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Optimizing The Effectiveness of The Agile Development Life Cycle - Post The Pandemic Era

Ayesha Anees Zaveri
Malaysian Institute of Information Technology, Universiti Kuala Lumpu, Malaysia
zaveri.ayesha@s.unikl.edu.my

Juliana Jaafar
Malaysian Institute of Information Technology, Universiti Kuala Lumpur, Malaysia
jjuliana@unikl.edu.my

Eiad Yafi
Faculty of Engineering and IT University of Technology Sydney, Sydney, Australia
eiad.yafi@uts.edu.au

Nabiha Faisal
Department of Computer Engineering, Bahria University, Karachi, Pakistan
nabiha.faisal07@gmail.com

Sehrish Habib
Malaysian Institute of Information Technology, Universiti Kuala Lumpur, Malaysia
Sehrish.habib@s.unikl.edu.my

Izma Shehzadi
Malaysian Institute of Information Technology, Universiti Kuala Lumpur, Malaysia
izma.shahzadi@s.unikl.edu.my

***Abstract*—** The global response to the COVID-19 pandemic meant that many organizations worldwide had to shift to remote work at short notice, greatly impacting the entire software development process. Agile processes handled during this period's drastic changes were invaluable because of the iteration approach. This research aims to improve the agile development life cycle during pandemic disruption. Here, we analyze the challenges of remote work, especially communication setbacks and possible participation withdrawals from the team. Afterward, we propose agile revisions that can aid in solving these challenges. It has been shown by some software development teams and from the literature on the subject that several critical conditions exist for agile adaptation to remote working environments. These include changes in organizational culture - better communication, virtual collaboration, and changes in sprint planning and execution. Emphasis is also placed on the ability of the leaders of multi-location agile teams to raise morale and productivity and define strategies for bringing a team to success. Considering the current post-pandemic conditions, this research provides insights that software development teams and organizations can consider to improve the agile software development life cycle and ensure that projects are successful while maximizing the teams' productivity.

***Index Terms* –** COVID-19, Software Development Life Cycle, Software Engineering, Requirements Engineering, Agile Methodology, Agile Software Development Life Cycle, Work from home, pandemic, Remote Work.

I. INTRODUCTION

The COVID-19 pandemic changed software development, especially for agile software startups. These companies had to deal with new levels of uncertainty and adapt their practices quickly to ensure delivery and customer satisfaction. This paper analyses how agile software startups tried to tackle the issues created by the pandemic to understand what steps software developers can take to enhance the agility of their development life cycle in these challenging times [1].

Agile methodologies did not just live through the COVID-19 pandemic period; they seem to have emerged stronger because of it. The fragility and responsiveness of agile methods have helped software startups serve and stay agile, adapting to the quickly changing customer requirements and market landscapes. As reported in one study, "the flexibility of Agile is making it more favourable," and "risks and uncertainty" are due to the pandemic. Through agile development core principles like iterative planning, continuous integration, and customer collaboration, these startups didn't just survive; they managed to stay on top of the competition, giving the audience more confidence [2].

Undoubtedly, the pandemic has had unique challenges that have led agile software startups to reassess and improve their processes. For example, transitioning to remote work requires new tools and methods to enhance collaboration and communication across diverse teams. Additionally, the pandemic has caused economic effects that have forced many startups to focus their development efforts and fine-tune their resource allocation thoughtfully. These factors exemplify the need for proficient adaptability and resiliency in ambiguity [3].

Agile software startups have taken numerous approaches and practices to address the problems posed by the pandemic. One important thing to note is adjusting "opportunity intelligence" to be more proactive toward greater anticipation of risks and uncertainty. As with many other challenges, agile startups have learned that there is a need for investment in the 'capability of employees, highlighting the importance of human resources during a crisis. These firms equip their staff with the required skills and knowledge to survive changing times. That approach

enhances employees, but more importantly, it increases their sense of value, wherein they understand that the organization's success also depends on them [5].

This research paper seeks to understand the approach taken by agile software startups during the COVID-19 pandemic and how the best practices during that time were able to optimize the agile development life cycle. This will greatly value software teams improving their resiliency and agility in facing obstacles. As discussed earlier, the core idea is to provide peace of mind regarding the effectiveness of agile methodologies during troubling times [6]. This, in essence, is useful to all organizations and their software teams. Hence, they are more resilient and adaptive to any future hurdles.

II. BACKGROUND OF STUDY

The COVID-19 pandemic has posed unique challenges to software development teams. They have had to shift their practices and processes to navigate the rapidly changing environment. Agile strategies for these issues, which focus on flexibility, collaboration, and continuous improvement, are essential currently.

