



Correlating requirement management drivers impacting Agile Adoption in Pharmaceutical Industry

Nadeem Akhter¹, Dr. Ekbal Rashid², Dr. Birendra Goswami³

Ph.D. Research Scholar, Sai Nath University,

Ranchi, Jharkhand, India

Associate Professor, Dept. of CSE

RTC Institute of Technology, Ranchi, Jharkhand, India

Professor, Dept. of Science and Technology

Sai Nath University, Ranchi, Jharkhand, India

nadeemakhin@yahoo.com, ekbalrashid2004@yahoo.com, , bg.ranchi@gmail.com

Abstract – Achieving customer satisfaction is an eternal challenge for pharmaceutical companies. One of the methods to better customer satisfaction is to roll out features to customers quickly and Agile methodology has been the solution. While Agile techniques are widely used because they have numerous demonstrated business advantages. The pharmaceutical industry has not yet been able to determine its success because due to the industry's inability to use standard agile techniques for its product & project development. The requirement management (RM) stage of the development life cycle is one of the most crucial. In this phase, all requirements needed for product development are gathered. But changes in requirements in development cycle have been the worst impediment in Pharmaceutical Industry towards Agile adoption. The value of agile practices has grown because of the assistance it provides for collaboration in software engineering. Requirement management follows various procedures despite being a fundamental stage of software engineering. Aim of this paper is to analyze the problems in requirement management and its effect in Agile sprints thereby assessing impact on Agile adoption in Pharmaceutical Industry. Surveyed data helped to prove that problems in RM process was addressed in sprints along with trends in Agile adoption. The Average Redressal of Requirement Problems (ARRP) was calculated to be 82.25% within Agile sprints. This directly impacts Time to Market and Improved Quality and 95% of respondents together confirmed as the primary reason for project success on Agile. Increase in adoption by 500% is positively impacted by better problem management of requirement in Agile.

Keywords: Waterfall, Agile, Adoption, Impediments, Requirement Management, Software, Pharmaceutical, Industry, Problem, Sprints, Customer Satisfaction

INTRODUCTION

The pharmaceutical industry has long used the Waterfall model, a sequential and linear project management methodology, to oversee software and drug development processes. The Waterfall model still has its place in some aspects of pharmaceutical projects, despite the rise of Agile methodologies in recent years. The phases are performed in order, and if the model is left unchanged, it prevents developers from going back to earlier steps. Herbert D. Bennington gave the first presentation on waterfall at the “Symposium on Advanced Programming Methods for Digital Computers” on June 29, 1956. And it wasn't until Bell and Thayer's 1976 publication that the word "Waterfall" was adopted.

From late 1900 to early 2000, the Classical Waterfall Software Development Model was widely employed. Royce in his paper [4] discussed the changes in classical waterfall model which would eventually pave the way for a model towards Agile.

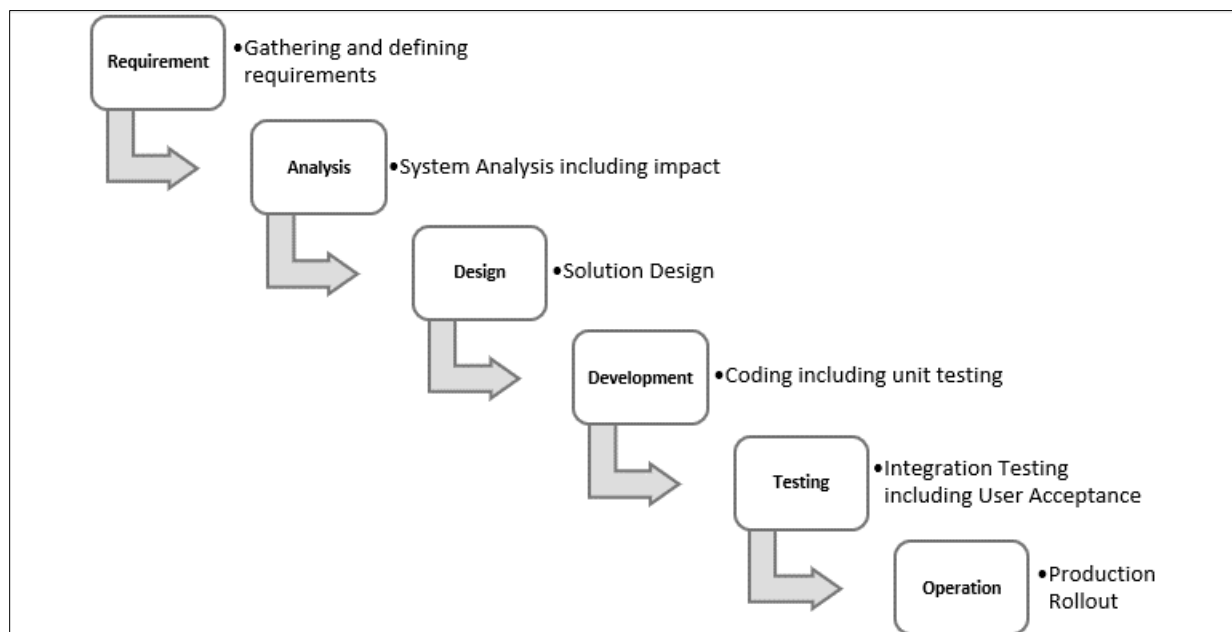


Fig 1 – Several Phases of Waterfall Model. [12]

The order of the steps was determined by the reasoning that follows. There is an "iteration with the preceding and subsequent steps but rarely with the more remote steps in the sequence" in the event of unanticipated challenges. The procedure is more effective because to the restriction on how far back you can go, which lowers the cost of features and changes [5].

