accuracy, and accessibility of its services, supporting both
110 the internal management and external user experience.

111 1.3 Research Objectives

112 1.3.1 General Objective

113 The general objective of this paper is to develop a system to automate and op-
114 timize the service flow and data management at UPV Regional Research Center
115 and evaluate its effectiveness. The system will be called TUKIB, an acronym for
116 Tracking Utility for Knowledge Integration and Benchmarking.

1.3.2 Specific Objectives

Specifically this study aims to:

1. Automate the management of service requests and tracking, enabling real-time monitoring of ongoing tasks and requests for both RRC staff and clients by developing an integrated workflow automation system that streamlines the UPV Regional Research Center's (RRC) service processes, reducing manual intervention and enhancing operational efficiency.
2. Create a centralized data management system for RRC that ensures secure, efficient storage and retrieval of information related to service requests, laboratory usage, and client transactions.
3. Improve communication and feedback mechanisms between RRC staff and clients, enabling the RRC to get the necessary statistics for customer satisfaction, and identify their service strengths and weaknesses.
4. Design and implement a chatbot, allowing the automation of the initial consultation process and for clients to interact with the system for service inquiries and assistance, providing immediate and accurate responses.
5. Evaluate the system's impact on operational efficiency, compare the automated workflow with the previous manual processes in terms of speed, accuracy, and user satisfaction.
6. Ensure the system is scalable and adaptable to future requirements, allowing the RRC to accommodate increased demand and potentially integrate additional features in the long term.

1.4 Scope and Limitations of the Research

This special problem focuses on developing the Tracking Utility for Knowledge Integration and Benchmarking (TUKIB), an integrated workflow automation system designed for the UPV Regional Research Center (RRC). The system aims to automate key service flow and data management aspects within the RRC.

TUKIB will cover the full-service management cycle of the UPV RRC, from initial client service requests to the completion and feedback stage. It will include features such as real-time tracking of service requests, a full inventory list and management of the RRC equipment, automated notifications to clients and

148 staff, and an integrated platform for storing and managing service data. Key
149 components such as user interfaces for staff and clients, real-time service status
150 updates, events and schedule management, transaction records, and a feedback
151 collection mechanism will be developed. Data accuracy will be ensured by min-
152 imizing manual input and automating repetitive processes, reducing errors and
153 improving operational efficiency. The project will also involve the deployment of
154 chatbots to enhance the communication flow between clients and staff, providing
155 instant responses to inquiries and updates on service requests. The system will
156 be scalable, allowing it to be adapted to other similar research institutions in the
157 future.

158 The system’s functionalities will be limited to the services provided by the
159 UPV RRC and may not cover other internal or external functions and services.
160 Customization will be tailored to the specific workflows of UPV RRC, so further
161 modification would be needed for implementation of different institutions or in-
162 dustries. The project will focus on workflow automation but will not delve into
163 advanced analytics or AI beyond using chatbots for customer communication and
164 statistics for service feedback reports. The system also requires a stable internet
165 connection for real-time features like notifications and status tracking; thus, its
166 performance may be compromised in areas with poor connectivity. The effective-
167 ness of the system depends on staff and client adaptability to the new system,
168 which may require a period of training and adjustment.

169 1.5 Significance of the Research

170 The development of TUKIB offers significant contributions on multiple fronts,
171 benefiting the researchers, the UPV RRC, and other research institutions facing
172 similar challenges in service and data management, the computer science commu-
173 nity, and the general society.

174 • The Researchers

175 The TUKIB project provides an invaluable opportunity for researchers
176 to apply their theoretical knowledge and practical skills to solve real-world
177 problems. It allows them to demonstrate their competency in system de-
178 sign, workflow automation, and software development, contributing to the
179 completion of their degree requirements.

180 Beyond academic fulfillment, the project also equips the researchers with
181 hands-on experience in managing complex systems, collaborating with stake-
182 holders, and implementing scalable technological solutions, which will be

beneficial in their future careers in computer science and related fields.

• The UPV RRC and Other Research Institutions

The TUKIB system will significantly improve the operational efficiency of the UPV Regional Research Center by automating its service request workflows and data management processes. The integration of this system will reduce the time and effort spent on manual tasks such as request processing, service tracking, and data entry. This not only streamlines the internal processes but also enhances the overall user experience for both researchers and external clients, who will benefit from a more transparent and efficient service flow.