A. Definition of Agile Approach

Agile software development is the method of software development in which the design process is continuously improved in a working model based on customer feedback. It receives regular updates through a process known as sprints, which are short time frames in which a backlog must be completed. The software development industry embraced the agile approach because it addresses the changing needs and conditions of the market at a greater speed than other approaches.

The industry has widely embraced the agile software development methodology, providing activities with a highly flexible, proactive, and responsive approach to building great software. Agile methods like Scrum and Kanban are based on teamwork, frequent revisions, and the active involvement of the end customer at various stages of development.

The defining feature of agile development is that it is iterative and incremental, which is different from the ever-straining traditional waterfall model. Agile design teams work in focused short sprints and consistently deliver working features of the application alongside customer feedback during further development phases. This helps address the market's changing needs, improves customer contentment, enhances loyalty, and ensures the software product's success.

A few approaches succeed in agile, usually for improving participants and stakeholder collaboration, allowing people to delegate from the standard approaches to development, and many others. Self-organizing agile teams fix responsive elements and enable quick decision-making alongside the ability to address changing circumstances to cultivate a culture of innovation and continuous improvement.

Studies suggest that incorporating agile methods, such as Scrum and Kanban, into development projects is bound to improve the attitudinal dynamics of undertaking the software development process.

Agile methodologies have increased success rates and customer satisfaction in projects by enabling stepwise completion of work, better time management, and forming specialized teams.

This said, the success of the agile methodology is not without issues. The organization's culture, stakeholder support, and level of responsiveness to change are some of the factors that determine whether agile practices work. Research on the challenges of remote-first companies adopting agile processes has shown that team collaboration, communication, and cohesiveness are more challenging when employees work from different locations [7,8,9].

B. Modifications for Agile Practices During the Pandemic

With the pandemic, there are new challenges that agile teams must consider and incorporate into their practices to be successful. The remote work scenario, shifting customer bases, and broken supply chains call for increased agility in software development processes. This pulled the need for segmentation. With the shift of work to the remote model, agile teams have had to adapt their communication, collaboration, and productivity to the new work environment.

An increase in the adoption of numerous video communication tools, such as online meetings, team management systems, and editing applications, has enabled and empowered remote teams to connect, exchange information, and execute decisions in seconds. Also, during the pandemic, agile teams had to adapt more quickly to changing demands as the traditional business structures were altered and new requirements emerged.

Research conducted on the consequences of the COVID-19 pandemic on agile project management in developing countries revealed that the outbreak affected firms' functions and their relations with various sectors, such as government, healthcare, finance, and other businesses, to the grave. In this regard, the scope and significance of agile project management have become greater as organizations need to ensure responsiveness to constantly evolving business needs, practices, and technologies [10,11,12].

C. Modification of Agile Practices Following Pandemic Impacts

Different sectors changed their operational procedures after the COVID-19 pandemic. The emergence of agile strategies and their adoption has presented a possible solution to thriving in the volatility faced after the

pandemic, not only in businesses but also in public policy adoption.

Organizational attention during the pandemic focused on a firm's ability to pivot, which was critical in meeting emerging customer demands. Agile methodologies, which focus on flexibility, iterative development, and continuous feedback, turned out to be very important, and organizations could shift their products, services, and workflows to the new normal.

The global transformation to the 'next normal' has deeply impacted emerging International Management. Good evidence shows that companies that practiced agility during the pandemic could weather the uncertainty better than those that did not implement agile practices. As the world is recovering from the pandemic, such companies have the right skill set to address the changing environment proactively.

At the pandemic's peak, companies already implementing agile strategies could remote work effectively and develop new services to meet the emerging market. Such companies had an edge over those still relying on traditional methods. In like manner, other reports have presented agile practices as a stable source of product and service value delivery even with the interruptions posed by COVID-19 for software firms. For firms, this pandemic has presented a great deal of challenges while also posing numerous important notes for the future. Given the changing nature of business, these reflections will be extremely helpful in determining how agile values can be implemented. The world after the pandemic will be a different place. With agility, companies can adeptly respond to new challenges and opportunities [11, 12, 13].

III. Research Methodology

This study follows a flowchart methodology designed to optimize the Agile Development Life Cycle SDLC in a post-pandemic world, especially concerning the issues posed by remote working and supply-chain bottlenecks. The flowchart begins with Identifying Challenges, which refers to understanding the distinct events impacting the Agile SDLC during the pandemic, including shifting to remote work and supply chain interruptions.

