Summer Internship

At

**KARKINOS**

Karkinos Healthcare Private Ltd.

(April 18th to June 18th, 2022)

Report

By

Dr. Vishaal Govinda

PG/21/129

PGDHM (Hospital and Health Management)

2021-2023

IIHMR DELHI

International Institute of Health Management Research,
New Delhi

# Acknowledgement

The internship opportunity I had with Karkinos Healthcare Pvt Ltd. was a great chance for learning and professional development. During my tenure here for the two months I was exposed to the technological advances of healthcare with a prime focus on cancer care. I had a wonderful opportunity to meet with several Industry experts and professionals who were kind enough to impart their experience and knowledge to me.

Bearing in mind of this tremendous opportunity I want to express my deepest gratitude to the Assistant Vice President (AVP) of Karkinos Healthcare Pvt Ltd., Dr. Sandipan De, who inspite of being extraordinarily busy with his duties, took time out to lend ears and guide me on the correct path while allowing me to carry out my project at their esteemed organization.

I further extend my gratitude to the Chief Product Officer (CPO), Mr. Manish Sharma for taking the time out to guide and share vital information, material and industry knowledge with me which I will remember for years to come.

I also want to mention on record that everyone I met at Karkinos Healthcare right from top to down were very helpful, welcoming and were always keen to impart their valuable experiences and knowledge to me.

I perceive this experience as a big milestone in my career development and will strive to utilize the knowledge gained here to my best effort for future endeavours.


**Dr. Vishaal Govinda**
PG/21/129

### Internship Completion Certificate

### To Whom It May Concern

This is to certify that **Dr. Vishaal Govinda,** has worked as **"Volunteer Intern"** with Karkinos Healthcare Private Limited and has successfully completed the internship under the guidance of Sandipan De.

Internship Duration: 18$^{th}$ April-2022 to 17$^{th}$ June-2022.

We wish all the best.

Karkinos Healthcare Pvt. Ltd.

**Pooja Sharma**
**Vice President-HR**

# FEEDBACK FORM

(Organization Supervisor)

Name of the Student: DR. VISHAAL GOVINDA

Summer Internship Institution: KARKINOS HEALTHCARE PVT. LTD.

Area of Summer Internship: PRODUCT MANAGEMENT INTERN

Attendance: 100%

Objectives met: Yes

Deliverables: He was an integral part of the product team, from taking part in meetings to helping draft PRDs. User Stories & Journey, wireframes and research work. He understood the basics of Software Product Management and was able to put

Strengths: forward valuable suggestions. Delivered Software Product Management toolkit

Punctual, Hardworking, fast learner, Attention to detail

Suggestions for Improvement:

All the objectives we Set out to achieve have been met.

Signature of the Officer-in-Charge (Internship)

Date: 15-06-2022
Place: BANGALORE

# Certificate of Approval

The Summer Internship Project titled **"Efficient product management for developing robust healthcare softwares"** at **"Karkinos Healthcare Pvt. Ltd."** is hereby approved as a certified study in management carried out and presented in a manner satisfactorily to warrant its acceptance as a prerequisite for the award of **Post Graduate Diploma in Health and Hospital Management** for which it has been submitted. It is understood that by this approval the undersigned do not necessarily endorse or approve any statement made, opinion expressed, or conclusion drawn therein but approve the report only for the purpose it is submitted.

**Ms. Divya Agarwal**
**Associate Dean- Admissions & Accreditation's**
**IIHMR- Delhi**

# FEEDBACK FORM
## (IIHMR MENTOR)

**Name of the Student:** Dr. Vishaal Govinda

**Summer Internship Institution:** Karkinos Healthcare Pvt. Ltd

**Area of Summer Internship:** Product Management Intern

**Attendance:** 100 %

**Objectives met:** YES

**Deliverables:** → Weekly progress report
→ Draft report submission

**Strengths:** Hardworking & Analytical

**Suggestions for Improvement:** Time management and become more tactful.

Ms Divya Agarwal

**Associate Dean- Admissions & Accreditation's**

Date- June 24, 2022
Place- DELHI

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# KARKINOS HEALTHCARE PVT. LTD, BANGALORE



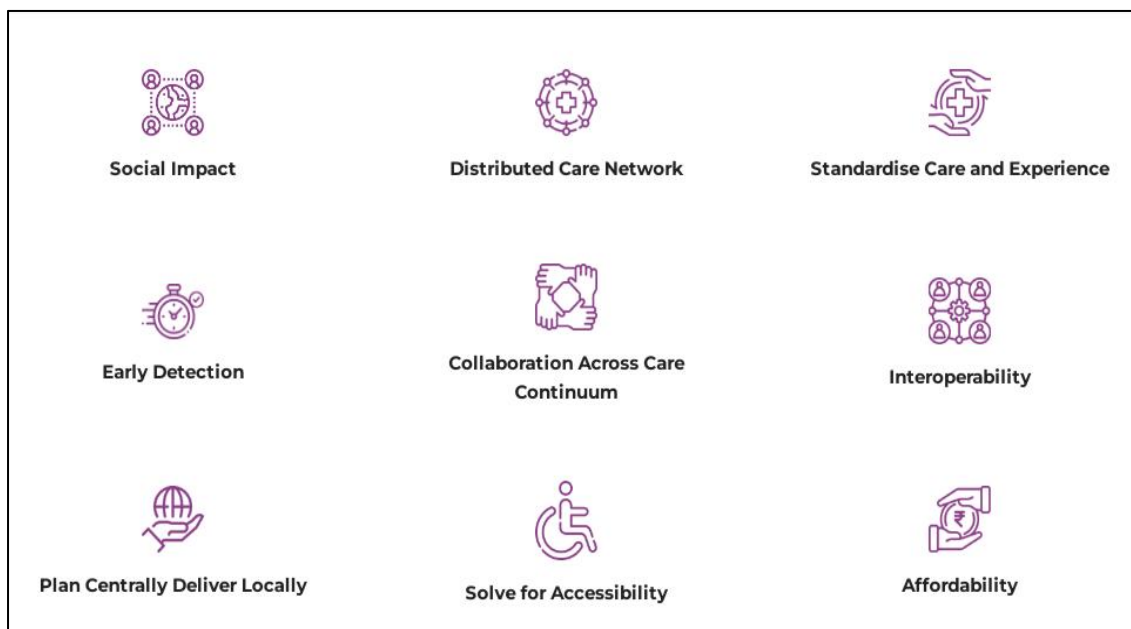## Organization Objectives

### Vision-

Powered by 4 D's

- Detection & Diagnosis Establishment of participatory systems and near homecare research on genomics as a foundation approach for prevention, innovation and game- based outreach approach for early diagnosis and wellness