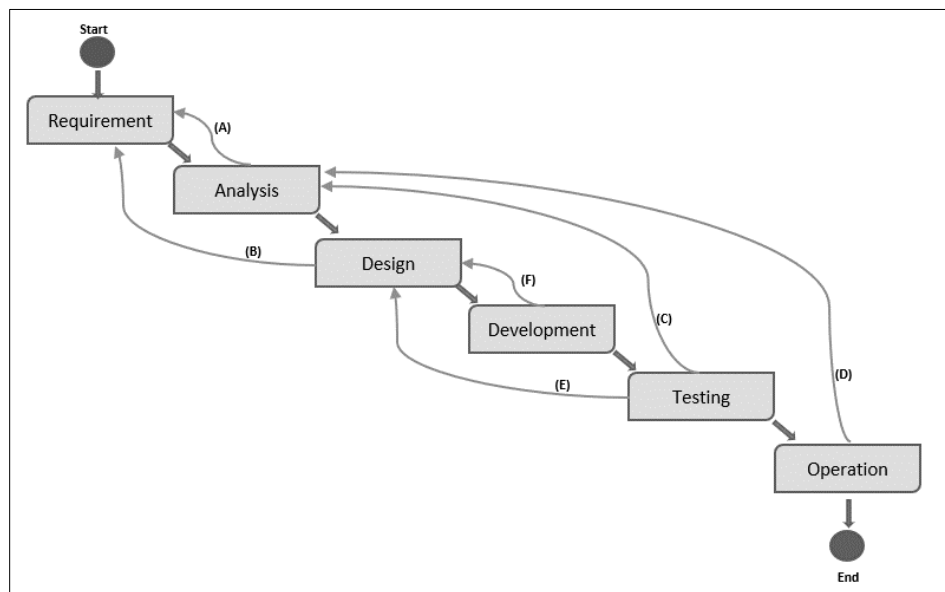


Fig 2 – Iterations within Waterfall Model. [4]

A – Requirement Issue based on Impact

B – Low Level Design Impediment

C – Integration Defects

D – Defects from Live/Production Environment.

E – Implementation Issues ex. NFRs.

F – Functional Defects

The sequential structure of waterfall techniques was a major drawback. Before starting a subsequent phase, a team had to finish the current phase. And in a professional setting, it was necessary to check or verify that completion. The waterfall method had the ability, as was to be predicted [3], to provide a highly rigid basis for bureaucracy, which is something innovative professionals absolutely detest. Furthermore, stakeholders hardly ever saw the program until it was finished, which may have led to a result that fell short of expectations. Therefore, a new strategy was already in place before Agile started to gain popularity as a replacement methodology.

Here's how the Waterfall model is utilized in the pharmaceutical industry:

Regulatory Compliance: The environment in which the pharmaceutical industry operates is very regulated. The linear and structured approach of the waterfall model, which places a strong emphasis on thorough documentation, traceability, and validation, is in line with regulatory requirements. Before moving on to the subsequent stage of drug development, this model aids in ensuring that all necessary regulatory procedures and documentation are finished.

Stability in Planning: The upfront planning and documentation of the Waterfall model are well-known. This approach offers stability in planning and aids in creating a clear roadmap from the start, which is important in the pharmaceutical industry where projects can last several years and involve numerous stakeholders. When managing lengthy drug development projects with predetermined milestones, this predictability and structured approach may be essential.

Quality Assurance: The Waterfall development lifecycle model encourages strict quality assurance procedures. To make sure the project adheres to established quality standards, each phase of the model typically includes reviews, validations, and quality checks. Adherence to quality assurance procedures is essential in the pharmaceutical industry, where patient safety is of the utmost importance.

Risk Mitigation: The Waterfall model places a strong emphasis on thorough planning and risk analysis up front. Pharmaceutical companies can create mitigation strategies and take the necessary precautions to address risks by identifying potential ones early in the project. This proactive approach to risk management fits in well with the industry's emphasis on safety.

Documentation and Traceability: Detailed specifications, design documents, and test plans are all necessary for the Waterfall model. The Waterfall model offers a structured framework to record and maintain these records throughout the project lifecycle in the pharmaceutical industry, where traceability and documentation are essential for regulatory compliance and audit purposes.

However, it's important to note that the Waterfall model also has its limitations in the pharmaceutical industry:

Lack of Flexibility: The sequential nature of the waterfall model makes it less flexible to changes and new requirements. Lack of flexibility can impede responsiveness and agility in a field where

scientific advancements, market trends, and regulatory changes can occur during the protracted drug development process.