A. Remote Work

Remote work profoundly affects communication, collaboration, and overall productivity within a team. Therefore, the branch modifies Agile principles if the obstacle is remote work by adding more virtual standups, robust communication tools, longer sprint durations, or other practices to address productivity impacts among the shifted work dynamics.

B. Supply Chain

Another severe problem identified is the disruption of supply chains due to the pandemic. This phase attends to the need to modify the Agile practices to adapt to the new normal of delays and interruptions in the supply chains so project deliverables can still be achieved.

C. Uncertainty Check

Another key component of a post-pandemic agile environment is the Uncertainty Check, which focuses on the organizational uncertainty level within one's organization. When the uncertainty is particularly high, the methodology suggests reducing the sprint length to mitigate unforeseen issues better. By shortening sprints or iterative cycles, teams can quickly implement changes and respond efficiently to shifting conditions.

D. Task Prioritization and Check-ins

After the challenges and uncertainty have been dealt with, the next step is prioritizing tasks. This ensures that crucial tasks are dealt with and completed first while considering any negative consequences of disturbances or delays. The team then checks in, which entails regularly evaluating progress and deviation from the project goals to ensure the team is not side-lined by hurdles.

E. Enhancing Collaboration

A critical component of the research methodology focuses on Enhancing collaboration for teams, particularly in a post-pandemic world where remote or hybrid working models are here to stay. The study seeks to stress the need for effective cooperation among team members to avoid a silo mentality and ensure that there is smooth interaction and flow of information.

F. Develop Frameworks for Agile Collaboration

The primary focus of these inquiries is to identify gaps that, if addressed, can enhance cooperation tools and communication methods and strengthen the team's performance level. Combining these gaps focuses on new approaches, Such as reviewing and adjusting Agile techniques to improve the processes continually.

G. Finalize the Agile Life Cycle

In the last phase, his efforts are focused on where specific procedures and improvements are incorporated to Finalize the Agile Life Cycle post-pandemic. Agile flexibilities and effectiveness globally are retained post-pandemic optimization and ensure sustainability is achieved in ever-changing and uncertain environments. Focusing on agile development, lifecycle optimization challenges, and sharpening practices will improve collaboration in partnership with a new approach in the post-pandemic world. Therefore, the flowchart of these exquisite changes reveals a comprehensive optimization methodology that strategy systematically solves Agile SDLC challenges, processes refinement, and, most importantly, aiding agile teams in this new world where the pandemic is over faces new challenges.