- Deliver managed healthcare 2 million+ patient hours saved annually

- Data and research contribute towards Atmanirbhar Bharat through drug discovery research and treatment innovation large scale screening and longitudinal data to build robust AI/ML analytics and predictive models

## Mission-

"Our mission is to ensure that no person is denied care either due to access or affordability. Since we are diagnosing cancer at an early stage, the cost can be brought down considerably. Almost 60 per cent of the cost associated with cancer is for indirect expenses. We navigate the care for patients with the existing Karkinos centres and help to carry out some of the treatments such as general surgeries, chemotherapy at locations close to the patient's home, and refer them for radiotherapy and complex procedures to super speciality cancer hospitals"

## Values-



| Social Impact | Distributed Care Network | Standardise Care and Experience |
| Early Detection | Collaboration Across Care Continuum | Interoperability |
| Plan Centrally Deliver Locally | Solve for Accessibility | Affordability |

**Social Impact-** Reduce travel time from 8-10 to 3-5 hours; 30-40% reduced cost of care Surveillance & early detection. Early detection, Better reach out & care, improved outcomes.

**Distributed Care Network-** Reversing current focus from treatment to early detection is possible with a Distributed Care Network.

**Standardise Care and Experience-** Standardised and Patient centric pathways, improve quality in delivery of care and patient outcomes.

**Early Detection-** Early Detection Enables Stage Shift in Cancer Incidence

**Collaboration Action Care Continuum-** Patients Centric approach that enables Care Collaboration across the Patient Care Continuum.

**Interoperability-** Enabling the Flow of Patient Information by adhering to the interoperability standards identified by the NDHM

**Plan Centrally Deliver Locally-** Command Centre to enable distributed deliver care delivery by a centralized knowledge architecture.

**Solve by Accessibility-** In a Patient Centric Model, Karkinos enables access to care near the patient's home driven by geo-tagging of care partners.

**Affordability-** A cancer care network enabling early detection with assured, affordable and quality focused treatment pathways.

## About Karkinos

Found in 2020, **Karkinos Healthcare Pvt. Ltd**, a purpose driven technology-led oncology platform, is focused on designing and delivering bespoke solutions for cancer care. The company, led by a blend of globally acclaimed medical professionals and technologists, is on a mission to create 'cancer centers without walls with a primary aim of addressing the accessibility or affordability gaps in cancer care.

Karkinos ('Kark' means cancer in Hindi and 'nos' means elimination) intends to set up 70 community care centres across the State in a year to offer distributed care. It plans to expand throughout the country's health system using a technology platform.

Karkinos is focused on addressing clinical needs through a digitally enabled distributed cancer care network, that will bring quality care closer to patients in cancer care. The fundamental principle of Karkinos health is democratization of cancer care in a participatory fashion with existing health providers, researchers, and technologists. Karkinos Healthcare is building an open standards-based technology platform that coordinates the cancer care continuum; a medical center for the treatment of complex cancers; and a research center that leverages technologies such as genomics, synthetic biology, sensors, and AI to analyze data and leading to the development of affordable cancer interventions. The technology platform is based on openEHR based Clinical Data Repository at the heart.

The clinical operations of the first such community centre has already started at Kothamangalam in Ernakulam district a few months back and other centres were opened recently at Chottanikkara, Thodupuzha, Munnar both in Ernakulam and Idukki.

It is estimated that there are 2.25 million cases of cancer in India every year, which doubles every 10 years. Three quarters of these cancers are detected in the late stages and mortality rates are devastatingly high because of lack of access to standardized cancer care. Whilst Indians are at the forefront of medical research in the West, India as a country is a laggard in researching and curing the condition.

Recently, Mayo Clinic of the U.S. has invested in a minority stake in the company.

Mayo Clinic will also nominate a member on the Board of Directors of Karkinos as part of this agreement besides transferring technical know-how.

Some of the investors of Karkinos Healthcare, which is pioneering the distributed cancer care Network model in India, include Ratan Tata, Venu Srinivasan, Kris Gopalakrishnan, Ronnie Screwvala, Vijay Shekar Sharma and Bhavish Agarwal.

The Tata Group has invested ₹110 crore in Karkinos while Rakuten Medical, the global clinical stage biotechnology company, and Reliance Digital Health, a subsidiary of Reliance Industries, hold minority stakes. Venture Capital fund Endiya Partners also has a stake in the company.

Karkinos Healthcare plans to address the cancer care problems with an end-to-end technology platform which coordinates cancer care continuum; medical center for treatment of complex cancers; and research center which leverages technologies such as genomics, synthetic biology, sensors, and AI to analyze data and leading to the development of affordable cancer interventions. The fundamental principle of Karkinos health is democratization of cancer care in a participatory fashion with existing health providers, researchers and technologists.

Karkinos Healthcare has set up a command centre to support the patient to undergo various components of treatment and an Advanced Cancer Diagnostic Laboratory in Kochi to guide the patient for treatment.

Cancer is the second most common cause for deaths in the country and 1.3 million new cases occur every year. Around 3.6 million are living with cancer and require medical help. In Kerala, as many as 66,000 new cases occur every year and around two lakh people live with the disease.

# Observational Learning:

At Karkinos Healthcare Pvt. Ltd, I was appointed as an Intern in the Product team, for a period of two months from April 18th, 2022 to June 17th, 2022.

During these two months I had the opportunity to understand the work-flow while learning the basics of product/software management methods and models. I worked on helping and making Product Requirement Documents (PRDs), Low-High Fidelity Wireframes, User Stories and User Journey's for implementation of features in the software as per customer request and future requirements. These were followed by preparation and portrayal of feature uses, by making Process Flow Diagrams and Swimlane diagrams: Journey of using an application from the perspective of different users. I was involved in making User Guide for a web based desktop application and also helped in collecting valuable resources for various research purposes required by the organization. I also learnt to use few software application used in designing: Figma (for high fidelity wireframes and prototypes), Balsamiq (for low fidelity wireframes), Draw IO.

