# Boosting Agile by Using User-Centered Design and Lean Startup: A Case Study of the Adoption of the Combined Approach in Software Development

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*Abstract*—**[Background] Despite the claimed benefits of an agile transformation, user involvement and added value are still reported as challenges in software development. A combined use of User-Centered Design and Lean Startup with Agile Development has been pointed out as a means to minimize these challenges. [Aims] This paper aimed to characterize how a transformation to such combined approach takes place in a multinational company, as well as to point out benefits and challenges to undergo such transformation. [Method] We performed a multiple case study. We collected data through semi-structured interviews, focus group session, questionnaire and observations. [Results] Our study revealed two major strategies to conduct the transformation: to create a dedicated Transformation Team to lead it and to make a Transformation Package Toolkit available to team members. Also, introducing a Product Designer role to a cross-functional team and using experimentation are among the most important benefits. Managerial mindset change and team autonomy are among the most concerning challenges. [Conclusions] Our results bring implications to industry practitioners: organizational and cultural changes involve role and responsibilities definitions, introduction of new working processes, and are dependent upon user engagement and managerial support. These sound paramount to organizations that aim to succeed in this yet-to-be-further-understood transformation.**

*Index Terms*—**Agile Development, User-Centered Design, Lean Startup, Agile Transformation, Case Study**

## I. INTRODUCTION

Motivations for an agile transformation are distinct. Dikert et al. [3] highlight the need to align software development with corporate strategies, the need to rapidly respond to market changes, and the teams' dissatisfaction with the current way of working. Such transformation might be challenging since it brings organizational changes, including structural (e.g., roles and responsibilities), technical (e.g., techniques), and cultural (e.g., trust) aspects [10]. Difficulties are even more challenging when considering a large-scale agile development setting (e.g., inter-team coordination [2], knowledge sharing [12]).

Despite the adopted strategy to guide the transformation (e.g., big bang or gradual introduction [9]) or the effort put in, customer involvement [1] and added value [5] are still among the main challenges. Vilkki [16] argues that agile needs to be combined with other approaches in order to provide better guidance for agile teams to improve the understanding of the problem at hand and to provide more aligned solutions as well as to keep the customer engaged.

A combined use of Agile Development, User-Centered Design (UCD), and Lean Startup has been argued as a means to tackle the before mentioned agile limitations (e.g., Convergence Model [17]). For instance, Lean UX [4] argues for the need to designers, engineers, and product managers 'act as one' to build a shared understanding around customers and what they need most. Jeff Gothelf, Lean UX co-author, says that a team needs to concern about who they are building a solution for and what success looks like, counter-arguing that often teams *'ship the feature off and don't look back'* [4].

While User-Centered Design [13] puts the user at the center of the discussion, aiming for creativity and empathy for designing user-centric solutions and helping developers to change their mindset on how to approach a problem and envision its solution [6], Lean Startup [14] focuses on adding value to business stakeholders by looking for the best solution through experimentation. A hypothesis about a satisfactory solution is defined and validated with users, and solutions pivoted until a fit and feasible resolution is achieved, reducing waste of resources, time, and financial investments.

Motivated by the need to provide better and more timely

solutions to its in-house customers and users, a multinational IT company used Pivotal Labs to inspire its transformation to the combined use of agile development (already in place), user-centered design, and lean startup. This paper reports on the case study of two agile product development teams within the financial area of this globally distributed and large organization. Our main contributions are:

- A set of actions taken by the company to support the transformation, including the definition of a Transformation Team to lead the process and a Transformation Package toolkit, which consists of a set of resources to help the teams kick-off and move towards the new processes, practices, and roles and responsibilities;
- Perceived benefits by the teams so far; and
- Perceived challenges by the teams during the transformation and considerations on how to overcome them.

Next, we detail the study and our contributions as well as discuss implications to industry practitioners.

## II. RESEARCH METHOD

We conducted a multiple case study [15] in a multinational company named ORG (name omitted for confidential reasons). We posed three research questions to guide our study. Next, we introduce the case and data collection and analysis methods.

- *RQ1:* How does the combined adoption of UCD and Lean Startup with Agile Development takes place?
- *RQ2:* What are the benefits on the combined adoption of UCD and Lean Startup with Agile Development?
- *RQ3:* What are the challenges on the combined adoption of UCD and Lean Startup with Agile Development?