Limited Stakeholder Involvement: With major decisions made early on, the Waterfall model typically involves little stakeholder involvement during the development process. This limited involvement can obstruct the incorporation of important feedback and insights from patients, clinicians, and other stakeholders in the pharmaceutical industry, where patient-centricity and collaboration among stakeholders are increasingly stressed.

Risk of late-stage errors: Since testing is postponed until after implementation, errors or other problems may not be discovered until much later in the development process under the Waterfall model. Finding and fixing errors early in the process is essential in the pharmaceutical industry, where safety and regulatory compliance are crucial. The late-stage testing strategy used in the Waterfall model increases the possibility of time- and money-consuming rework or potential safety issues going undetected until the very end.

Limited feedback and learning: The Waterfall model offer few chances for development-related learning and improvement. It becomes difficult to apply lessons from earlier phases into later ones because each is unique and stands alone. The absence of feedback loops in the Waterfall model can be problematic in the pharmaceutical industry, where continuous improvement is essential.

Overall, the Waterfall model is still used in the pharmaceutical industry for some aspects of drug development, but Agile methodologies are increasingly valued for their ability to increase productivity, teamwork, and responsiveness in a sector that is changing quickly.

Agile is based on a basic principle of Continuous Value Delivery to Customer and the end users.

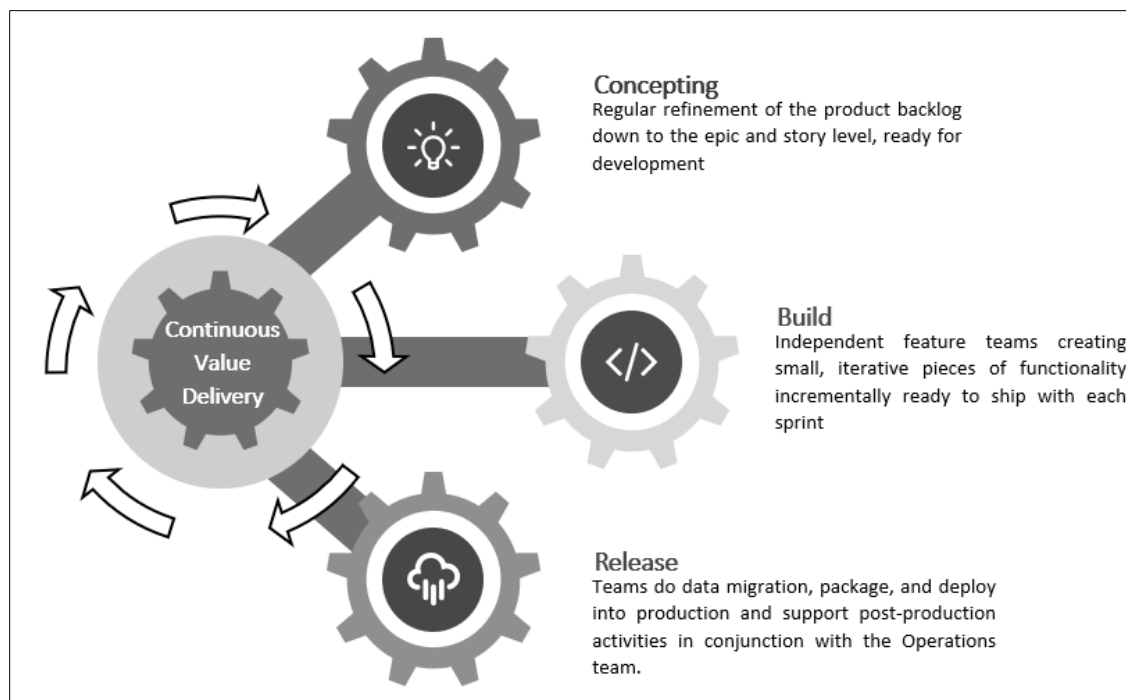


Fig 3 – The CVD Model of Agile. Extended from [1]

Agile development model is short burst of sprints of 1-4 weeks where pre-agreed feature sets are solutioned, developed, testing and released for Users.