**Product Requirement Documents (PRDs):** A product requirements document (PRD) is an artifact used in the product development process to communicate what capabilities must be included in a product release to the development and testing teams. The PRD will contain everything that must be included in a release to be considered complete, serving as a guide for subsequent documents in the release process.

**Wireframes:** A wireframe is a schematic or blueprint that is useful for helping you, your programmers and designers think and communicate about the structure of the software or website you're building. Wireframes can range from Low (hand drawn sketches, less detailed concept) to High (Highly Detailed Render of prototypes) fidelity.

**User Story:** A user story is an informal, general explanation of a software feature written from the perspective of the end user or customer. The purpose of a user story is to articulate how a piece of work will deliver a particular value back to the customer

**User Journey:** User journey is a visualization of an individual's emotions/ relationships with a product/service over time and across different channels.

**Process Flow Diagrams/Swimlane Diagrams:** Process flow diagram (PFD) is a flowsheet/flowchart used to demonstrate the functionality/feature of a software from the perspective of a single end user. Eg. Physicians, Administrators etc. Swimlane Diagram, is similar to PFDs, only that it involves two or more than two types of end users and establishes a relationship between them in entire flow of a particular feature/functionality.

There were regular meetings with the Product Team where I could share my work progress, updates and doubts to the entire team. These meetings were quite insightful and gave me a lot of understanding on how such meetings ensure that everyone on the team were able to coordinate better to resolve and complete tasks with complete transparency while reducing miscommunication. I had a chance to attend and record 'minutes of meeting' of many important meetings concerning user testing, telemedicine, developer and design updates as well which further enhanced my knowledge.

On a group level, I with two other of my Co-Interns: Dr.Afreen Hussain and Manish Bajaj conducted various presentations for the entire product team which was quoted as 'Knowledge Days'. We presented on Topics: 'Product/Software Management, Lifecycle and Management Models' and 'Deep Medicine by Eric Topol'. These days were an opportunity for the entire team to learn and relearn the basics and several developments in healthcare information technology field. My co-interns and I via these presentations had tremendous exposure to learn a vast array of technical information. These opportunities broadened my knowledge on how healthcare could be promoted using modern tools and technology.

We also worked on making a comprehensive playbook/toolkit on Software Product management which we presented and submitted to the organisation.

**Conclusive Learning:**

Overall it was an eye opener to various aspects and responsibilities of the Product Team right from Requirements analysis, Designing and Coding to implementation of Software governed by Quality control, Testing and Maintenance. These all small sub-

teams work cohesively to ensure successful delivery of the final product and I had the opportunity to understand these workings well.

# Project Report

## Efficient product management and its real world application for developing robust healthcare software's- A review

## Abstract

This narrative review was conducted to understand the basics of product management in developing efficient healthcare softwares and applications. A software is a component of the product which a higher order thing. In the fast paced ever evolving healthcare scenario development of such softwares is usually plagued by various hurdles. The healthcare information technology field is little behind on progress in comparison to other domains. Most of the healthcare softwares ranging from standalone services to complete EHRs/EMRs are not user friendly leading to physician burnouts, mistreatment and misdiagnosis. The current trends of product management approach attracts more than needed alteration of end product resulting in low quality healthcare softwares. It becomes crucial for aspiring product mangers to understand the basics of Software Development Lifecycle (SDLC) and it various management models. Its important to choose an iterative approach towards software development while taking into consideration the veiwpoint of end users and customers to develop and deploy effective and efficient softwares and applications which are enjoyable to use. Periodic backlog grooming along with employment of automation makes the overall process easier while reducing burden on the product team. Application of smart and flexible thinking governed by good product management and general management principles becomes crucial in developing such softwares.

## Keywords

Product management, Roadmap, Software Development lifecycle (SDLC), SDLC models, UI/UX, Test Driven Development, Backlogs

## Introduction

A product is a deliverable which delivers value and experience to its users. It can be a combination of systems, solutions, materials and services delivered. In the context of healthcare softwares and applications, its important to understand that a product is a higher order thing and a software is a component of the higher order. A software can be used as a service and as a product. Software as a product will require purchase of licensing under which various solutions and services can be availed offered by the software. A service is an intangible, temporary product that is the result of co-creating value by at least one activity performed at the interface between the supplier and customer and that does not imply a change of ownership. A solution is a customer-specific product created from different products, processes and resources and tailored to serve a specific business or customer need. (1)

Usually there is a rift between delivery and marketing teams with both exerting pressure on each other to meet their respective deadlines for the release. This leads to dysfunction within the team. Hence, Product management is a key success factor for successful product launch and longevity as it spans the entire life-cycle and thus ensures both a technical and business perspective. The need for such a product management is often felt more in technology companies that have a laissez-faire culture. (2) Such a free hand, no action culture does not usually work out well in the healthcare information technology field as there is massive competition and developments happening at a fast pace. Hence an incremental software development methodology governed by good product management principles is usually employed to attain higher flexibility and to better satisfy customer requirements, may it be a Business to Business (B2B) or Business to Consumer (B2C) transaction. (3)

Its important for a product manager to understand the Software Development Life-Cycle (SDLC) and the various management models employed to ensure value orientation and consistency across the healthcare software releases. (4)
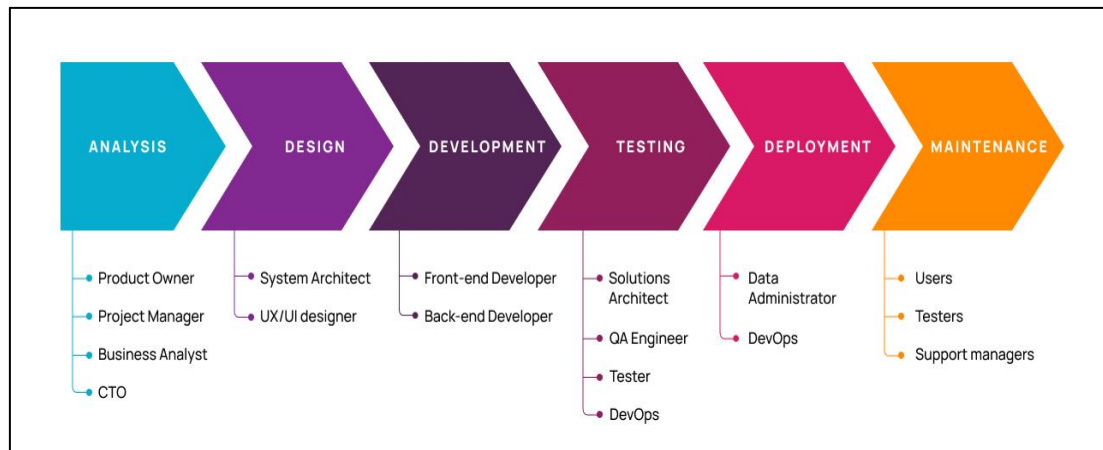
## Software Development Lifecycle (SDLC)



