

Boosting human capital: how the COVID-19 pandemic accelerated agile methodology adoption in software development

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Abstract. *COVID-19 Pandemic period has changed the way business operate and forced workers and companies to adapt new ways of working and new business practices, being faced to new challenges.*

One of the most important shifts, consisting in working remotely, has also increased the usage of Agile Methodology, especially in software development. Agile Methodology consists in a dynamic and flexible way of working, capable of creating a working environment that empowers worker, creativity, autonomy, constant feedback, efficient communication, and iterative work. The paper aims to discuss the positive correlation between the increase in usage of Agile Methodology, due to social distancing procedures during COVID-19 Pandemic, and the Human Capital - particularly in IT development workforce area.

Keywords: COVID-19, Pandemy, Social distancing, Waterfall Methodology, Agile Methodology, Human Capital.

JEL Classification: J010, I000, O350, O390, Z130.

Introduction

COVID-19 Pandemic period has changed the way business operate and forced workers and companies to adapt new ways of working and new business practices, being faced to new challenges.

One of the most important shifts, consisting in working remotely, has also increased the usage of Agile Methodology, a dynamic and flexible way of working, capable of creating a working environment that empowers worker, creativity, autonomy, constant feedback, efficient communication, and iterative work.

Before COVID-19 Pandemic, many IT delivery projects were divided between using Waterfall or Agile methodologies. During and after pandemic, the use of Agile methodology has increased. The details of this shift and the dependencies with the human capital will be further detailed in the following article.

Agile Methodology is focused on iterative progress, constant proactivity and reactivity to any challenges and changes that may occur. Since worldwide the market has known many fluctuations in terms of traditional processes, Agile methodology has proven to be a way of working that allowed the quick fixes, quick adjustments to any unplanned shifts that needed to occur, combining this progress with effective communication and feedback across the companies and in relationship to the markets.

This article aims to describe, with applicability in IT domain, that Agile Methodology usage has increased, naturally, among development teams and among companies and together with this increase workers human capital has also grown. By encouraging an environment with continuous flexibility, adaptability, continuous learning, agile methodology has enabled workers to aim and to gain new skills, to enhance their abilities. The agile framework is consistently helping the team to strengthen teamwork and communication, therefore activating new skillsets and capabilities of the workforce.

Waterfall Methodology. Description and challenges during COVID-19 Pandemic.

The waterfall methodology is a project management approach that defines a linear, sequential progression of a project. The project follows clear, strict phases throughout its development, with well-defined and formalized procedures for deviations. Each phase must be completed before moving on to the next. This approach requires all stages to be synchronized and planned progressively to be completed linearly over time.

The most well-known stages of the waterfall methodology are as follows: Analysis and Requirements Specification Phase, Solution Design/ Architecture, Implementation, Testing and Acceptance Phase, Solution Installation Phase, Maintenance Phase.

In Analysis and Requirements Specification Phase, the final product to be achieved is outlined. Business and development workflows are defined, and the resources to be used in the project are identified. The requirements specification, work methods, and business processes are defined from both technical and non-technical/functional perspectives. The implementation team and the product reception team work intensively to establish the acceptance criteria for the product to be delivered.

In Solution Design and Architecture phase, the architecture of the solution to be implemented is outlined and agreed upon. In the waterfall methodology, the phases follow one another linearly and are interdependent. Therefore, phase 2 uses the complete and analyzed information from phase 1 to fully define the product of the second phase.

The third phase is the implementation phase, where technical and functional resources distribute the work equitably so that the final product can be delivered as officially agreed upon in the previous phases. This phase itself has its own granularity, depending on the project, to ensure that deliverables and the product are synchronized technically and functionally into a consistent final product.

In the Testing and Acceptance Phase, after the previous implementation phase is completed, the final product is tested. The goal is to confirm that the product meets expectations (according to the previous phases) and is fully functional. Once this stage is completed, the project moves on to the next phase.

In the Solution Installation phase, once the product has been accepted by the client, it is installed in the client's production environment. This is the point at which the product is delivered.

During Maintenance phase, the product has been delivered into the production environment, and end-users begin to use it. The delivery team remains available for a defined period to fix any errors and support end-users as they adapt to the new product.