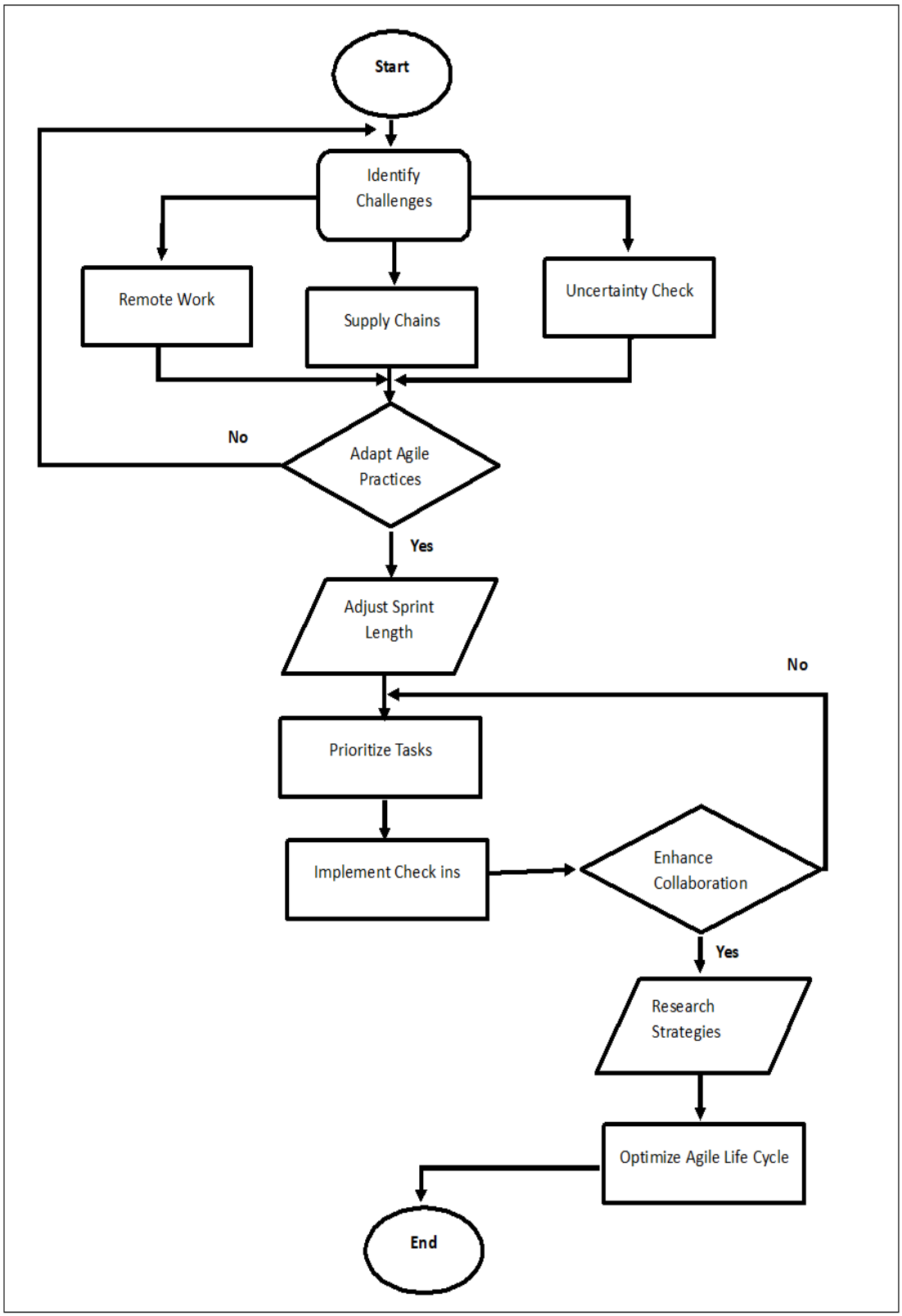

Figure 1 Flow Chart of Research Methodology

IV. Research Questions

RQ 1. What new challenges did the COVID-19 pandemic introduce to agile software development teams?

The ramifications of the COVID-19 pandemic are obvious, with all industries facing new challenges. Novel obstacles are present within the software and application development sector as well. Agile development teams are most affected as they are the most responsive and adaptive to changing circumstances [1,2,3].

Most Agile teams have and continue to lose out on in-person collaboration, a level blocker of the Agile methodology. Having to maintain a safe physical distance and work remotely during the pandemic has caused a major shift in communication and collaboration using virtual tools, which creates new challenges when it comes to coordination [12]. In addition, there have also been supply chain and business continuity interruptions, which makes providing adequate goods and services harder to achieve and even more complex [13].

There is a stronger need to be agile and responsive in these uncertain and volatile times, especially with the world changing as quickly as it does. Market conditions, customer demands, and, most importantly, critical projects and resources have set a very strange set of conditions that have to be addressed by agile teams [12].

In addition to that, during times of crisis, covering the general health and productivity of team members has also suffered drastically as remote work continues to stay the new normal. Team members have personal issues, such as looking after family members or being ill, making things extremely difficult [12, 13].

Notwithstanding these issues, agile software development teams seem to be coping well regarding resilience and adaptability. Flexibility and a responsive approach to iteration within the team helped address the changes to be made [14].

Agile teams have prioritized communication, empathy, and support using remote collaboration tools, which ultimately helped maintain focus and achieve customer value [11, 12]. Also, the heightened emphasis on automation and agile practices such as continuous integration and deployment contributed to the changes that agile teams had to deal with during the pandemic [13, 14].

The COVID-19 pandemic has demonstrated some pros and cons of agile software development approaches. While the adverse effects of this crisis are endless, we can also congratulate agile teams for adapting to the new norm [12, 13].

RQ 2. How did agile teams respond to the processes and practices necessary because of the pandemic?

Every project requires some level of flexibility or adaptability, which agile teams usually possess. However, the pandemic had its own set of challenges. To adapt these practices for remote work, agile teams succeeded in these strategies:

A. Maintaining frequent communication

This helped compensate for the collective face-to-face interactions vital for agile teams. Improved communications led to better coping within-person meetings suffering from increased social distancing.

B. Focusing on outcomes

Emphasizing the results over the work made the teams more adjusted and made the changes more friendly.

C. Leveraging technology

Video conferencing and other online workplaces became crucial in keeping teams working and active [11, 12, 14, 15].

RQ 3. What measures should organizations take to enhance the effectiveness of the agile development cycle after the pandemic or when disruption is likely to happen?

The evolution of the COVID-19 pandemic compelled numerous businesses to embrace agile frameworks as a proactive response to the rapidly evolving business landscape. There are ways to enhance agile development in a post-pandemic world or in times of other disruption:

A. Don't mistake agile for rushed:

While agile aids in adaptability and flexibility, it's essential to remember that maintaining proper work standards comes with flexibility.