Figure 1.Stages of Software Development Lifecycle (SDLC) governed by various members
Healthcare IT Team
Image Source: https://brocoders.com/blog/agile-software-development-life-cycle/

The first step in the SDLC is known as requirements analysis/requirements engineering which is a crucial step for understanding the software/product roadmap. Such a roadmap offers a plan of action and product managers use these roadmaps to outline future functionalities and when new features will be released. In a sense an appropriate market analysis of healthcare needs and concerns along with understanding how competitors are performing will shed light on vision, direction, priorities, and

progress of the healthcare software/application over time. (5) The next aspect of design is extremely important as it dictates the core User Interface (UI) and User Experience (UX) which regulates the effective and enjoyable use of the software.(6) This becomes crucial in the healthcare setups may it be for separate services like telemedicine, health chat bots, health wearables using IOT (smart watch, fit-bits, at home ECG monitoring patches, medical devices), E prescriptions, online appointment scheduling within standalone license based softwares/products  to complete Electronic Health Records (EHRs) and Electronic Medical Records (EMRs) encompassing all these services along with vast multitude of more services such as Clinical Decision Support System(CDSS),etc required by hospitals.(7) In the current day and scenario such softwares especially the EHRs/EMRs are very clunky to handle resulting in physician burnout leading to mismanagement and misdiagnosis of patients. Hence, the

design step needs to ensure the vision of creating a user friendly and efficient experience while navigating such softwares. (8)

The development phase is what brings the design into life with the backend developers using appropriate coding to develop the tech stack while enabling frontend developers to enforce Application Programming Interface (APIs), plugins, version updates and automation without disturbing the backend. (9) A tech stack sometimes also referred to as solutions stack is nothing but several layers of code which forms the foundation of any software and its important to remember that its quite hard to rip off a layer from this foundation as it can result in bugs and glitches in the software. A well built tech stack with a good frontend interoperability offers smooth communication between different softwares and components. (10,11) From the perspective of the legal product requirements, its important to remember that the platform being built should concede with the Data Protection and IT Laws governing each country or region as healthcare data often contains sensitive patient information. (12)

Testing is a important step in accomplishing and evaluating the quality of a software product. Testing is performed at different levels throughout the life cycle of a software product. (13)
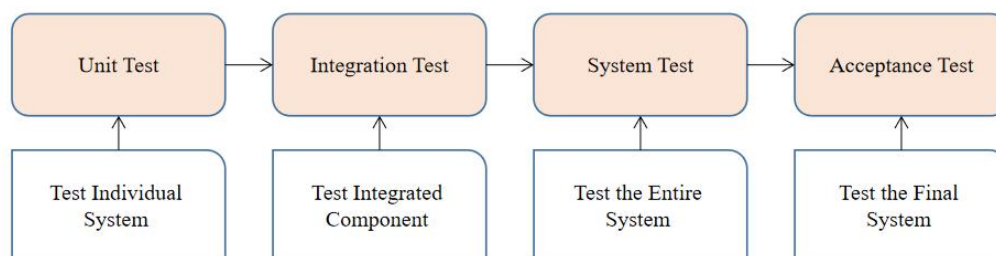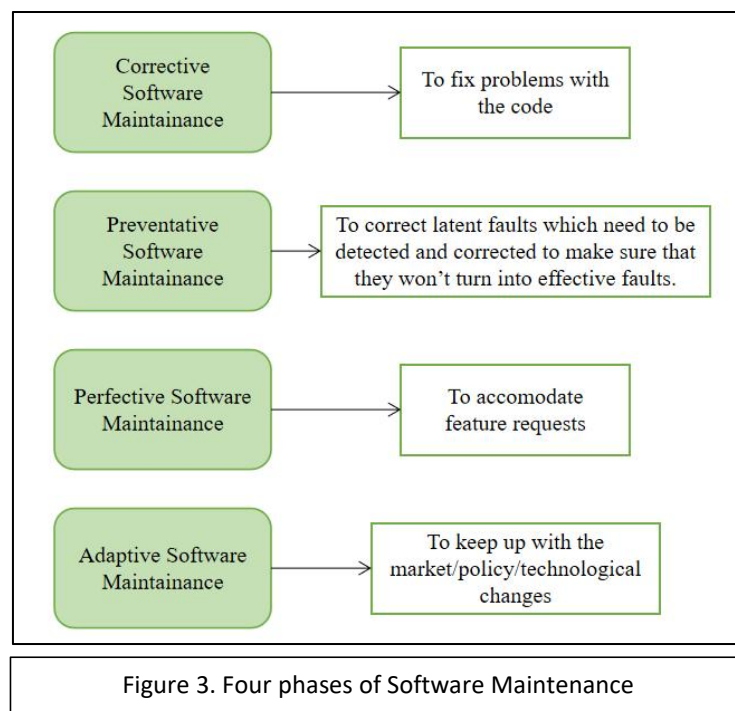


Figure 2. Levels of Testing

During and after the development phase the software undergoes testing where its scrutinized to various regression tactics to see how it performs and behaves in a controlled and live environment. These testing methods include white box (structural) and black box (functional) testing. Traditionally testing was done after development, but in recent years the applicability of such traditional methods has resulted in loss and damage. Hence, a test-driven development (TDD) is often followed nowadays which overcomes such inefficiencies. (14)

Once it passes all the required check-lists either a Minimum Viable Product (MVP) or complete software with almost all features is deployed.(15) Since the Healthcare field is constantly evolving especially after the inception of Covid, these healthcare SDLCs usually employ the use of MVPs as this iterative approach ensures there is no feature creep and the software remains light and easy to use with features being added later depending on customer and market requirements. Hence several consistent versions will be launched periodically with additional relevant features being added over time.(16) However this iterative approach also attracts several requests for features every now and then if the roadmap is not well planned.(17)