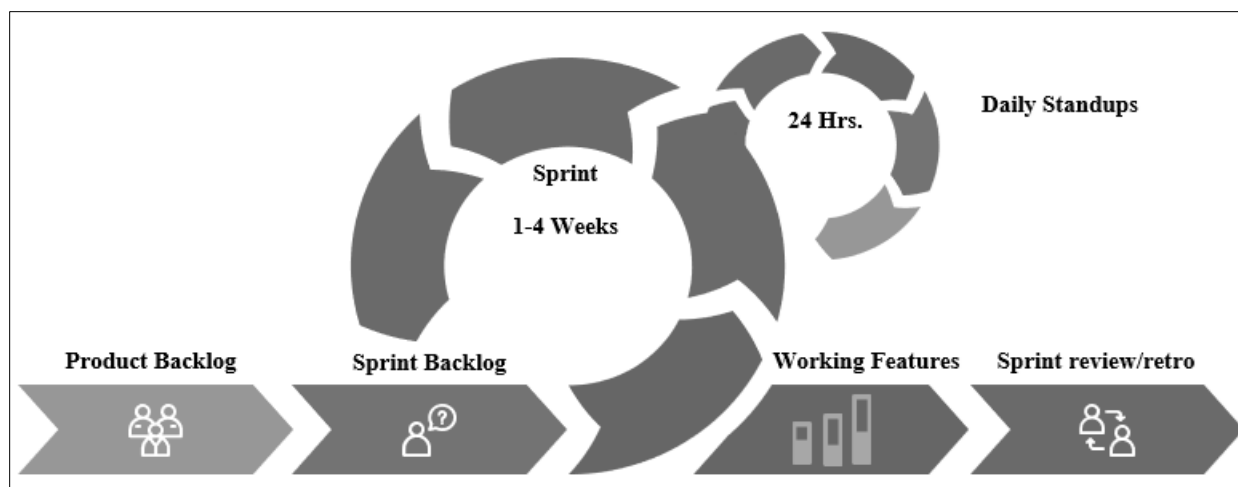


Fig 4 – The Agile model of Sprints. [1]

Agile is frequently preferred over the waterfall technique because it provides an incredibly flexible and less rigorous approach to development [6]. Cross-functional synergies and the emergence of groupthink are ubiquitous, and collaboration is the name of the game. Rapid and flexible innovation is introduced to replace the siloed mentality that was so prevalent in the waterfall approach. Steps are frequently released early and then refined repeatedly for improvement. The concept of accepting errors early [10] and repeating the development repeatedly often results in a much superior product than the final product after being released from a sequential production method like Waterfall.

List of key parameters or Program Characteristics for model comparison. [3]

<i>Parameters</i>	<i>Within Agile</i>	<i>Within Waterfall</i>
<i>Time to Market</i>	Agile's success depends on its ability to launch a Minimum Viable Product (MVP) quickly. After the MVP launch, features are incrementally developed and made available to end users. Companies are able to market features more quickly	Whereas in Waterfall it follows a big bang approach of all or none working software.
<i>Flexibility</i>	With Agile team creates a working prototype of the entire project and features so the client can see how it's made and decide whether to make any changes.	In Waterfall, it's challenging to go back and make changes after a step has been completed. With Waterfall, this is more challenging to accomplish because the customer must outline all of their preferences before seeing a working version
<i>Collaboration</i>	Collocated teams with enhanced collaboration are essential to Agile's success.	In Waterfall different teams can operate in siloed mode and only ensure the success of their phase of team.
<i>Predictability</i>	Since testing occurs frequently throughout the entire process with Agile, the customer can periodically verify that the final product is what they had in mind. This increases the likelihood that the project will be completed on schedule and within budget.	In a waterfall project, the product is primarily tested at the end. Testing may come too late in the cycle to make significant adjustments if the customer's needs weren't initially well understood or if they have changed since the project's inception. The customer then has to come up with additional funds to purchase the item they now require.
<i>Engagement</i>	Agile views the customer as a stakeholder and a member of the implementation team and incorporates them into every stage of the process. Hence Customer engagement is high across all stages of implementation.	Whereas in Waterfall, there are predominantly 2 touchpoints for Customers, ones during requirement gathering and second one during User/Business Acceptance testing. So Customer engagement is light and only at start and just before the finish line.

Fig.5 Agile Vs Waterfall comparison on key program characteristics [3]

The paper is an attempt to analyze Agile adoption and correlate the redressal of problems in requirement management to Agile.

I. LITERATURE REVIEW

Many research scholars have written on evolution of Agile model since its advent – despite perceived impediments of Agile model. There are varied works by different scholars both in “for” and “against” the Agile model. These works and writings have created initial thoughts for the present research work.

The Waterfall model has been traditionally used as a project & product development methodology. But it follows a sequential, linear approach to project management. It involves distinct phases such as requirements gathering, design, implementation, testing, and deployment. While the Waterfall model has been widely used in the past, it has garnered criticism for its inherent drawbacks. Comparing [16] the Waterfall model with the Spiral model and highlights that the Waterfall model lacks flexibility, making it difficult to accommodate changes in requirements or respond to customer feedback. The strict linear approach of the Waterfall model does not allow for iterative development and may lead to customer dissatisfaction. Author [4], the original proponent of the Waterfall model, acknowledges its drawbacks. He emphasizes that the model assumes complete and accurate requirements upfront, which is often an unrealistic expectation. The lack of flexibility in the Waterfall model can lead to high project risks and potential rework during later stages.

Author [17] points out that the Waterfall model is inflexible and does not facilitate early feedback or collaboration among stakeholders. The linear progression of phases makes it challenging to rectify errors discovered during later stages, potentially leading to costly rework. The author [18] criticizes the Waterfall model for its rigidity, as it assumes that requirements can be frozen at the beginning of the project. He highlights that this assumption is unrealistic in dynamic environments and that changes in requirements can lead to delays and increased costs. When Waterfall model and Agile methodologies are compared, the Waterfall model is ill-suited

for complex projects [19]. Lack of flexibility and adaptability in the Waterfall model can result in diminished customer satisfaction and decreased project success rates.