Furthermore, other research institutions facing similar challenges in managing their services and data will be able to adapt TUKIB to their own workflows, allowing them to optimize resource allocation and improve communication between staff and clients. TUKIB's customizable and scalable nature makes it a valuable model for research institutions looking to enhance their operations without investing in entirely new systems.

• The Computer Science Community

For the computer science community, TUKIB represents a meaningful contribution in terms of integrating workflow automation, real-time tracking, and chatbot technology into a research-driven service environment. The project showcases an innovative approach to solving a niche problem, providing a practical application for the latest software development methods and techniques in workflow optimization. Additionally, it demonstrates the importance of developing scalable, customizable solutions that can be adapted to a variety of organizational contexts.

This research also serves as a case study in designing user-centered automation systems, contributing to the knowledge of software solutions that bridge the gap between operational requirements and technological advancements. The learnings from TUKIB could inspire future research in workflow management, data accuracy, and intelligent user interfaces.

• The General Society

On a broader scale, the TUKIB project has the potential to benefit society by promoting more efficient research processes. By optimizing how research institutions manage their services, TUKIB indirectly supports the advancement of scientific research. With more streamlined workflows and

221 reduced administrative burdens, research institutions can focus their re-
222 sources on the core activities of scientific discovery and innovation. This, in
223 turn, may lead to faster advancements in areas like environmental science,
224 technology development, and public health, which could have far-reaching
225 societal impacts.

226
227 In summary, TUKIB stands as an important system not only for those
228 immediately involved in its implementation but also for the larger commu-
229 nity of researchers, developers, and society as a whole. Its contributions
230 reach across the fields of computer science, research, and institutional man-
231 agement, offering lasting benefits in terms of technological innovation and
232 service improvement.

Chapter 2

Review of Related Literature

The purpose of this literature review is to provide a comprehensive background on automated systems for workflow automation, especially on service processes, which will inform the development of the system for the University of the Philippines Visayas - Regional Research Center (UPV RRC). This review aims to identify existing solutions, highlight gaps and challenges, and explore technologies that can be used to develop the system to improve the UPV RRC's operational efficiency.

2.1 Challenges in Manual Service Handling

Manual handling of service processes and data management can often lead to challenges, including inefficiencies, errors, and delays. One of the most common issues is the risk of data entry errors. Even small data entry errors can devastate outcomes, corrupting important data. A study involving three different data entry methods (double entry, visual checking, and single entry) revealed that manual entry, particularly visual checking, has a significantly higher number of errors-2958% more than double entry methods (Beaty, 1999). These errors can be subtle and difficult to detect, compounding their negative impact on operational efficiency.

Another limitation of manual service handling is its reliance on human intervention, which frequently results in mistakes that are hard to correct. These errors can escalate operational costs, affect service quality, and lead to customer dissatisfaction. For organizations with manual systems, human error compromises not just data integrity but also the scalability and effectiveness of service

257 operations. Additionally, manual systems lack real-time monitoring capabilities,
258 which are critical for improving service processes. Without automated tracking
259 tools, organizations often miss out on insights that could highlight areas needing
260 improvement.

261 Current practices in manual service handling also highlight limitations in
262 widely used tools like Google Sheets and Google Docs, which are often insuffi-
263 cient for managing large-scale workflows. These tools lack advanced data retrieval
264 capabilities, and users have reported issues with data not being pulled correctly.
265 According to Okta’s documentation on Google Sheets limitations, there are sig-
266 nificant challenges when retrieving and integrating data, leading to inefficiencies
267 in data management processes. Moreover, manual entry in Google Forms is prone
268 to errors, which can undermine the accuracy of collected data.