Considering all above scenarios are well met, the final phase of maintenance is an ever lasting phase until the the software goes out of market. This phase ensures that the software stays on par with developments of the healthcare field by launching periodic version updates and feature additions to increase the longevity of the healthcare software/service/application.(18) The maintenance phase has four stages as shown in Figure 3. which ensure the longevity and efficiency of the software. (19)



Figure 3. Four phases of Software Maintenance

**SDLC Management Models:**

There are various management models and the most used ones are: waterfall, spiral, Evolutionary prototyping, rational unified process(RUP), agile, v-shaped management models. The ability to understand which model is ideal for what situations is extremely important. The criticality of the software to be made also plays an influential role. Small projects are usually appropriate for an agile approach. Larger projects may require a more rigorous approach employing a combination of multiple lifecycle models. (20) Healthcare softwares usually work best when developed using an iterative model.(21)

The waterfall model shown in figure 4, also known as the grandfather of all lifecycle models is an ideal management model when the domain is well understood. (22) This ideal situation is not seen in the healthcare field as its ever evolving, hence this model falls short in this context. Advantages of waterfall model: early detection of errors. Disadvantages include lack of flexibility and its less than ideal for most real world applications.(23)
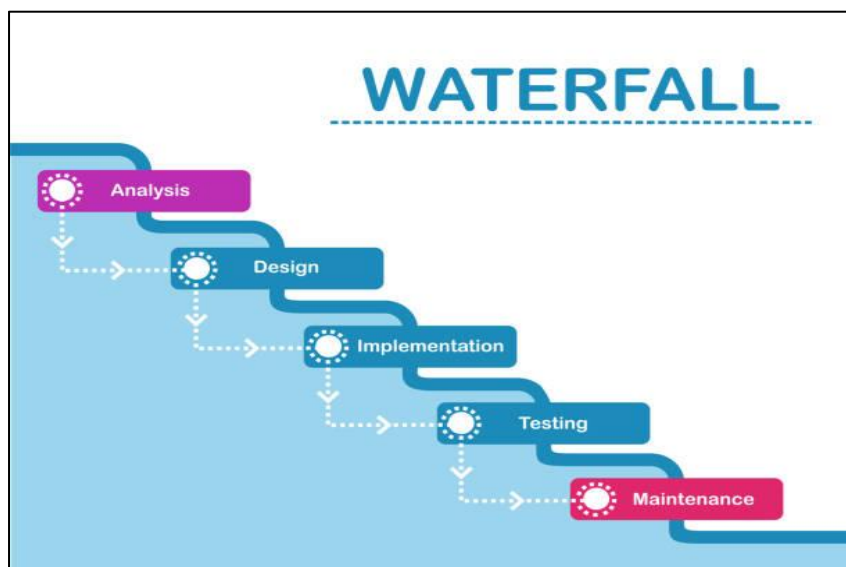


Figure 4. Waterfall Model
Creator: Sylfide | Credit: Getty Images/iStockphoto

Spiral Model shown in figure 5, is an incremental risk oriented life cycle model. This Model repeats steps of a project, starting with modest goals and expanding outward in ever-wider spirals (called rounds). Each round of the spiral constitutes a project, and each round may follow traditional software development methodology such as

modified waterfall. (24) A risk analysis is performed each round. Fundamental flaws in the project or process are more likely to be discovered in the earlier phases, resulting in simpler fixes. This lowers the overall risk of the project: large risks should be identified and mitigated. Advantages of spiral model: Risk reduction, functionality can be added in later phases and software can be produced early with core features. Disadvantages are that this model requires specific expertise, its complex and is highly dependant on risk analysis. (25)
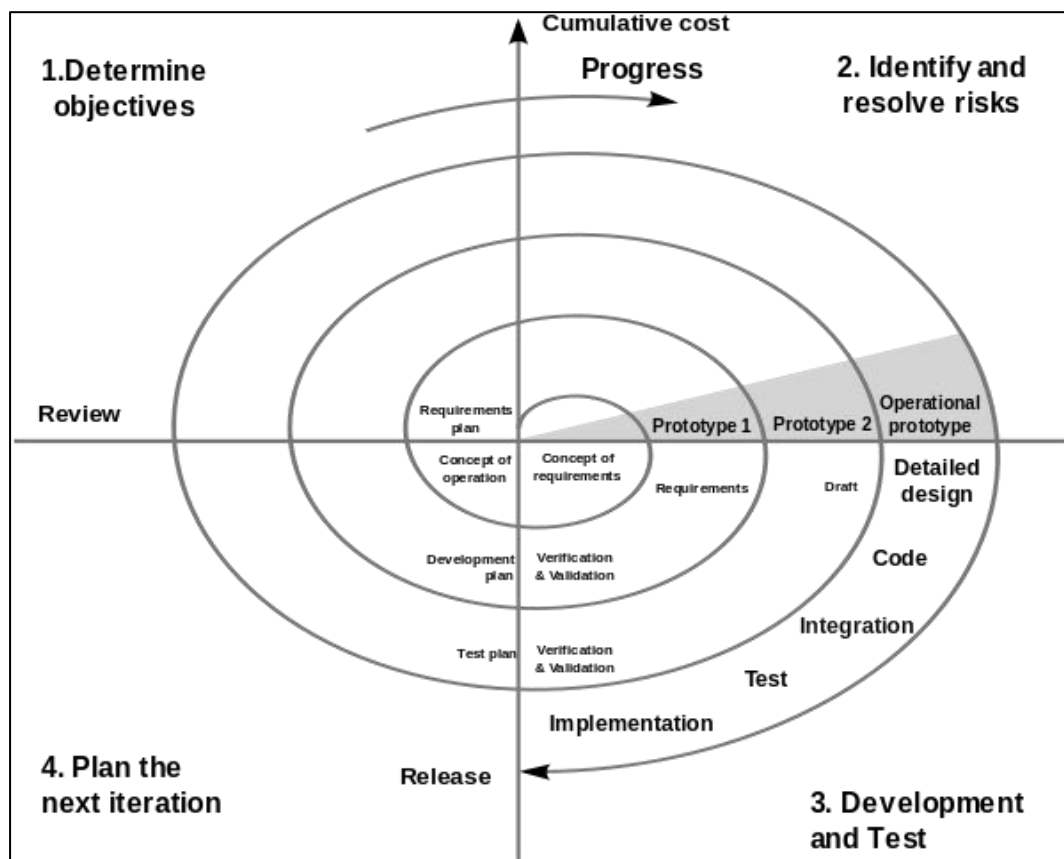