The literature review reveals several drawbacks associated with the Waterfall model. Its linear, sequential approach lacks flexibility and adaptability, making it challenging to accommodate changing requirements and respond to customer feedback. The model's rigidity can lead to costly rework and delays. The limitations of the Waterfall model have prompted the adoption of more iterative and collaborative approaches, such as Agile methodologies. Another paper published by author [12] concludes that combination of Waterfall and Agile is the best approach considering cost and transition. But the authors [13] discussed how the linear nature of tasks and activities defined in the classic waterfall has negative consequences in the overall project hence creating a hybrid model also has similar drawbacks. The authors [11] talk about “The adoption of agility at a large scale often requires the integration of agile and non-agile development elements” in their work. We believe this is the first step of transition towards Agile.

The Agile model is an iterative and collaborative approach to project & product development that emphasizes flexibility, adaptability, and customer collaboration. It has gained significant popularity in recent years due to its ability to address the limitations of traditional models like the Waterfall model. The Agile Manifesto [20], authored by a group of software developers and practitioners, outlines the core values and principles of Agile methodologies. It emphasizes the benefits of focusing on customer collaboration, responsiveness to change, and delivering working software iteratively. The manifesto serves as a foundational document for understanding the benefits of the Agile model.

There are several benefits of Agile modeling, including increased customer satisfaction, improved quality of software, and faster time to market [21]. Agile methodologies enable frequent communication and collaboration between developers and stakeholders, leading to a better understanding of requirements and increased customer involvement throughout the development process. Author [22] emphasizes the benefits of Agile's user stories approach, which focuses on understanding and documenting requirements from the end-user's perspective. This approach promotes customer engagement, allows for prioritization of features, and provides flexibility for changing requirements. User stories facilitate effective communication and ensure

that the developed software aligns with user needs. Author [23] explores the benefits of Scrum, an Agile framework, and highlights the increased productivity and efficiency it offers. He emphasizes that Agile methodologies promote transparency, accountability, and continuous improvement through frequent inspection and adaptation. Scrum enables teams to deliver value quickly and respond effectively to changing market demands. Authors [24] conducted a systematic review of empirical studies on Agile project & product development. Their findings indicate that Agile methodologies contribute to increased customer satisfaction, enhanced software quality, improved teamwork and communication, and higher project success rates. They emphasize the iterative and incremental nature of Agile methodologies as key factors in achieving these benefits. Agile methodologies promote customer collaboration, responsiveness to change, and iterative development, leading to increased customer satisfaction, improved software quality, and faster time to market. They facilitate effective communication, stakeholder engagement, and adapt

The Agile model has gained significant attention in the project & product development industry due to its flexibility, adaptability, and customer-centric approach. However, the adoption of Agile methodologies is not without challenges. There are several factors influencing the adoption of Agile methodologies which includes organizational culture, management support, team characteristics, and project characteristics as key factors [24]. Positive team dynamics, effective communication, and supportive management contribute to successful Agile adoption. Authors [25] analyze the factors affecting the adoption of Agile methods. They identify organizational culture, management support, and requirements volatility as critical factors. A culture that encourages collaboration, flexibility, and continuous learning is conducive to Agile adoption. Authors [26] conducted a survey to identify critical success factors for Agile projects. Their findings highlight factors such as customer involvement, teamwork, communication, and user satisfaction as significant contributors to the successful adoption of Agile methodologies. The authors [27] perform a systematic literature review to identify factors influencing Agile adoption. They categorize these factors into organizational, project-related, individual, and technical factors. Organizational culture, management support, and training emerge as key factors impacting successful Agile adoption. When examining the opinions of project professionals regarding Agile transformation. They identify factors such as top management support, clear

communication, training, and process tailoring as critical for successful Agile adoption and transformation within organizations [28]. There are several factors that impact the adoption of the Agile model. Organizational culture, management support, team dynamics, and project characteristics play significant roles in determining the success of Agile adoption. Customer involvement, effective communication, and training also contribute to successful Agile implementation.

Agile provides the ability to better manage requirements. Agile model is setup for success with business users providing incremental requirements while in development cycle. Agile modeling practices has positive impact on requirement management in Agile projects. [38] It provides insights into effective techniques for capturing and managing requirements in Agile environments Steven. In the book, the author [39] delves into the cooperative nature of Agile project & product development and emphasizes the importance of effective requirement management. He discusses strategies for collaborative requirements gathering, elicitation, and validation in Agile teams. The authors [40] presents an in-depth exploration of requirements management practices, including their relevance to Agile development. It provides guidance on how to apply use cases to Agile projects and effectively manage evolving requirements. In this empirical study published the authors [41] investigated the impact of Agile requirements engineering practices on project success and customer satisfaction and found the importance of effective requirement management techniques in achieving positive outcomes in Agile projects. Software architecture needs to be aligned with Agile practices. The authors [42] examined the impact of requirement management on architecture decisions in Agile projects and provides insights into effective techniques for managing requirements within an Agile software architecture context. Using Lean practices in agile can also be helpful in adoption. The author in his book [43] addresses the challenges of requirement management in Agile environments and offers lean requirements practices suitable for Agile teams, programs, and enterprise-level Agile adoption.