Given the clear, linear nature of the waterfall methodology, certain strengths and disadvantages can be delineated. Among the clear advantages of using the waterfall methodology are the clarity regarding the product and each phase that has occurred, is occurring, and will occur, as well as the existence of clear, progressively developed documentation.

The disadvantages include inflexibility and the need to adopt a clear risk management strategy (each phase is dependent on the previous one and conditions the next one). Most importantly, for the waterfall methodology to work in favor of the project and not hinder its progress, it must be chosen carefully, documented thoroughly, and applied to the specific needs of the project in question.

The decrease in usage of Waterfall methodology, during COVID-19 Pandemic and after it has, in conclusion, multiple reasons:

- Waterfall methodology can lead to inflexibility in changing environments, because it stands for a linear development approach that makes it difficult to adapt to quick changes. On the opposite side, the pandemic imposed fast and risky changes, in order to keep many development project on track and efficient.
- Waterfall Methodology can face challenges faced to remote work context. Waterfall methodology has its bases on upfront planning and linear execution, beginning one phase only after finishing another, with strong documented dependencies and organized synchronization between the phases. This can be challenging in a period such as Covid-19 Pandemy, given the high risk and challenges also involved by the remote work settlement, considering aspects such as communication, challenges, risk management and stress management that converges from the rapid shifts that need to happen worldwide.
- Feedback is not naturally encouraged by the model. Waterfall methodology strenghts does not rely on feedback and iterative work. It relies on upfront planning, strong risk management, linear development. During COVID-19 pandemic, due to recurrent changes that occurred not only in IT sector, but also worldwide, the need to keep the attention to feedback and to integrate it inside fast changes has been an important asset for the teams working in Agile Methodology environment. On the other hand. Waterfall methodology has lost sympathy also because of this lack of reactivity and encouragement of feedback gathering and adoption.

COVID-19 pandemic has increased the risk intensity and types, in IT development projects. Agile methodology incremental development allows an easier and more efficient set-up and development changes due to short term appeared risks. Waterfall methodology, being more strict, linear, rigid, has lost sympathy.

Agile Methodology. Description and advantages in usage during COVID-19 Pandemic

The Agile methodology is a project management approach that defines an incremental, iterative progression. Throughout its development, the project consists of phases that overlap and interweave, allowing continuous integration, advancing flexibly and collaboratively, and continuously improving, with the ability to make changes to both requirements and work priorities. Agile methodology emphasizes flexibility, recurring feedback, and responsiveness to the work being done.

Within the Agile methodology, several frameworks are defined, including Scrum, Kanban, and Extreme Programming. Depending on the framework, specific processes and ceremonies are established to facilitate continuous collaboration and sustained communication. Together, these create a model that matures over time, naturally encouraging the team towards collaboration, flexibility, and evolving work ideas to achieve objectives.

Regardless of the chosen framework, Agile methodology follows the Agile Manifesto, which outlines the ideals of the model and facilitates its adoption as an ideology. The Agile Manifesto supports and proposes: Individuals and interactions over processes and tools, Working software over comprehensive documentation, Customer collaboration over contract negotiations, Responding to change over following a plan. Additionally, Agile methodology includes a set of 12 principles highlighted by each practice proposed by Agile frameworks.

Therefore, among the advantages of using Agile in software development we can count on flexibility, permissiveness, continuous collaboration, and the presence of a framework of ceremonies and communication that facilitates collaborative, iterative, and constantly evolving work.

In the context of remote work and social distancy, among with the stress of facing a life threatening social context, the Agile Methodology in software development increased, due to its pillar principles that acted properly for the entire social and workforce context of the Pandemic.

The flexibility that stands for the Agile Methodology is the only solution for the changing context of the Pandemic, in software development labour market. The permissiveness, the continuous collaboration and the facilitated ceremonies and communication framework allow quick fix solutions, in a continious changing social and working environment. Considering the iterative pillar principle, Agile Methodology allows objectives to be changed directly in order to make them fit for the continious evolving market.

Direct correlation between Human Capital and Agile Methodology

According to the accepted terminology in specialized literature, human capital encompasses the capabilities of individuals, which are unique to each person, and either remain the same or grow in complexity in any social environment. These capabilities can be leveraged in the labor market in exchange for economic resources of any kind.