Figure 5. Spiral Model
Source: https://www.pngkey.com/detail/u2q8q8o0w7e6a9w7_spiral-model/

Evolutionary prototyping model shown in figure 6 offers prototypes which are continuously refined and rebuilt until a complete version with all features is achieved. In this model the developers start by developing parts of the system that they understand instead of the whole system. Advantages of evolutionary prototyping include immediate feedback, Its an ideal model when all requirements are not well understood. Disadvantages include that this model is difficult to plan, and it entertains excuses to cut and fix features as per customers resulting in a low quality software. (26)
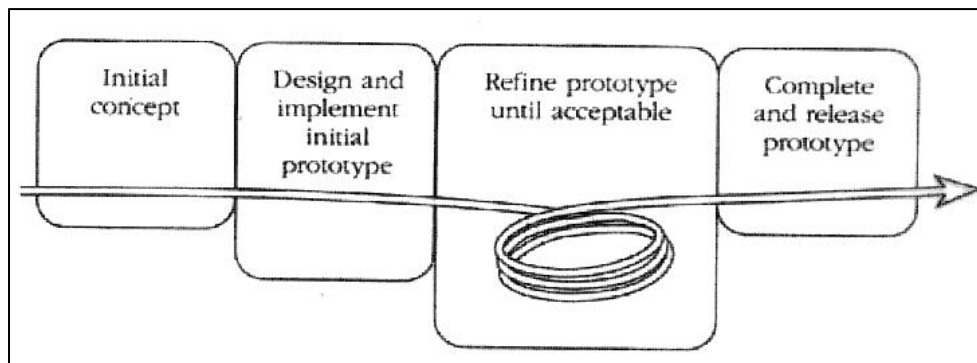
Figure 6. Evolutionary Prototyping
Source: https://hci.cs.siue.edu/NSF/Files/Semester/Week13-1/PPT-Text/Slide12.html

Rational unified process (RUP) also referred to as Unified Software Process (USP) shown in figure 7, is a process product which is an iterative model with four phases of inception, elaboration, construction and transition.Rational Unified Process is designed and documented using the Unified Modeling Language (UML). (27) Advantages of RUP/USP: provides a very coherent backbone to the process, it has a well-defined and regular structure, uses an object-oriented approach for its description, reuse of code is efficient and fast resulting in quick product delivery. Disadvantages include requirement of high expertise, everchanging advancements pose a problem to reuse of components leading to an undisciplined format of software development. (28)
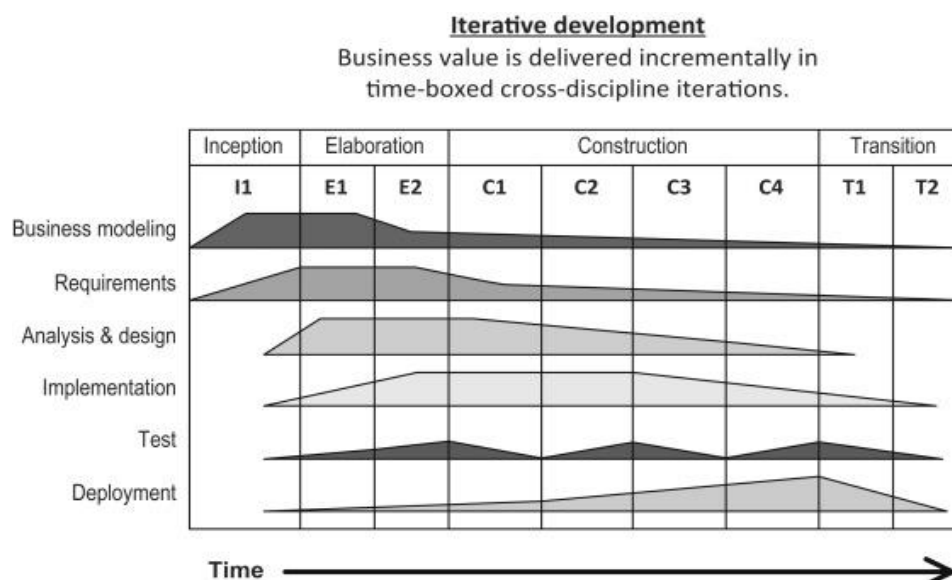

Figure 7. Rational Unified Process (RUP)
Source: https://www.sciencedirect.com/topics/computer-science/rational-unified-process
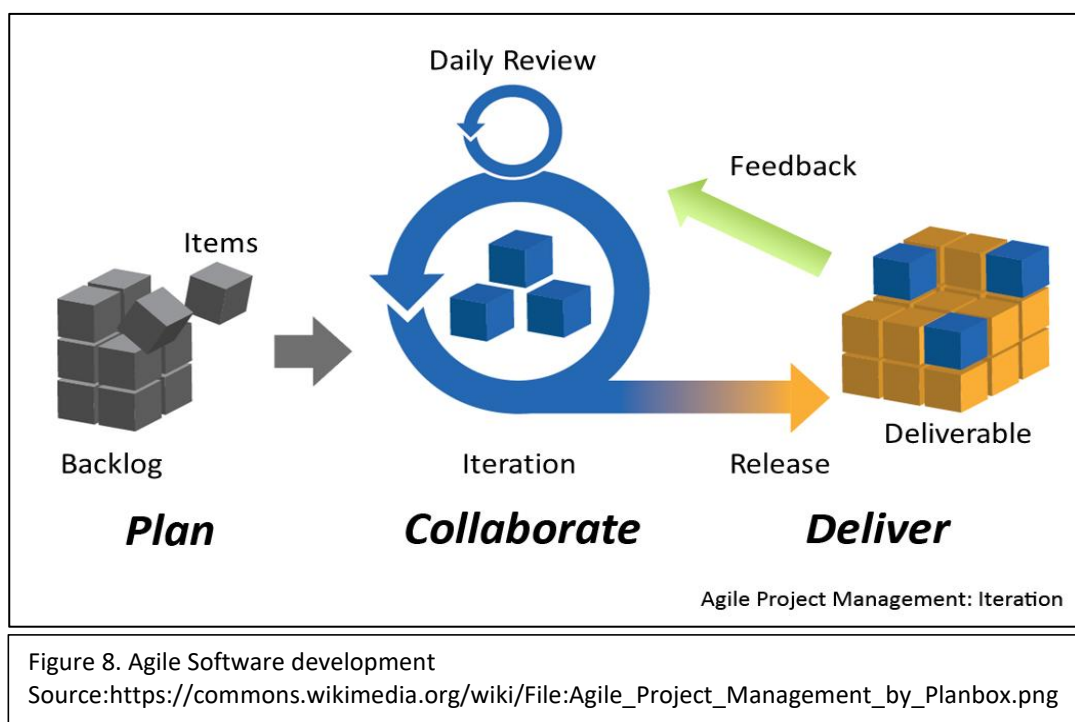
Agile management shown in figure 8, is one most used management models for creating healthcare softwares and applications. Its based on a highly iterative and