269 The impact of these manual methods on stakeholders is substantial. Organi-
270 zations relying on manual workflows often experience extended processing times,
271 directly affecting service delivery. For instance, tasks that could be automated are
272 unnecessarily prolonged when handled manually, delaying customer satisfaction.
273 Furthermore, manual systems offer limited visibility and tracking capabilities.
274 Without real-time performance metrics, organizations cannot effectively monitor
275 their workflows or identify improvement areas. According to research, companies
276 that automate their workflows experience reduced errors and faster processing
277 times, which lead to improved operational efficiency and better customer out-
278 comes. Thus, the inefficiencies inherent in manual service handling are a barrier
279 to organizational growth, and stakeholders across all levels—from employees to
280 customers—are adversely affected (Davis, n.d.).

281 2.2 Workflow Automation

282 Workflow automation refers to the utilization of technology systems, usually in-
283 volving several software and hardware integrations, to efficiently carry out repeti-
284 tive tasks, thereby reducing the roles of humans in it (Winarko, 2021). Workflow
285 automation simplifies the sequencing and completion of tasks within a process by
286 minimizing manual input. Also known as business process automation (BPA),
287 this approach replaces human intervention with digital technologies to automate
288 workflows. At the core of workflow automation is the ability to streamline pro-
289 cesses in various job functions—such as HR, accounting, and procurement—into a
290 series of repeated steps without human involvement. Users can define these steps
291 and use tools like drag-and-drop interfaces to create automated workflows.

292 Research indicates that automating business processes through workflow au-
293 tomation can re-engineer operations, increase productivity, and improve decision-
294 making timeliness (Abecker et al., 2000; Aversano et al., 2002; Kumar & Zhao,
295 1999). It can also enhance efficiency, ensure quality data collection, and improve
296 overall output quality (London et al., 2009; Pakdil et al., 2009). Suitable pro-
297 cesses for automation typically exhibit characteristics such as repeatability and
298 predictability (Baresi et al., 1999; Basu & Kumar, 2002).

299 A workflow automation software uses rule-based logic to automate tasks that
300 would otherwise require manual effort, such as data entry. While traditionally
301 seen as a tool for IT departments, this software simplifies complex business op-
302 erations, enhancing efficiency, productivity, and overall customer satisfaction. It
303 is a valuable resource across the entire organization. Connecting various business
304 processes automates critical tasks, sequences, and approvals, allowing workflows
305 to progress automatically without human intervention. This leads to several key
306 advantages for businesses (ServiceNow, n.d.).

307 Automating workflows offers significant benefits by addressing the limitations
308 and inefficiencies associated with manual processes. While employees are crucial
309 assets, their capacity to handle repetitive tasks is limited, and relying solely on
310 them can lead to bottlenecks, errors, and revenue loss. By automating key steps
311 and handoffs, workflows proceed more swiftly, reducing the time spent on man-
312 ual tasks and enabling employees to focus on strategic initiatives. Furthermore,
313 automated workflows provide transparency and detailed records, which improve
314 accountability by clearly documenting task progress and responsibilities. Automa-
315 tion also minimizes errors by adhering to predefined rules and methodologies set
316 by programmers, maintaining consistent results. Ultimately, these improvements
317 improve customer experience by speeding up processes, reducing errors, and en-
318 hancing service delivery.

319 **2.2.1 Workflow automation in different industries**

320 Automation was used for several workflows across a range of industries. Certain
321 industries, like manufacturing and banking, have a long history of using automa-
322 tion, while others, such as legal consultation, hospitality, and transportation, are
323 newer to automation (Zayas-Cabán, Haque, & Kemper, 2021). Across industries,
324 various workflows have been automated, such as accounting tasks, document rout-
325 ing, resource allocation, quality monitoring and control, report generation, and
326 supply chain and logistics management (Aguirre & Rodriguez, 2017; McQuilken,
327 2014).

328 In the education sector, many universities worldwide use automation tools of
329 some form, driven by the need for efficiency and compliance with educational
330 standards. These tools facilitate various processes, including enrollment, grad-
331 ing, and course management, allowing educators to focus more on teaching and
332 student engagement (?, ?). Similarly, automation in healthcare has improved
333 the accuracy and accessibility of patient information, resulting in more informed
334 decision-making. Even in government offices, the evident use of automation tools
335 for service processes can also be observed to enhance service efficiency and trans-
336 parency.