Usage of Agile in projects leads to higher project success which in turn creates better value for customers. Authors [29] conducted a quantitative analysis to assess the impact of Agile on project success. Their findings indicate that Agile projects have higher success rates compared to traditional projects. Agile methodologies contribute to improved project quality, customer

satisfaction, and team collaboration, resulting in increased project success. The success of Agile is first and foremost dependent on requirement management. Authors [30] investigated the impact of Agile requirements engineering practices on project success. Their empirical study reveals that Agile practices such as continuous customer involvement, iterative development, and frequent communication positively influence project success. These practices enable better understanding of requirements and increase customer satisfaction. The authors [24] conducted a systematic review of empirical studies on Agile project & product development. Their findings indicate that Agile methodologies contribute to higher project success rates. The iterative and collaborative nature of Agile promotes faster feedback cycles, improved customer satisfaction, and reduced project risks. The authors [31] investigate the mediating role of project management performance in the relationship between Agile practices and project success. Their study suggests that Agile practices positively impact project management performance, which, in turn, influences project success. Agile methodologies contribute to improved coordination, flexibility, and adaptability, leading to higher project success rates. Agile practices promote effective communication, collaboration, and continuous improvement, enhancing project outcomes. Authors [32] examine the effect of Agile project management on software quality and project success in multicultural projects. Their study reveals a positive relationship between Agile project management and software quality, which ultimately leads to increased project success.

The adoption of Agile methodologies has gained significant traction enabling organizations to improve project outcomes and enhance their competitive edge. Authors [33] provided a comprehensive literature review of technology adoption models. While not specific to Agile methodologies, the review highlights the importance of factors such as organizational readiness, management support, employee skills, and perceived benefits in the successful adoption of new technologies, which can be applied to Agile adoption in different industries. Additionally, Business and Information Security strategies are also important for better adoption. Authors [34] examine the alignment between business and information systems (IS) strategies. Their findings suggest that a strong alignment between business and IS strategies positively influences the adoption and success of IS initiatives. This parameter can be extrapolated to Agile adoption, emphasizing the importance of aligning Agile practices with organizational goals and strategies. The authors [35] investigate the impact of requirements engineering practices on project success.

Their study highlights the significance of early and continuous customer involvement, effective communication, and iterative development in improving project outcomes. These practices align closely with Agile principles, emphasizing their positive impact on Agile adoption. Authors [36] performed a systematic literature review to identify factors impacting Agile project & product development adoption. Their study highlights various parameters such as organizational culture, leadership support, project characteristics, and team factors. These parameters positively influence Agile adoption by fostering a supportive environment, facilitating collaboration, and aligning project requirements with Agile principles. The authors [37] conducted a systematic literature review to identify factors influencing Agile methodology adoption. They categorize these factors into organizational, team, and individual dimensions. Factors such as organizational culture, management support, effective communication, and employee skills positively impact Agile adoption and successful implementation.

Agile adoption is being hampered by the disconnect between the traditional pharmaceutical approach to product development and evaluation and its incremental approach. But creating agile methodologies to support agile development methodologies is a crucial first step in solving these issues [44].

Utilizing the agile framework has advantages for the pharmaceutical industry, including better requirement control, higher quality delivered systems, and increased employee motivation and satisfaction. These advantages add value to the organization [45].

The literature review emphasizes the positive impact of various parameters on the adoption of Agile methodologies in the pharmaceutical industry. Organizational readiness, management support, alignment between business and Agile strategies, requirements engineering practices, and team factors are key parameters that influence the successful adoption of Agile practices. By considering these parameters, organizations can increase the likelihood of successful Agile adoption and leverage its benefits in project & product development.

II. SIGNIFICANCE OF THE STUDY

This quantitative correlational study aimed to examine Agile's adoption trend and importance of better redressal of problems in requirements towards its adoption. The study design targeted employees across all designations who are part of project & product teams using Agile or other models. The study examined the correlation of requirement management drivers which are impacting the Agile adoption. The outcome of this study is significant for Pharmaceutical Industry to prioritize and focus on adopting Agile completely leading to better project success outcomes.

III. METHODOLOGY

This quantitative correlational study is aimed to examine parameters that impact Agile adoption. The study design targeted employees across different levels across different organizations.

The population of this study included employees from different organizations. Therefore, the population size can vary, so we assumed that more than half of the population can impact the correlational study for maximum variability so $p=0.5$. It was first necessary to set the confidence level to determine the appropriate sample size. The author(s) set the confidence level to 95% and an acceptable margin of error is 5%. And the author(s) calculated the sample size using Cochran's Formula.

Since $p = 0.5$ so $q = 0.5$ (since $q = 1-p$). With 95% confidence, and at 5%—plus or minus—precision, so $e = 0.05$. A 95% confidence level gives us Z value of 1.96.

$$n_0 = \frac{z^2 pq}{e^2}$$

(1)

$$((1.96)^2 (0.5) (0.5)) / (0.05)^2 = 385.$$

So, a random sample of 385 professionals in our target population was enough to give us the confidence levels we needed.