### A. Case Setting

ORG has software product development sites in the USA (headquarters), India, and Brazil. With over 7,000 employees and responsible for about 1,200 software products, the IT department started its agile transformation in 2015 and moved to the combined use of Agile, UCD, and Lean Startup principles in late 2017. The adopted approach was inspired in the Pivotal Labs [1] methodology, registered in a Guidelines Book[2], which proposes a 'team rhythm' composed of principles and ceremonies based on the 3 before mentioned approaches. It also suggests the adoption of a cross-functional team composed of three main roles: Product Designer, Product Manager, and Software Engineer. The Pivotal Labs' main goal is to help teams to build software products that deliver meaningful value for users and their business. Thus, it offers a framework and initial starting point for any team to discuss its specific needs and define its own way towards software development.

We observed *in-loco* two teams from the financial area located in Brazil. Team A is responsible for a software product that calculates the cost of associated services offered by the products sold by ORG and displays this information to ORG consumers. Team B is responsible for the software product

### TABLE I
### PARTICIPANTS' PROFILE

| ID | Role | Training | IT Work Exp | Company Exp |
|---|---|---|---|---|
| P1 | Software Engineer | Enabler | 10 | 4 |
| P2 | Product Manager | Enabler | 19 | 0,5 |
| P3 | Software Engineer | Learner | 6 | 1 |
| P4 | Software Engineer | Learner | 15 | 11 |
| P5 | Product Designer | Enabler | 27 | 10 |
| P6 | Software Engineer | Enabler | 21 | 8 |
| P7 | Software Engineer | Learner | 7 | 7 |
| P8 | Product Manager | Enabler | 21 | 6 |
| P9 | Product Designer | Enabler | 5 | 4 |
| P10 | Product Manager | Learner | 16 | 7,5 |
| P11 | Product Manager | Learner | 23 | 10,5 |
| P12 | Software Engineer | Learner | 5,5 | 4 |
| P13 | Software Engineer | Enabler | 20 | 11 |
| P14 | Software Engineer | Enabler | 5 | 5 |
| P15 | BR Transformation Lead | - | 12 | 7 |

that gathers information about these services from other ORG software products and stores them for Product A to use. In addition to the 14 team members, we also counted with the Brazilian Transformation Leader (see profile in Table I). These teams are working in a dedicated lab at the PUCRS prepared for ORG teams.

### B. Data Collection and Analysis Methods

We used multiple data sources: a questionnaire to collect the participants' profile (name, role, main responsibilities, time in years working in IT and at ORG, and whether the person participated of the immersion training in US—labeled Enabler in Table I or is being trained by the enablers in Brazil—labeled Learner); semi-structured interviews to gather information on their perceptions about the combined transformation, the training experience, and benefits and challenges; daily observations of team ceremonies and shadowing of roles for an in-depth knowledge; and focal group sessions with the 8 Enablers to promote discussion among them on specific topics that emerged from the previous data collection sources (e.g., to discuss the Product Designer new role). Interviews and focus group sessions were voice recorded and transcribed for analysis; they lasted in average 30 min and 1.5h, respectively.

Data were analyzed following the content analysis procedure by Krippendorff [11], organized into the following steps: organization and pre-analysis, reading and categorization, and recording the results. Using Atlas.TI[3], we first read the dataset, extracted text excerpts and marked them as codes. These codes were revisited and grouped into larger codes, forming categories. This iterative process was conducted by two researchers and revised constantly by two senior researchers.

## III. RESULTS

### A. How does the combined adoption of User-Centered Design and Lean Startup with Agile Development takes place? (RQ1)

ORG made two major decisions on how to drive the combined transformation in its IT department. First, a Transfor-

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[1]https://pivotal.io/Labs

[2]Restricted access to customers only. Summary available online.

[3]atlasti.com

mation Team was created to lead the transformation. Second, this team defined a Transformation Package Toolkit as a means to help the teams to kick-off and work towards the transformation. As a consequence, major changes outcomes involve roles and responsibilities reshaped, and working processes, practices and activities, tools, and artifacts modified (either new or adjusted). These are explained in details next.

**Transformation Team** The CIO office created a dedicated transformation team to lead the IT transformation. Composed of a Transformation Team Leader Head, a Lead Representative from the USA, Brazil, and India sites, and a senior consulting from Pivotal, the main responsibility of this team is to define strategies and roll out respective actions towards the transformation worldwide. They also liaison with business senior managers and representatives who champion the participation and engagement of business (in-house customers and end users) personnel. Moreover, the team also leads the discussion of which product teams should first get engaged in the transformation and be prioritized to participate in the 'learn-on-the-job' hands-on immersion training in the headquarters. This transformation team defined a Transformation Package Toolkit, which has been slowly being adopted by the prioritized teams worldwide as discussed next.