We can further refine the definition of human capital to be more quantifiable. The most accepted method in the literature for aggregating human capital involves two main components: educational capital (formal schooling and related education) and biological capital (biological endowments, which are significant factors in an individual's adaptability).

By delving deeper into these two measurable components, we can outline some aggregate indicators representing and measuring the elements of human capital. These indicators can be accumulated individually or collectively.

The measure of educational capital, a major component of human capital, can be assessed through the following indicators: preventive health, formal education based on mandatory institutional study outcomes, formal education based on optional study outcomes, financial literacy (measurable by the allocation of financial resources across different consumption areas), proactive health culture, formal education regarding continuous study, social skills, cognitive skills, practical skills, adaptability skills, corrective health, and others.

On the other hand, measuring biological capital, another major component of human capital, is challenging but is also influenced by educational capital. Educated individuals often have better access to quality healthcare services.

Clearly, each of these discussed components encompasses various other relevant indicators at different levels.

The impact of human capital on the labor market and, consequently, on a country's economic level, is immense, especially today. For example, consider the aggregate indicator of cognitive ability. Suppose an employee works in the IT & Telecommunications sector. Their approach to work, in terms of acquiring and processing new information, can be crucial for their professional and financial development. New technologies are constantly emerging, both in response to and in anticipation of reality. This individual must stay attuned to societal needs and the technical tools for their work (new programming technologies, new tools). They must also inspire their clients to increase their receptivity and cognitive abilities to ensure the longevity of their work. By inspiring clients to learn and adapt, they secure long-term clientele.

It is evident that their cognitive abilities will enhance their work quality and complexity, thus impacting the company. Consequently, their professional and financial status will also improve. Extrapolating this to the entire IT and Telecommunications labor market, the impact of cognitive abilities (or their measurement) will determine the direction and scope of the labor market in this field.

The same link can be further taken into consideration when discussing about Agile methodology increase usage during Pandemic and the involvement of this increase upon human capital of the IT and Telecommunication work market.

Agile Methodology and the Human capital can be easily correlated, as Agile methodology practices are mainly focusing on the workers skills and resources to create a work mechanism to increase communication, efficiency and efficacy.

Agile Methodology practices aim to create, based on the team resources and together with them, a working mechanism, that would evolve into empowering the team and the teamwork, hand in hand with the human behaviour and conduite. The success of the adoption consists into the success of adaptability of the team members to a new mechanism. A mature and successful team will be able to empower each team member and to provide

the needed autonomy, to be creative, but consistent and organized in a working mechanism. The result upon the worker is that it will feel more empowered, more responsible, and even more motivated, leading to increased creativity, work satisfaction and autonomy. This results into increased human capital.

In the way of working proposed by the principles of the Agile Methodology, there are several ceremonies/meetings that will be held across the team. This can be, for example, retrospective meeting, Sprint Planning, Sprint Demo and so on. Given the recurrence of the ceremonies, the worker is enforced to a continuous learning, being recurrently provoked to deliver, to be present and to take part upon the 360 ideas that are exchanged inside the team, for the project to advance in the respective iterations. This continuous learning encourages the worker to gain new skills, new perspectives, to keep growing and accepting challenges. This working mechanism increases a culture of development, of growing, being continuously in deep connection to the project and among the team. The results are, naturally, first handed upon human capital. The worker will be part of a continuous growing environment, receptive, that is recurrently asking the individual to step forward and to demonstrate what he has achieved, during controlled and efficient team ceremonies.

One of the key tools of implementing and maturing an Agile team development is the communication between team members and with the delivery environment. Agile Methodology best practices propose and encourage the team to be collaborative, to communicate frequently, to be aware constantly of the 360 degrees dimension of the delivery. In agile methodology there is a strong importance of communication, and there are many communication methods proposed. Among them, the tools existent, currently, are matching the needed requirements for the agile team in order to mature, also considering the communication dimension. On one hand, the need to accommodate to the communication best practices across the team and with the team environment increase the communication skills of the worker, increasing accordingly the human capital. On the other hand, the need to understand also and accommodate with the respective tools encouraged by the model (e.g. JIRA, Azure DevOps) help the worker to increase the adaptability component of the human capital, among with his continuous learning skills and the actual learning benefit.