337 2.3 Client and stakeholder feedback mechanisms

338 Automated systems enhance client and stakeholder feedback mechanisms, offering
339 faster, more accurate, and easily accessible ways to gather feedback. In contrast to
340 manual systems, where feedback collection is often slow and inefficient, automation
341 streamlines the process and allows organizations to capture valuable insights in
342 real-time. Automated feedback systems provide multiple channels for clients to
343 share their experiences, such as surveys, feedback forms, chatbots, and email
344 prompts, making it more convenient for them to respond.

345 One of the key advantages of automation in feedback mechanisms is its abil-
346 ity to increase client satisfaction. Automated systems ensure timely follow-up,
347 enabling organizations to respond to client issues promptly. This immediacy im-
348 proves client trust, as they feel heard and valued. Furthermore, automation allows
349 consistent feedback collection without burdening staff with repetitive tasks. For
350 instance, after a service interaction or product delivery, an automated system can
351 trigger a feedback request immediately, reducing the chances of missed feedback
352 opportunities. Automation also enhances the quality and volume of feedback col-
353 lected. By integrating analytics tools, organizations can sort and analyze client
354 responses faster, identifying trends and areas for improvement more effectively
355 than manual methods. This enables companies to act swiftly on the feedback
356 received, leading to quicker improvements in service quality and customer sat-
357 isfaction. Additionally, automated feedback systems can be configured to send
358 reminders to clients who have not yet provided feedback, thus increasing the re-
359 sponse rate.

360 Moreover, automated systems contribute to data centralization and organi-
361 zation, making tracking feedback over time and measuring progress on key per-
362 formance indicators (KPIs) easier. For example, client satisfaction scores, Net
363 Promoter Scores (NPS), and other metrics can be automatically compiled and

364 visualized in dashboards, providing stakeholders with actionable insights. This
365 real-time access to data helps address individual client concerns and allows busi-
366 nesses to refine their services based on aggregate feedback.

367 In stakeholder management, automated systems enhance transparency and
368 engagement. Regular automated reports on client satisfaction metrics keep stake-
369 holders informed about service performance and areas that require attention. This
370 fosters a culture of continuous improvement, as stakeholders can actively shape
371 the business strategy based on real-time feedback. As summary, automated feed-
372 back mechanisms lead to greater client satisfaction by streamlining the feedback
373 process, improving response times, and providing actionable insights that support
374 long-term business growth.

375 2.4 Existing Systems

376 The development of various digital automation systems and platforms has prolif-
377 erated over the years. These systems encompass a wide range of functionalities -
378 from automating tasks to facilitating collaboration among staff.

379 For instance, Enterprise Resource Planning (ERP) Systems are integrated
380 software solutions that manage the core business processes of an organization
381 (Blahusiakova, 2023). ERP systems integrate various business processes, such
382 as Finance, Human Resources, Supply Chain Management, and Customer Rela-
383 tionship Management (CRM), into one complete system to streamline processes
384 and information across the organization (Kimberling, 2024). Examples of existing
385 ERP systems that are used by businesses and organizations are Microsoft Dy-
386 namics 365 Business Central, Syspro, QT9, and Acumatica. In addition to these
387 comprehensive systems, some businesses and institutions are also utilizing Google
388 apps like Google Drive, Docs, and Sheets to facilitate easier information sharing,
389 enabling teams to work collaboratively.

390 Moreover, online automation platforms like Zapier and Integromat (Make)
391 help automate interactions between different apps, enabling businesses to inte-
392 grate multiple systems and optimize workflows without the need for coding (Wolf,
393 2020). These systems are examples of how institutions tackle complex tasks, re-
394 duce manual data entry, and improve decision-making.

395 2.5 Gaps in the existing systems and solutions

396 Despite the availability of various existing automation systems, significant gaps
397 persist that hinder their effectiveness. One major gap is customization limitations
398 which prevent organizations from tailoring solutions to their specific workflows
399 (Aleixo et. al., 2010). These one-size-fits-all solutions can lead to inefficiencies, as
400 standardized systems may not align with different organizations’ unique processes
401 or requirements. Employees might adapt their workflows to fit the software rather
402 than the software, enhancing their operational efficiency.