B. Reflect and learn:

Determine what hindered and aided productivity during periods of disruption. Recommend practices that helped the teams to excel under stress to be used in normal operating procedures.

C. Embrace ongoing learning and development:

The pandemic has shown the need to be flexible. Support continuous development and learning in teams to cope with prospective uncertainties in the future.

Agility is about coping with change. Organizations will be able to strengthen their ability to thrive in the "next normal" by acting upon lessons learned from the recent disruptions.

RQ 4. On what aspects, if any, did the pandemic change agile practices, and was the impact of these changes positive in the long run?

It is pertinent to note the adoption rate of agile methodologies during the pandemic and their positive impact on businesses. Still, as discussed, the rate of escalation and its effects are more complex. Certain changes, such as increased remote work and trust in

communication technology, appear here to stay. [7] describes how the pandemic compelled the software development community to transition to remote collaboration.

There is an argument on whether these modifications are advantageous in the long run. Some say remote work increases productivity and work-life balance, but others cite communication and teamwork issues. Adopting agile methodologies is no magic wand, and being agile is much more than that, which is why deeper digging is crucial. (COVID-19's Uncomfortable Revelations About Agile and Sustainable Organizations in a VUCA World, 2020)

In the end, the pandemic was a giant test for Agile. Companies that pay attention to their pandemic experiences and critically recognize what was beneficial and what needs to be reformed will be more successfully positioned to benefit in the future. Did your library have any publications on the enduring effects of changes made during the pandemic on certain agile workflows? If so, it would be very interesting to investigate these publications for further analysis. [16, 17, 18].

V. Optimizing Agile Practices for the Pandemic Era

To maximize the efficiency of the agile development life cycle during the pandemic, there are several options that organizations can execute:

A. Foster Enhanced Collaboration:

Adopt and improve communication and collaboration technologies that facilitate effective teamwork regardless of where people are located.

B. Emphasize Flexibility and Learning:

Foster continuous learning and adaptation on the part of team members to ensure they can respond to challenges and opportunities as they arise.

C. Decrease Time Needed To Make Decisions:

Give authority to functional teams to make decisions without seeking approval from the higher levels of management, thus cutting bureaucratic processes for faster response.

D. Encourage Freedom of Expression:

Foster unlimited and frank communication between team employees, members of the relevant stakeholders, and customers to achieve shared context.

E. Improve Practices Of Working From Home:

Clearly defined policies, accompanying infrastructure, and support for conditions necessary for effective remote collaboration should be implemented.

The COVID-19 pandemic has prompted the software development industry to change its processes and practices due to new challenges such as remote work, supply chain issues, and economic instability. In this regard, the agile project life cycle has developed into an important tool or strategy that software groups can utilize to be effective and responsive to the shifting dynamics of business [19]. Figure 2 illustrates the optimization strategy adopted by agile practices.

Agile practices like Scrum and Kanban have always been known for providing ease of iteration and giving feedback and changes at any time. Some of that ease was evident during the pandemic when organizations were forced to change their products and services to meet the growing expectations. The focus on the shift of cross-functional teams, along with Agile's focus on more detailed planning and unconstrained delivery timelines, means that teams can be self-sufficient and flexible despite disruptions [20, 21].

In addition, the transition to remote work has made transparency, visibility, and constant communication inherent in agile practices even more important. Practices like daily standups, retrospectives, and natural Agile ceremonies have enabled distributed teams to be aligned, identify problems, resolve problems rapidly, and create a shared sense of belonging within the team. Likewise, the ability to gather and respond to customer concerns during the pandemic enabled faster and more appropriate responses to the customers' needs. Agile principles have made adapting to the conditions easier for businesses [20].

Still, the pandemic has added new circumstances that potentially threaten the performance of an agile development life cycle. As the pandemic created a remote working environment, achieving the same collaboration and support gained through co-located working formats has become increasingly challenging. Moreover, the economic downturn resulting from the pandemic has led to funding and resource restrictions, which agile teams might find overstretching and making it difficult to deliver value promptly [21].