**Transformation Package** As a means to help the teams to understand the fundamentals of UCD and Lean Startup as well as to brush up Agile Development knowledge, and provide them with a skill set to work towards the combined transformation, a set of resources is made available, namely: workshops, cookbooks, learn-on-the-job hands-on immersion training, and health-check assessment tools.

*Workshops:* Targeting middle-management but also welcoming development team members, the workshops aim to provide basics on the individual approachesf, their combined use, and offer a forum for discussion of expected changes. As a consequence of informed knowledge and debate, the Transformation Team seeks for the engagement of middle-management with this activity, which also tackles diverse additional topics (e.g., how-to engage users, assess progress, prioritize user needs; roles and responsibilities changes, etc).

*Cookbooks:* Produced by ORG, the *cookbooks* are quick guides to techniques (e.g., persona) and practices (e.g., behavior-driven development) targeting mainly development members who are yet not engaged in the transformation. This strategy is an attempt to keep people up-to-date with new terms and activities. The Transformation Teams expects that, by making these cookbooks available, development members will reduce resistance to changes and keep others motivated and eager to learn more when the time comes.

*Learn-on-the-Job Hands-on Immersion Training:* Led by Pivotal Labs consulting personnel who are software developers, architects, team leads, etc themselves, this activity is at the core of the Transformation Package Toolkit and is meant to promote mindset and cultural change, and shape new skills. For 12 weeks, selected team members travel to the USA headquarter office to work side-by-side with Pivotal Labs representatives in a certain ORG software product backlog of

their own. By acting as team members and indeed contributing to the product development, Pivotal Labs representatives coach and mentor ORG team members, forming "Pilot Teams". A Software Engineer highlighted − *"It was not like a traditional training. The Pivotal guys executed a certain activity and we kind of just followed them, learning by observing and doing ourselves. when we were done, they would give us links and videos for us to study the topic further." (P14)* Another member concluded − *"These guys were teaching us to learn how to learn and change our mindsets. They were always asking us to say why we thought they have done a certain thing and discussing our responses with us. This helped shape our new mindset. This was indeed a driven culture change for us." (P9)* Daily work involves activities from understanding the user needs to deciding on the best solution, as well as hands-on software development and deployment. During this period, role and responsibilities are also revisited, including the definition of new roles—such as the Product Designer (described next), as part of teams' evolving maturing process.

*Pilot Teams Acting as Enablers:* To scale up the learn-on-the-job immersion strategy, the Transformation Team defined a strategy of snowballing training: those directly trained by Pivotal Labs personnel—the Enablers—are now acting as coaches of new learning teams–the Learners. Upon their return, the Enablers were straight up allocated to work with new Learners from their own product group, forming new working teams. The Brazilian Transformation Lead mentioned − *"We selected the best of the best to participate on the hands-on immersion. These highly skilled guys will be the seeds of the transformation [in the financial area] in Brazil." (P15)* A Product Manager recalled − *"We were quite concerned at first. We realize our responsibility and riskiness of the snowballing strategy. But users are happy with results and senior managers are positive this will work in the long-run." (P2)*

*Health-Check Assessment:* Kicked-off using an artifact provided by Pivotal Labs, the teams self-assessed their progress and evolution with the help of Pivotal Labs personnel, including practices, product quality, team ownership, and user involvement. The results of this self-assessment is consolidated amongst all worldwide teams from a certain business area (e.g., all product teams from the financial area) and used by the Transformation Team as input to reconsider the transformation goals and toolkit strategies and resources.

**Roles and Working Processes Transformation** As mentioned, the combined Pivotal Labs approach suggests a cross-functional product team structure composed of three roles—Product Manager, Product Designer, and Software Engineer. ORG followed this structure by introducing the Product Designer role and redefining the two others as described next.