403 Additionally, the lack of adaptability to changing processes can render these
404 existing systems ineffective over time. While these existing solutions might be
405 beneficial to some companies, they can be detrimental to organizations that rely
406 on their capacity to meet customer demands(Akkermans et al., 2003). Also, as
407 organizations evolve, they often need to adjust their workflows in response to new
408 challenges, regulations, or market demands. Rigid Systems that cannot easily
409 accommodate such changes can become obsolete.

410 Furthermore, many existing software solutions are proprietary, increasing costs
411 for organizations. Proprietary systems often have high licensing fees, maintenance
412 costs, and limited scalability(Goel and Gupta, 2012; Prasad and Reddy, 2013).
413 Organizations may find themselves locked into contracts that are not cost-effective,
414 particularly if the software does not deliver the expected return on investment.
415 On top of that, the difficulty of adapting and getting these automation systems
416 to work effectively is also well documented (Adams et al., 2003; Sarker and Lee,
417 2003; Scott and Vessey, 2000).

418 2.6 Chatbot

419 With the increasing use of the Internet, many businesses and institutions are
420 utilizing online platforms to manage customer inquiries. Consequently, a growing
421 number of them are adopting chatbots to enhance customer service, streamline
422 operations, and boost productivity (Suta et al., 2020). In recent years, chatbots
423 have become an important tool across various industries, particularly in service
424 delivery and automation.

425 The word “chatbot” is a portmanteau word that is a combination of the words
426 “chatting” and “robot” (Rese, Ganster, & Baier, 2020). A chatbot is an example of
427 technology that is used in computer-mediated communication, where an intelligent
428 system occupies roles once served by humans (Austin Beattie & Edwards, 2020).

429 It is also defined as conversational software that is capable of simulating human
430 conversation with an end user through text or voice interaction (Nuruzzaman &
431 Hussain, 2018).

432 Chatbots can be broadly categorized into two types; rule-based and AI-based
433 chatbots. Rule-based chatbots function with a set of guidelines through pattern-
434 matching and are limited in their conversation. This means that it can only
435 respond to a limited range of queries and vocabulary. AI-based chatbots leverage
436 artificial intelligence(AI), natural language processing(NLP), and machine learn-
437 ing(ML) technologies and algorithms to understand different keywords that users
438 type in when chatting with them. This integration significantly enhances user
439 experience and operational efficiency as these chatbots learn and adapt over time
440 (Kar & Halder, 2016).

441 2.6.1 Chatbots in Service Automation

442 Chatbots are deployed across different platforms, including websites, social me-
443 dia, and instant messaging applications, making them good tools for both internal
444 and external organizational tasks (Hagberg et al., 2016; Zarouali et al., 2018). In-
445 ternally, chatbots support services, including IT Service Management (ITSM),
446 Human Resource Management (HRM), and learning management systems (Wolf,
447 2020; Nawaz& Gomes, 2019; Bakouan, 2018). Externally, chatbots are increas-
448 ingly replacing traditional branded websites, offering a more interactive platform
449 for customer relationship management, sales, and marketing (Broeck, 2019).

450 Institutions are utilizing chatbots for various applications. For instance, Penn-
451 sylvania State University employs a chatbot called “LionChat” to address fre-
452 quently asked questions regarding admissions, student aid, and tuition costs (PennState,
453 2020). In healthcare, AI chatbots can be utilized to enhance patient care and
454 streamline processes such as checking symptoms, reminders, and appointment
455 scheduling(Altamimi et al., 2023). Moreover, a case study by (Fan et al., n.d.) on
456 the utilization of a self-diagnosis chatbot in China highlighted the potential for
457 chatbots to improve user engagement by offering real-time feedback and person-
458 alized responses.

459 2.7 Synthesis

460 As previously mentioned, the researchers aim to create a workflow automation sys-
461 tem specifically for the University of the Philippines Visayas Regional Research

462 Center (UPV RRC) to streamline and optimize their service flow and data man-
463 agement. Currently, the institution is using manual processes employing tools
464 such as Google apps.

465 The difficulty of manual service handling is discussed in this chapter, as well as
466 the benefits of having an automated system. Several studies mentioned indicate
467 that workflow automation can significantly streamline repetitive tasks, improve
468 data accuracy, and enhance decision-making processes reducing human interven-
469 tion.