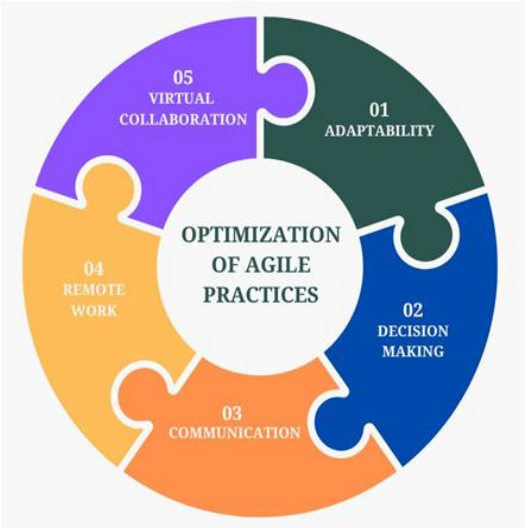

Figure 2 Agile practices Optimization

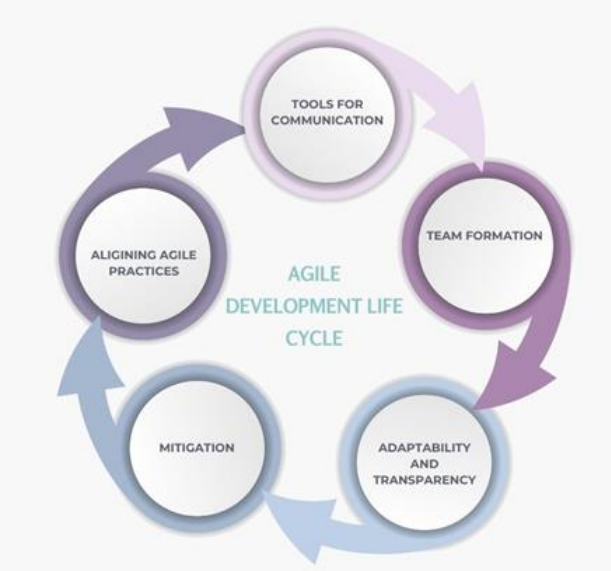

Figure 3 Agile Development Life Cycle

To enhance the efficiency of the agile development life cycle represented in Figure X, organizations during the pandemic period need to address these issues by:

- Spending on remote collaboration and communication tools like video conferencing, virtual whiteboards, and project management applications.
- Promoting strong, agile cultures within teams that embrace transparency, adaptability, and improvement.
- Taking care of employees' health and well-being by implementing strategies to support remote work while minimizing stress and burnout.
- Integrating agile practices with the organization's pandemic response strategy to align software development with shifting business values and priorities.

These strategies allow the organization to meet the challenges presented by the pandemic by utilizing the agile development life cycle and help deliver customer-centric software solutions critical to business success [15].

VI. Adaptation of Communication Strategies within Agile Teams for Effective Collaboration during the Pandemic by Organization

Due to the pandemic, organizations had to rethink how agile teams communicated and collaborated across distances. In this case, here's their communication strategies:

A. Embracing a Multi-Channel Approach

Digital aid dependence:

Slack, Microsoft Teams, and Zoom emerged as the primary platforms for daily standups, sprint planning, backlog grooming, and other informal queries team members may have had.

Project management application usage:

Jira, Trello, and Asana helped track progress and task assignments, ensuring transparency, even when team members were physically distanced.

Visual collaboration application use:

Miro, Mural, and other platforms enabled virtual brainstorming sessions, collaborative design sessions, and other visual problem-solving activities.

B. Move Toward Asynchronous Communication:

Different time zones and scheduling considerations:

With team members dispersed over different locations, asynchronous communication through shared documents, project wikis, and videos facilitated the flexibility to save them from chronic meeting fatigue.

Recording decisions and conversations:

Notes and meeting minutes became necessary documents to ensure that everybody was informed and aligned regardless of their location and availability for meetings.

C. Clear and Consistent Communication:

Through clear communication to bypass confusion:

Teams adopted the approach of overcommunicating to avoid misunderstandings," conveying unclear information is never the best option. Proactive transparency was favoured, and regular updates were shared to create collaboration.

Improving Information Dissemination by Streamlining Communication Channels: Communication protocols did aid in reducing confusion and optimizing the flow of information by clarifying which channels are to be used for what.

D. Cohesion within Team Members in Remote Working Environment:

Promoting interaction:

Team building exercises, online games, and virtual coffee breaks boosted morale. They helped build camaraderie in a physically distanced setting.

Allowing avenues for informal communication:

The social interactions accompanying a traditional office setting were supplemented by informal Slack channels or virtual watercoolers, allowing for casual banter amongst team members.

E. Tailoring One's Approach to Communication:

Recognizing that one size doesn't fit all:

Remember that a singular approach will not work effectively across the board.

Providing opportunities for feedback:

Greater awareness of each team member's communication preferences to provide written, verbal, or visual aids was offered.