One of Agile Methodology principles, as also described above, is the customer focus. Agile practices describe processes where the link with the client is constantly maintained, the feedback is provoked and beneficial for the team, to correct or to increase developments in the time, for the future iterations. The result is also naturally beneficial upon the worker because, based on the continuously received feedback, he is encouraged to grow, to upskill, to change and correct in the areas where improvements are needed. Receiving and understanding feedback, among with the corrective attitude imposed by it, represent high assets for the human capital of the worker.

Agile methodology encourages flexibility, along with adaptability and reactivity and proactivity to change. The qualities that increase in this flexible, adaptable work environment is beneficial for the human capital of the worker.

The focus of the Agile methodology is to use and increase human capital of the worker, in order to create a working mechanism that will increase the efficiency of the delivery, along with the efficiency of the team. Strong collaboration, feedback, proactivity, satisfaction, consistency, autonomy, empowerment, are just a few of the main common focus points of the model with Human capital of the worker.

COVID-19 pandemic has increased the usage of Agile methodology in software implementation

The COVID-19 pandemic brought about significant changes in work methods, particularly through the imposition of social distancing. As a result, remote work and online collaboration were encouraged, as well as remote interactions with public institutions.

The principles underlying Agile methodology supported effective remote work. Adaptability to change, a cornerstone of Agile methodology, facilitated necessary changes in projects already underway amidst the presence of risk.

The Agile work model's ability to reallocate tasks and resources quickly to achieve efficiency and effectiveness came to the forefront. During the pandemic, due to shifts at all levels—both in terms of the labor market and working conditions, as well as the market for products and services—demand and supply underwent changes imposed by new risks.

The Agile work model, with its premise of working incrementally and allowing for short-term changes, enabled project trajectory adjustments while maintaining balance within the delivery team and the entire project.

Additionally, Agile emphasizes frequent delivery. One of Agile's tools is sequential, frequent deliveries. For example, in the SCRUM framework, work is conducted in iterations called sprints, typically lasting two weeks. The delivery team undertakes as much work as it can handle during the iteration, and at the end, a demo is presented to the client, followed by a delivery. Thus, the Agile model, and specifically SCRUM, allows for quick changes and rapid deliveries in response to unforeseen situations, all within the project's guiding principles.

At its core, the Agile model involves collaborative work, continuous feedback, and ongoing communication. From the beginning, certain recurring or on-demand ceremonies are established to create a cohesive work mechanism. Initially, the team members support the work mechanism, but as the project matures, the mechanism itself propels the team, particularly in terms of continuous feedback and communication. Due to the persistence of

remote work caused by the COVID-19 pandemic, the tools provided by Agile methodology proved to be valuable assets for teams already working in an Agile manner. The facilitation of ceremonies (Retrospectives, Backlog Refinement, Sprint Planning, Daily Meetings) allowed many Agile teams to feel the effects of remote work more gently.

The iterative work model promoted by Agile enabled teams to foster autonomy and trust in individuals to manage their own work. The mechanisms for feedback, communication, and collaboration through recurring ceremonies, as well as continuous delivery, provided granularity and transparency in work, benefiting both development teams and clients during the COVID-19 pandemic.

Indeed, the choice of work methodology, whether Waterfall or Agile, primarily depends on the project's purpose and type. However, during the COVID-19 pandemic, the Agile methodology proved to be more suitable, beyond the intrinsic reasons for its selection.

Conclusions

The COVID-19 pandemic has encouraged the use of the Agile methodology over Waterfall in IT development projects. The reasons are numerous and are rooted in the core principles of the Agile model, which perfectly aligned with the needs during and after the pandemic. This period highlighted the strengths of the Agile model and motivated workers to evolve.

The increased use of the Agile methodology has also led to growth in the human capital of workers, aspects highlighted and described in the existing paper, with focus on the preliminary determinants of the Agile model: enhanced flexibility and adaptability, improved collaboration and communication, frequent feedback and iterative progress, empowerment and autonomy, focus on delivering continuous value. Overall, the agile methodology's principles and practices create a long term working environment that empowers continuous learning and improvement, significantly contributing to the growth of human capital.

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