470 While existing systems for workflow automation are available, there are still
471 gaps that these systems cannot fill, such as limitations with customization, cost-
472 effectiveness, adaptability, and integration issues. The proposed system for UPV
473 RRC aims to address these specific gaps by offering a tailored solution that meets
474 the specific needs of the institution. One technology that can be particularly
475 beneficial for this is a chatbot, which will enhance the consultation process when
476 availing a service from the institution by providing instant responses to inquiries.

477 Chapter 3

478 Research Methodology

479 This chapter presents the tools, techniques, and methodologies used in the de-
480 velopment of the TUKIB system, an integrated workflow automation solution
481 designed for the UPV Regional Research Center (RRC). It specifies the software
482 and hardware requirements, as well as the comprehensive process involved in cre-
483 ating the system.

484 3.1 Research Activities

485 3.1.1 Development Framework

486 Agile Methodology

487 The software development approach that the developers will follow in devel-
488 oping TUKIB is the agile methodology. Agile methodology, or simply agile, is
489 a framework that emphasizes iterative development and features communication
490 and collaboration, adaptive planning, and continuous development (Agile Frame-
491 work, 2022). The developers chose this framework because of its flexibility and
492 adaptability to change, which is beneficial, especially with evolving user require-
493 ments.

494 As seen from Figure 3.1, agile involves continuously cycling through phases of
495 development, testing, and review or feedback before finally launching the system.
496 This enables developers to make adjustments and improvements based on user
497 input.

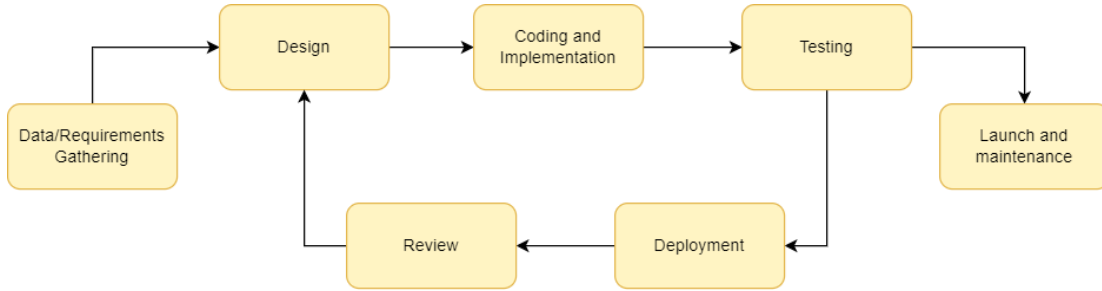


Figure 3.1: Agile Methodology

498 Data Gathering and Documentation

499 The developers will begin the project by visiting the UPV RRC, where they
 500 will conduct interviews with stakeholders. This phase is crucial for understanding
 501 the specific needs of the institution and planning the features of the system ac-
 502 cordingly. The data gathered during these interviews will inform the subsequent
 503 processes of the project, ensuring that the system is tailored to meet the require-
 504 ments and expectations of its users.

506 System Design

507 After data gathering, the system’s architectural design will be developed. This
 508 process will involve creating a context model to outline the system’s interactions
 509 with external entities, as well as a data flow diagram to illustrate how data moves
 510 through the components of the system. A process flow diagram will also be
 511 constructed to detail the specific processes and workflows, while database models
 512 will be designed to ensure efficient data storage and retrieval.

513 The researchers will also focus on effective user interfaces (UI) for service re-
 514 quest handling and management, investigating best practices and design principles
 515 that enhance user experience based on feedback from users of existing similar soft-
 516 ware or systems. Once all necessary information is gathered, a mock-up design
 517 of TUKIB will be created, serving as the basis for the system’s prototype. To-
 518 gether, these diagrams and designs will provide a comprehensive framework that
 519 will guide the development and implementation of the system effectively.

521 Implementation

522 From the design phase, the development of the system will start. The frontend
 523 will be built to ensure a user-friendly interface, while the backend will support
 524 functionality through efficient data processing and secure user authentication. A

525 chatbot will also be integrated to facilitate real-time support and user interaction
526 with the system.