Offering chances for communication:

Routine retrospectives and check-in meetings allowed teams to think through their communication decisions and make any needed changes.

These adaptive communication strategies allow organizations to ensure that teams placed under these conditions can prosper and continue their goals despite the changes in the business environment.

VII. Implementation of Strategies by Organizations to Optimize Effectiveness of the Agile Development Life Cycle during the Pandemic

Companies were compelled to transform their agile working methods with strategies supporting remote operations. Here are the techniques that they used:

A. Communication & Collaboration:

Digital communication was enhanced: The use of Slack, Microsoft Teams, and Zoom was vital for daily standups, informal conversations, and other business meetings as a way of overcoming physical separation.

B. More meetings that are shorter in duration:

To engage employees, teams worked with set objectives to overcome "Zoom fatigue" and focused on more concise meetings.

C. Used technology for collaboration:

Miro and Mural allowed collaborative work on virtual whiteboards supporting remote brainstorming and problem-solving sessions.

D. Flexibility & Adaptability:

Adapting asynchronous communication: Since many people have different peak hours for productivity, teams started using project management boards, documents, and other tools to communicate asynchronously for more autonomy and flexibility.

E. Iterative planning and re-prioritization:

To meet the demands of an uncertain environment, firms focused on shorter planning cycles and more regular re-assignment of task priorities.

F. Team Endorsement, Support, and Well-being:

Understanding the emotional toll of the pandemic, companies took measures to support employee well-being, such as balancing flexible work arrangements, virtual team-building exercises, and providing mental health resources.

G. Remote ICT Team Building Activities:

Companies introduced team-building practices such as virtual coffee breaks, happy hour games, and book clubs to address disconnection.

H. Tools and Technical Infrastructure

Creating a robust infrastructure for remote work: Companies adopted practices that ensured secure and reliable VPNs, cloud-based development environments, and collaboration tools for remote work, such as Loom and Slack.

I. Workflows And Processes Management Through Automation

Organizations utilized CI/CD pipelines, automated testing, and other DevOps methods to enhance their literature review strategy. They focused on processes to increase efficiency by reducing dependencies on manual tasks.

These are only a few illustrations, and the approaches taken differ based on each organization's context and requirements. But the main idea remains the same. In a post-pandemic world, there must be a focus on communication, employee wellness, and agility [21,22,23].

VIII. Limitations and Future Work

This research expands on existing literature regarding adopting agile methodologies within the planning in remote work settings necessitated by pandemic interruptions. However, it has several drawbacks. It was based on a modest sample size and cohort of case study analysis, which is not representative of myriad experiences across industries, units, and regions. Furthermore, the context of the pandemic poses peculiar circumstances that are unlikely to resemble a true state hybrid remote work setup in the long run.

The broad scope of organizational and technological resources, the differing seniority levels of team members, and other organizational climate nuances limit the results' applicability. The consistency in measuring aspects such as productivity, communication, and even team spirit also poses great challenges in remote environments.

Future research should address the effectiveness and sustainability of remote and hybrid agile practices through longitudinal empirical studies. More comprehensive performance measurement systems, collaboration tools, and frameworks specific to hybrid and asynchronous teams must be developed. Furthermore, optimizing agile in changing work contexts and nurturing resilience and

high performance at the software development team level will require additional exploration of leadership, culture, and team dynamics.

CONCLUSION

The software industry had to cope with hardships never witnessed before amidst the COVID-19 pandemic. The company's socio-technological landscape must rapidly change to meet the new norm's requirements. We investigated how companies maximize the efficacy of the agile development life cycle during this time of turbulence.

Our results show that the pandemic impeded agility practices like remote working and collaboration software. At the same time, it casts a shadow on every core agility practice, including adaptability to change, communication, and perpetual improvement. Companies that managed to survive this phase suffered in silence and adopted the motto of 'for the greater good,' withdrew their participation from the race, and sought sustenance in the learned experiences of actively changing prioritizations towards the best intentions of their teams.

There is no debate about the consequences of the pandemic on the market, especially in software development. From adopting strong digital systems to responsive and responsive teams, the lessons learned will redefine the imperatives of agile methodologies. Looking ahead, we need to emphasize informal interaction, learning from peers, and putting humans at the center of the agile framework to improve and innovate the approaches towards development in an ever-complex and uncertain reality [20, 21, 22].

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REFERENCES

[1] Camara, Rafael & Marinho, Marcelo Luiz & Sampaio, Suzana & Cadete, Saulo. How do Agile Software Startups deal with uncertainties caused by the Covid-19 pandemic? International Journal of Software Engineering & Applications. 11. 15-34, 2020.