We used research data (collected through Surveys) to establish the trend of enterprises moving towards Agile for larger transformation and correlate the positive impact of the parameters on Agile usage for enterprises who are truly agile or intend to move into agile soon. Data from 3 different Surveys are used.

Survey#1 [8] - 642 participants gave their opinions on the data. Access was open to all. The plausibility of the information was roughly assessed. Participants who made implausible statements or did not respond were disqualified from the analysis. Participants who chose at least one answer option in a multiple-choice question were identified.

Survey#2 [9] – The survey was run on Agile and Business Analysts forums. 43 responses were received.

Survey#3 [14] – 3220 participants responded to a series of survey questions based on their role and organization.

Survey Question – What are the Reasons for Organizations to work or adopt Agile?

<i>Reasons</i>	<i>% Selection</i>
<i>Improve Time to Market</i>	56%
<i>Improve Quality</i>	39%
<i>Reduce Project Risks</i>	38%
<i>Improve team Morale</i>	35%
<i>Improve value of products</i>	32%
<i>Improve Predictability</i>	22%

Table.1 Percentage of reasons for use of Agile model

Survey Question – What extent of missing requirement is a problem in Agile project (MRP)?

<i>Responses</i>	<i>% Selection</i>
<i>Not a Problem</i>	12%

<i>Successfully Addressed</i>	9%
<i>Usually Addressed</i>	49%
<i>Occasionally Addressed</i>	16%
<i>Not Addressed</i>	14%

Table.2 Percentage of responses for problem of missing requirement in Agile

Survey Question – What extent of inadequate or ambiguous requirements a problem in Agile (ARP)?

<i>Responses</i>	<i>% Selection</i>
<i>Not a Problem</i>	5%
<i>Successfully Addressed</i>	21%
<i>Usually Addressed</i>	40%
<i>Occasionally Addressed</i>	28%
<i>Not Addressed</i>	7%

Table.3 Percentage of responses for problem of ambiguous requirement in Agile

Survey Question – What extent of conflicting requirements problem in Agile (NRP)?

<i>Responses</i>	<i>% Selection</i>
<i>Not a Problem</i>	16%
<i>Successfully Addressed</i>	26%
<i>Usually Addressed</i>	33%
<i>Occasionally Addressed</i>	23%
<i>Not Addressed</i>	2%

Table.4 Percentage of responses for problem of conflicting requirement in Agile

Survey Question – What extent of changing requirements a problem in Agile (CRP)?

<i>Responses</i>	<i>% Selection</i>
<i>Not a Problem</i>	9%
<i>Successfully Addressed</i>	35%
<i>Usually Addressed</i>	30%
<i>Occasionally Addressed</i>	19%

<i>Not Addressed</i>	7%
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Table.5 Percentage of responses for problem of changing requirements in Agile

Survey Question - Estimating success rates of Projects with different models

Model	Not Specified	00-09%	10-19%	20-29%	30-39%	40-49%	50-59%	60-69%	70-79%	80-89%	90-100%
<i>Agile</i>	6%	0%	0%	1%	0%	2%	3%	9%	32%	20%	28%
<i>Hybrid</i>	5%	0%	0%	1%	2%	3%	9%	13%	30%	26%	12%
<i>Selective</i>	8%	1%	3%	3%	3%	3%	8%	10%	24%	27%	9%
<i>Classic</i>	5%	0%	0%	0%	2%	0%	16%	14%	26%	23%	14%

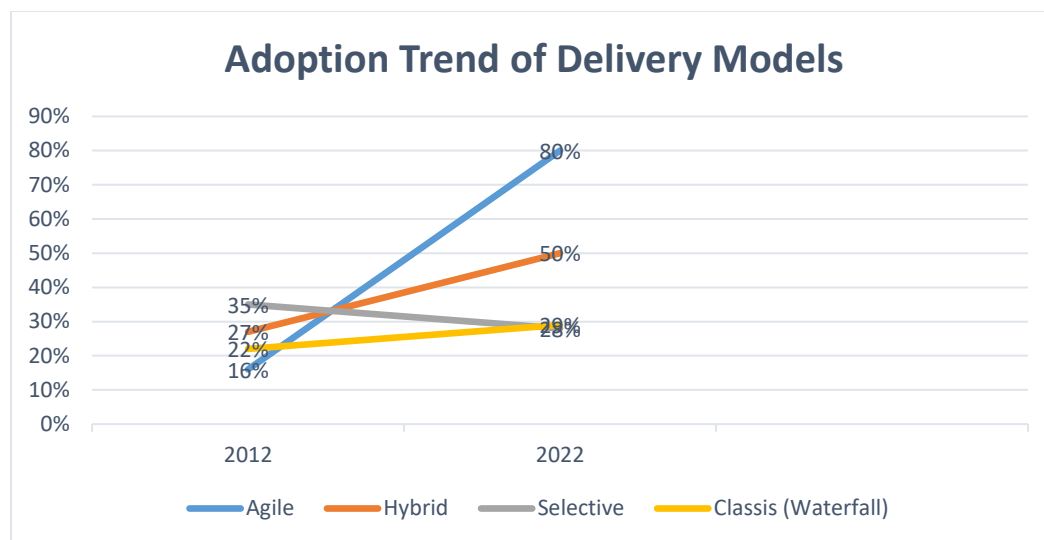
Table.6 Percentage estimating success in different models.