527 Since the developers are following the Agile methodology, the implementation
528 phase will occur alongside testing. This iterative process will involve cycles of
529 development and testing during each sprint, with each sprint lasting two weeks.
530 This approach allows for continuous feedback and improvements, ensuring the
531 system meets user needs effectively.

532

533 **Testing**

534 The testing of the system will be consisted of 3 main components to ensure
535 its reliability, usability, and overall performance.

536 • **Alpha Testing.** During and after the development of each feature, ex-
537 tensive user testing will be conducted to ensure that each feature works as
538 intended. Any bugs or problems will be immediately fixed. For features
539 dependent on other features (i.e. user account creation must function cor-
540 rectly before user can log in), thorough testing will ensure and verify that
541 the integration between these features operates smoothly.

542 • **Automated testing.** Automated testing will be implemented to ensure
543 reliability and efficiency in testing the features of the system. This ap-
544 proach will allow for the execution of predefined test cases that can be run
545 repeatedly with minimal manual intervention.

546 • **Beta Testing.** Beta testing will be done with a limited group of users com-
547 posed of available RRC staff and selected potential customers of RRC (e.g.
548 students and faculty). This phase will allow real-world usage feedback and
549 will help in identifying any remaining bugs and usability issues. Users will
550 test the system in various environments and will be encouraged to provide
551 insights on functionality, performance, and overall experience.

552

553 **Deployment and Maintenance**

554 The final product of the study, TUKIB, will made available to the intended
555 users. In this phase, ongoing maintenance and regular performance monitoring,
556 especially of the backend, are essential to ensure stability and reliability. Feedback
557 form will be issued to users in to gather their thoughts and insights about the
558 system or if they have encountered any bugs. Constant feedback from users during
559 this phase will guide further improvements and updates.

560 3.2 Development Tools

561 3.2.1 Hardware

562 The hardware requirements for the development of the system include a computer
563 or laptop with the following specifications:

- 564 • Processor: Intel Core i5, its equivalent on other brands or higher
- 565 • RAM: 6GB or higher
- 566 • Storage: 200GB SSD or more for faster data access and retrieval Operating
567 System: Windows 10 or higher, macOS, or Linux

568 These specifications are necessary to ensure smooth development and testing
569 of the system, especially when handling large datasets and concurrent processes.

570 3.2.2 Software

571 The TUKIB system will be developed using a range of modern software tools
572 tailored to meet the specific needs of the research center’s workflow automation
573 and data management processes.

574 • HTML5, CSS, and ReactJS

575 These technologies will be used for front-end development of the system.
576 HTML5 will structure the webpages, CSS will be responsible for the visual
577 styling, and ReactJS enables dynamic and interactive user interfaces.

579 • PostgreSQL

580 For backend development, PostgreSQL is will be used as the database man-
581 agement system, offering robust data storage, querying, and management
582 capabilities.

584 • Rasa Framework

585 Rasa will be used for the chatbot development. It allows the creation of
586 a conversational AI system which will handle the service requests, queries,

587 and management capabilities of the system.

588

589 • **Figma**

590 Figma will be utilized for designing the UI/UX of the system. Figma allows
591 design collaboration, which will enable the team to create the system pro-
592 totype, wireframe, and mock-up interfaces before implementation, ensuring
593 a user-friendly experience for both clients and researchers.

594

595 • **VS Code**

596 Visual Studio Code (VS Code) is the primary code editor that will be used
597 to develop the system. Its features, such as syntax highlighting, extensions,
598 integrated Git, and debugging tools, make it the most suitable environment
599 for writing and testing front-end and back-end code.

600

601 • **Github**

602 GitHub will be used to facilitate for version control and collaboration through-
603 out the development of the system. The project code is stored in repositories,
604 allowing the team to manage changes, track progress, and collaborate
605 effectively. It also serves as a backup and source for future development or
606 modification.

607 Chapter 4

608 Preliminary Results/System 609 Prototype

610 This chapter presents the preliminary results or the system prototype of your SP.
611 Include screenshots, tables, or graphs and provide the discussion of results.

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⁶⁵¹ **Appendix A**

⁶⁵² **Appendix Title**

653 **Appendix B**

654 **Resource Persons**

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663