[2] Lisbôa, Diego & Rocha, Thayssa & Machado, Letícia & Caldeira, Clara & Souza, Cleidson. Working in the COVID-19 pandemic: an observational study. Journal on Interactive Systems. 12. 283-293, 2021.

[3] M. Zahedi, M. Abbasi, and S. N. Khanachah, "Providing a lean and agile supply chain model in project-based organizations," Annals of Management and Organization Research, vol. 1, no. 3, pp. 213–233, Feb. 2020.

[4] Singhal, Anjali. Adhering Agile Methodology in Covid-19. International Journal of Computer Science Engineering and Information Technology Research. 11. 45-50, 2021.

[5] Martin Kropp, Andreas Meier, Craig Anslow, Robert Biddle,
Satisfaction and its correlations in agile software development, Journal of Systems and Software, Volume 164, 2020.

[6] Camara, Rafael & Alves, Annelyelthon & Monte, Iury & Marinho, Marcelo Luiz. Agile Global Software Development: A Systematic Literature Review. 31-40, 2020.

[7] Mancl, D., Fraser, S.D. (2020). COVID-19's Influence on the Future of Agile. In: Paasivaara, M., Kruchten, P. (eds) Agile Processes in Software Engineering and Extreme Programming – Workshops. XP 2020. Lecture Notes in Business Information Processing, vol 396. Springer, Cham, 2020.

[8] Schmidtner, M., Doering, C., & Timinger, H., Agile Working During COVID-19 Pandemic. IEEE Engineering Management Review, 49, 18-32, 2021.

[9] Sharma, M., Luthra, S., Joshi, S. et al. Challenges to agile project management during COVID-19 pandemic: an emerging economy perspective. Oper Manag Res 15, 461–474, 2022.

[10] Worley, Christopher & Jules, Claudy, COVID-19's Uncomfortable Revelations About Agile and Sustainable Organizations in a VUCA World. The Journal of Applied Behavioral Science, 2020.

[11] Camara, R.D., Marinho, M.L., Sampaio, S., & Cadete, S How do Agile Software Startups deal with uncertainties by the Covid-19 pandemic? 2020.

[12] Rometsch, Lisa & Wegner, Richard & Brusch, Florian & Neumann, Michael & Linke, Lukas, When is Good Good Enough? Context Factors for Good Remote Work of Agile Software Development Teams. The Otto Case, 2022.

[13] Făgărăşan, Cristian & Cristea, Ciprian & Cristea, Maria & Popa, O & Mihele, C & Pisla, Adrian, Key performance indicators used to measure the adherence to the iterative software delivery model and policies. IOP Conference Series: Materials Science and Engineering, 2022.

[14] Saeedi, Kawther & Visvizi, Anna, Software Development Methodologies, HEIs, and the Digital Economy. Education Sciences, 2021.

[15] Zayat, Wael & Senvar, Ozlem, Framework Study for Agile Software Development Via Scrum and Kanban. International Journal of Innovation and Technology Management, 2020.

[16] Dam, Hoa & Tran, Truyen & Grundy, John & Ghose, Aditya & Kamei, Yasutaka., Towards effective AI-powered agile project management, 2018.

[17] Dhir, Saru & Kumar, Deepak & Singh, V., Success and Failure Factors that Impact Project Implementation Using Agile Software Development Methodology. 10.1007/978-981-10-8848-3_62, 2019.

[18] Nazir, S., Price, B., Surendra, N.C. et al. Adapting agile development practices for hyper-agile environments: lessons learned from a COVID-19 emergency response research project. Inf Technol Manag 23, 193–211, 2022.

[19] Batra, Dinesh, The Impact of the COVID-19 on Organizational and Information Systems Agility. Information Systems Management. 37. 361-365. 10.1080/10580530.2020.1821843. 2020.

[20] Daniel Brosseau, Sherina Ebrahim, Christopher Handscomb, and Shail Thaker, The journey to an agile organization, McKinsey & Company, May 2019.

[21] Darrell Rigby, Jeff Sutherland, and Andy Noble, Agile at Scale, Harvard Business Review, May 2018.

[22] Zaveri, A. A., Jaafar, J., Yafi, E., & Shehmir, S. Evolution of Requirements Engineering in Agile Methodology–Literature Review, Journal of Engineering Technology and Applied Physics 6 (2), 57-65, September 20204.

[23] Zaveri, A. A., Jaafar, J., Yafi, E., & Shehmir, S. (2024). Impact of Covid-19 on Agile Software Development. In Board Diversity and Corporate Governance (pp. 69-84). Cham: Springer Nature Switzerland.