incremental development and employs TDD like other iterative models discussed above. (29) The major difference of the agile model over other iterative models is that it offers rapid customer satisfaction with continuous delivery of useful software. Software is rarely perfectly fit for use upon first release, but the best software evolves over time to achieve maximal effectiveness. Physicians are more involved in the agile user testing process of each incremental version which provides better insights in what design works best. (30) Major disadvantages of the agile model include too much customer focussed delivery, lack of documentation and inability of product teams to adapt to changes to meet deadlines. (31)



Figure 8. Agile Software development
Source:https://commons.wikimedia.org/wiki/File:Agile_Project_Management_by_Planbox.png

## Product/Software backlogs:

A product backlog is a prioritized list of work for the development team that is derived from the roadmap and its requirements. It is a set of tasks needed to complete the final Product. These backlogs usually include bugs,feature requests and enhancements. (32) Developers typically build new features, modify existing features, and fix bugs based on the items at the top of the backlog. For many teams, the backlog is the primary software product management artifact or primary non-code artifact. Analysts usually identify and prioritize the backlogs depending upon criticality and value of the backlog. (33) Resolution of backlogs is crucial to ensure effectiveness of

software to be delivered. A large unresolved backlog is the nightmare for any product team, hence backlog grooming should be done periodically to understand what is achievable and what is not. Several models are available which help to prioritize and resolve backlogs effectively. Some effective models are MOSCOW, Critical Path Model (CPM), Value vs Effort matrix. These backlog management models when employed right along with regular team meetings can result in effective resolution of backlogs.(34) An ideal backlog resolution is never really complete in a agile environment, however keeping backlogs at the bare minimum should be the aim for any product manager. Breaking the backlogs into smaller manageable chunks, deletion of old backlogs which will never be resolved are some more methods which can make life easy going during the development process.(35)

## Role of automation in development process:

Software automation is an important step in business scaling and software development as it offers substantial cost-saving and helps the IT staff refocus more on strategic activities than administrative functions.(36) Automation of mundane tasks,testing, data cleaning, file organization, important reminders, version updates and controlled access help coordinate activities better in the software development process. (37) It is important to understand that relying on manual and ad hoc solutions should not be an option as it can result in the usage of out of date software versions, loss of old stable versions, data breach, data loss due to network outages and can divert focus of the team on small tasks which are otherwise insignificant. Many IT companies have had huge losses and failures due to not relying on proper automation in the past. (38)

## Conclusion:

Due to the ever evolving scenario of the healthcare field, relying too much on a set path or single technique for software development can never be an option. Several issues hinder the progress of healthcare software development in current day and age. These issues range from product related issues such as gold plating of requirements to

technology related issues with too much dependency on the advertised benefits of a previously unused technology and lack of automation. It even extends to application of basic management principles plagued by poor management of employees, self burden and heroics discouraging team involvement while encouraging unnecessary risk taking. Its important to keep the expectations grounded in reality. Its essential for a product manager to fully own the vision and roadmap of the healthcare software product to be developed. The product team should develop a deep understanding of the end users and needs to help create useful product experiences that address those needs. A good ability to push back on software engineering estimates if project is under or over-scoped is essential. The team should have a good knack to understand the technical constraints and should be able to spot performance bugs while synthesizing insights from user research, customer meetings, end user metrics and feedback to prioritize improvements and new feature ideas. A combination of smart thinking along with application of principles and iterative management techniques mentioned above can help kickstart the software development process in making robust healthcare softwares.

## References:

1. Ebert C, Brinkkemper S. Software product management – An industry evaluation [Internet]. 2022 [cited 20 June 2022]. Available from: https://www.sciencedirect.com/science/article/abs/pii/S0164121214000156

2. Juneja P. The Need for Product Management in Organizations [Internet]. Managementstudyguide.com. 2022 [cited 20 June 2022]. Available from: https://www.managementstudyguide.com/need-for-product-management.htm

3. Greer D, Ruhe G. Software release planning: an evolutionary and iterative approach. Information and Software Technology. 2004;46(4):243-253. Available from:
https://www.sciencedirect.com/science/article/abs/pii/S095058490300140X

4. Raza M. The Software Development Lifecycle (SDLC): An Introduction [Internet]. BMC Blogs. 2022. Available from: https://www.bmc.com/blogs/sdlc-software-development-lifecycle/

5.  Zhang H, Zhang H, Wang X, Yang Z, Zhao Y. Analysis of Requirements for Developing an mHealth-Based Health Management Platform. JMIR mHealth and uHealth. 2017;5(8):e117. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5561389/

6.  Lindberg O. Editorx.com. 2022. Available from: https://www.editorx.com/shaping-design/article/healthcare-ux-design

7.  Miller A. Why UX in Healthcare Technology Matters and Where It's Going | 2020. Medium. 2022. Available from: https://uxplanet.org/why-ux-in-healthcare-technology-matters-and-where-its-going-2020-82a2cb09ef55

8.  Howe J, Adams K, Hettinger A, Ratwani R. Electronic Health Record Usability Issues and Potential Contribution to Patient Harm. JAMA. 2018;319(12):1276. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5885839/

9.  O'Dowd E. What are Benefits of Healthcare Application Backend as a Service?. HIT INFRASTRUCURE. 2022. Available from: https://hitinfrastructure.com/news/what-are-benefits-of-healthcare-application-backend-as-a-service

10. Herman H, Grobbelaar S, Pistorius C. The design and development of technology platforms in a developing country healthcare context from an ecosystem perspective. BMC Medical Informatics and Decision Making. 2020;20(1):55. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7068897/

11. Korkishko I. Healthcare industry trends and development tech stack for 2020. Medium. 2020. Available from: https://medium.com/gobeyond-ai/healthcare-industry-trends-and-development-tech-stack-for-2020-f56e74f06ffa