Survey Question - Respondents were asked for Changes to Applied Delivery Models and current experiences by users from 2012 to 2020 within their project and/or organization.

Delivery Model	2012	2022
<i>Consistently Agile</i>	16%	80%
<i>Hybrid</i>	27%	50%
<i>Selective</i>	35%	28%
<i>Consistently Classic Project Management</i>	22%	28%

Table.7 Transitions of Delivery Model Users

Based on the adoption and usage from surveys, the adoption trend from 2012 to 2022 is as below.



Graph.1 Adoption and Usage Trend of Delivery Models [8][14]

IV. RESULT ANALYSIS

We analyzed all the responses pertaining to problems in Requirement management

Redressal Missing requirement problem (MRP) = 74% were able to address in within the Agile sprint

Redressal Ambiguous requirements problem (ARP) = 89% were able to address in within the Agile sprint

Redressal Conflicting requirements problem (NRP) = 82% were able to address in within the Agile sprint

Redressal Changing requirements problem (CRP) = 84% were able to address in within the Agile sprint

We calculated the Avg Redressals of Requirement Problem ARR_P across all sprints.

$$ARRP = \sum_{sprint=x}^{sprint=1} N (MRP, ARP, NRP, CRP)$$

(2)

Where x is equal to total sprints and N is equal to all requirements.

ARRP is calculated as 82.25%. It signifies that 82.25% of problems in requirements within Agile sprints can be addressed without project success getting impacted. *This reassures that we can achieve high level flexibility in scope which can be better addressed with Agile.*

80% of the respondents estimated that projects success rate would be more than 70% in case of Agile being used for Product and Project development. Clearly Agile is leading the way with more and more enterprises willing to adopt and reap the benefits by using Agile delivery model for their transformations.

As per survey data, Agile adoption has increased by 500% from 2012 to 2022. And this is evident by the project success of 80% for Agile users which is driving the high adoption. Project success is dependent on several factors but primarily reduced Time to Market and improved quality of features. 95% of respondents together have quoted these 2 important factors. And with calculated ARRP of 82.25%, Agile's adoption is positively impacted by better problem management within requirements.

V. CONCLUSION

Agile practices, which place a high value on relationships, working programs, client cooperation, and responding to change, have gained widespread recognition in the project & product development industry over the past ten years. We firmly believe that agile perfectly complements the evolving approach to requirement management that results in higher quality. There's no denying that Agile project management is a very well-liked project & product development methodology, with at least 71% of American businesses using it currently [7]. Furthermore, Scrum, the most well-known Agile framework, is now used by 61% of respondents from 76 different countries. This, along with the 88% of workers and professionals from other countries who believe that Agile point to future growth. For businesses, obtaining customer satisfaction is a never-ending challenge. Rolling out features to customers quickly, in stages, and

in bytes is one way to increase customer satisfaction. The worst obstacle to the waterfall model, however, has been changes in requirements during the development cycle for which Agile is the solution. Agile adoption has jumped by 5 times in the last decade mainly due to the increased project success that it leads to. More than 80% of problems are address for requirements leading to better time to market and better quality of product.

The pharmaceutical industry has been adopting the Agile methodology as businesses look to improve their drug development procedures, boost collaboration, and better adapt to shifting market dynamics [7]. It's important to note that due to the industry's unique characteristics, including lengthy development cycles, strict regulatory processes, and the requirement for extensive documentation, the adoption of Agile in the pharmaceutical industry may face difficulties. But with the right adaptation and implementation tactics, pharmaceutical firms can use Agile methodologies to spur innovation, boost productivity, and ultimately speed up the release of safe and effective medicines.

VI. FUTURE SCOPE

Teams working on the software development projects are dispersed all over the world. Because most or all the team members connect remotely, a simple ceremony like a Daily Standup is not effective enough. Agile collaboration loses some of its essential qualities and can occasionally lose its effectiveness. But there is plethora of collaboration tools which needs to be integrated in the culture towards Agile adoption. Agile encourages less documentation rather more collaboration. Reduced documentation, however, implies fewer formal agreements, particularly with customers. Reduced customer satisfaction may result from a conflict over how a feature behaves or an expectation on non-functional requirements.

Agile methodologies can be combined with Requirement Management (RM) techniques across sprints. The authors suggest that for future maintenance and the implementation of various phases of RM, there is a need for documentation and a prioritization process in an agile environment. Many agile techniques (such as extreme programming, crystal methodology, and lean) have evolved hence there is a call for further research and demonstrable practical

outcomes, the findings of this study will be helpful to those looking for interesting areas of research in this field. Conflicts in requirements arise from poorly defined and clarified processes. In an agile environment, a proper framework for prioritizing requirements is necessary.

VII. REFERENCES

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