12. McGraw D, Mandl K. Privacy protections to encourage use of health-relevant digital data in a learning health system. npj Digital Medicine. 2021;4(1). Available from: https://www.nature.com/articles/s41746-020-00362-8

13. Levels of Testing - javatpoint. www.javatpoint.com. 2022. Available from: https://www.javatpoint.com/levels-of-testing

14. Honest N. Role of Testing in Software Development Life Cycle. International Journal of Computer Sciences and Engineering. 2019;7(5):886-889. Available from: https://www.researchgate.net/publication/335809902_Role_of_Testing_in_Software_Development_Life_Cycle

15. Khristich S. How to Build an MVP for Healthcare: a Complete Guide. Tateeda.com. 2022. Available from: https://tateeda.com/blog/how-to-build-an-mvp-for-a-healthcare-product

16. Geevarghese D. Everything You Need to Know about Healthcare MVP Development. Cabotsolutions.com. 2020. Available from: https://www.cabotsolutions.com/everything-need-to-know-about-healthcare-mvp-development

17. Gladchuk V. How to Build an MVP for an IT Healthcare Project. GreenM. 2021. Available from: https://greenm.io/how-to-build-an-mvp-for-an-it-healthcare-project/

18. Al Rababah A, A. Alzahrani A. Software Maintenance Model through the Development Distinct Stages. IJCSNS International Journal of Computer Science and Network Security. 2022;19(2). Available from: https://www.researchgate.net/publication/333176174_Software_Maintenance_Model_through_the_Development_Distinct_Stages

19. The 4 Types of Software Maintenance-What is Software Maintenance. Cpl.thalesgroup.com. 2022. Available from: https://cpl.thalesgroup.com/software-monetization/four-types-of-software-maintenance

20. 11. Sami M. Software Development Life Cycle Models and Methodologies - Mohamed Sami. Mohamed Sami. 2012. Available from: https://melsatar.blog/2012/03/15/software-development-life-cycle-models-and-methodologies/

21. 12. Ivanova D, Kadurin V. A new proposed software development methodology for healthcare industry. THERMOPHYSICAL BASIS OF ENERGY TECHNOLOGIES (TBET 2020). 2021. Available from: https://aip.scitation.org/doi/pdf/10.1063/5.0042261

22. 13. Petersen K, Wohlin C, Baca D. The Waterfall Model in Large-Scale Development. Lecture Notes in Business Information Processing [Internet]. 2009 :386-400. Available from: https://www.researchgate.net/publication/30498645_The_Waterfall_Model_in_Large-Scale_Development

23. 14. Lenz R. A Practical Approach to Process Support in Health Information Systems. Journal of the American Medical Informatics Association.

2002;9(6):571-585. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC349375/

24. Conrad E, Feldman J. Domain 4: Software Development Security . ScienceDirect. 2014. Available from: https://www.sciencedirect.com/topics/computer-science/spiral-model

25. Boehm B. The Spiral Model as a Tool for Evolutionary Acquisition. CROSSTALK The Journal of Defense Software Engineering. 2001;14(5):10. Available from: https://www.researchgate.net/publication/228805054_The_Spiral_Model_as_a_Tool_for_Evolutionary_Acquisition

26. Xiaoshuan Z, Zetian F, Wengui C, Dong T, Jian Z. Applying evolutionary prototyping model in developing FIDSS: An intelligent decision support system for fish disease/health management. Expert Systems with Applications. 2009;36(2):3901-3913. Available from: https://www.researchgate.net/publication/223584799_Applying_evolutionary_prototyping_model_in_developing_FIDSS_An_intelligent_decision_support_system_for_fish_diseasehealth_management

27. Kruchten P. What Is the Rational Unified Process?. The Rational Edge. 2001. Available from: https://www.researchgate.net/publication/220018149_The_Rational_Unified_Process--An_Introduction

28. Anwar A. A Review of RUP (Rational Unified Process). International Journal of Software Engineering (IJSE). 2014;5(2):24.

29. Holden R, Boustani M, Azar J. Agile Innovation to transform healthcare: innovating in complex adaptive systems is an everyday process, not a light bulb event. BMJ Innovations. 2021;7(2):499-505. Available from: https://innovations.bmj.com/content/7/2/499

30. Kannan V, Basit M, Youngblood J, Bryson T, Toomay S, Fish J et al. Agile co-development for clinical adoption and adaptation of innovative technologies. 2017 IEEE Healthcare Innovations and Point of Care Technologies (HI-POCT). 2017;:56-59. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6197812/

31. Sindhwani R, Singh P, Prajapati D, Iqbal A, Phanden R, Malhotra V. Agile System in Health Care: Literature Review. Lecture Notes in Mechanical

Engineering. 2019;:643-652. Available from: https://www.researchgate.net/publication/332602412_Agile_System_in_Health_Care_Literature_Review

32. Karlsson J. Agile Product Backlogs | Perforce Software. Perforce Software. 2022. Available from: https://www.perforce.com/resources/hns/agile-product-backlog-basics

33. Sedano T, Ralph P, Peraire C. The Product Backlog. 2019 IEEE/ACM 41st International Conference on Software Engineering (ICSE). 2019;41. Available from:
https://www.researchgate.net/publication/330823863_The_Product_Backlog

34. Pinchas A. 9 Techniques for Prioritizing the Product Backlog | Parabol. Available from: https://www.parabol.co/blog/product-backlog-prioritization-techniques/

35. 7 Ways to Prioritize Your Product Backlog. Productplan.com. 2022. Available from: https://www.productplan.com/learn/prioritize-product-backlog/

36. Yarlagadda R, Hussaini Syed H. SOFTWARE ENGINEERING AUTOMATION IN IT. INTERNATIONAL JOURNAL OF INNOVATIONS IN ENGINEERING RESEARCH AND TECHNOLOGY. 2021;8(2):54-62. Available from: https://www.researchgate.net/publication/351853523_SOFTWARE_ENGINEERING_AUTOMATION_IN_IT

37. Bhagat V. Automation in Software Development- A New Stream of Revolution. PixelCrayons. 2021. Available from: https://www.pixelcrayons.com/blog/automation-in-software-development-a-new-stream-of-revolution/

38. Francis R. The 7 worst automation failures. CSO Online. 2022. Available from: https://www.csoonline.com/article/3188426/the-7-worst-automation-failures.html