Prior to the combined transformation, ORG had established a Product Owner role, responsible for interacting with stakeholders, including in-house customers and end users, as suggested by the Scrum framework. This person would act as the focal point to both customers and users. The Product Owner role is now split into a Product Manager and Product Designer roles. While the Product Manager focuses on the

customers, negotiating budget and major deadlines as well as validating the problem understanding and suggested solutions, the Product Designer brings the in-house user needs at 'first-hand' to the cross-functional product team. − *"The end user has finally a voice with the IT department."* (P9) This change might not be novel to others, but this is major for ORG − *"I have the chance to literally sit with the user and discuss which issue is on our way. I don't hear it from the Product Owner, now I see it and better grasp what is at stake."* (P5)

But this interaction with the customer and users *"is con-ducted as one"*, says P8. He adds *"Now we consider the business perspective and the user point of view altogether; we can balance them when conflict or limitations arise"*. The team understands that this new setup *"helps us to seek for the better solution and also add value to the company."* (P2)

More specifically, the Product Designer also acts as a facilitator to everyone − *"They guide the discussion about which problem we have to solve by using new techniques such as affinity clustering to highlight user interview ideas, and help us better understand business process flows using user journey mapping and validate them using the now-near-next technique with the user. We don't have to second guess things anymore."* (P12) Another Software Engineer adds − *"The Product Designer also suggests metrics to measure the success of the defined solution and mediates this discussion with the users. It is rewarding to know right away when we are in the right path or we have to pivot a solution."* (P3)

The Product Manager is still in charge of the product backlog and delivery pace. But her way of working has changed − *"We used to receive a list of software requirements defined by the business representatives and our responsibility was to implement them. We could not always clarify them when in doubt. Now, we start off by receiving a set of problem descriptions and issues, and go on from these."* (P10)

This role now also acts as the direct bridge between the company's business interests, the end users, and the IT depart-ment by closely working together to the product team to ensure that IT is focused and adds value − *"Since we introduced experimentation we are driven by the 'adding value' mindset. The Product Manager helps us with this."* (P11)

Moreover, new techniques were also introduced or revisited such as working in pairs − *"This new setup, where we have a single large table and work in pairs for most of the activities, has increased our productivity despite all the odds."* (P1) New tools are also in place and are considered keen for supporting the transformation − *"Pivotal Tracker[4] is indeed central to our work. We don't work based on sprints any longer, so we just open Pivotal Tracker any time we meet with the customers to show them metrics, user stories, code deliver packages, whatever we have to report or want to discuss. We have a single tool that centralizes all our artifacts."* (P2)

The introduced roles and responsibilities, as well as work processes (activities, techniques, tools, etc) changes bring a set of perceived benefits and challenges as described next.

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[4]https://www.pivotaltracker.com

*B. What are the benefits on the combined adoption of UCD and Lean Startup with Agile Development? (RQ2)*

The cited benefits by the participants are organized into categories as they emerged during the coding process.

**Cross-functional Teams** With the redesigned responsibil-ities of the Product Manager and the introduction of the Product Designer role, the newly defined cross-functional team co-shares responsibilities towards the product under devel-opment − *"Having both roles working closely together is key. While Product Managers focus on the business, Product Designers focus on the user, we bring the engineering perspec-tive."* (P4). This leads to a shared knowledge and vision about the problem and the product that the team is working on − *"Before we were only present at the [product] scope definition meetings. At the end, the requirements came 'chewed' our way. It was like 'do it'. Now, we do participate in the understanding of the user needs and, as a consequence, we all are well aware of what has to be done. Everyone is always up-to-date."* (P3) A Product Manager adds − *"It is like we co-own the solution."* (P10) This also fosters trust among the team members − *"I felt very proud. Our customer does want our opinion."*(P6)

**Boosting Agile** Focusing on the problem understanding is of greater value than refining software requirements only − *"By discussing the problem we can consider different solu-tions. They almost come naturally."* (P2) As a consequence, the teams can now conduct experimentations − *"Whatever we see fit, the Product Designer and I [Product Manager] hypothesize about a possible solution and have the freedom to test it. We also use experimentation to validate the answers to our questions and make sure we got the right problem. In the end, we need be sure that we understand the problem correctly and not only do what we are told."* (P8) Yet another benefit of using experimentation is having room to fail up front from development − *"We used to work based on sprints and release plans; there was no room whatsoever to experiment and fail. With our new continuous development and release approach, we can explore, test, and pivot candidate solutions. Time slot gives room for value-driven development."* (P1)

**Technical Aspects** The participants also considered that the combined transformation helped them to improve technical-related aspects. For instance, they believe that by having a continuous delivery, as opposed to work based on sprints, was an interesting change − *"We finished, reviewed the code with the users, and deployed it. We did not have to wait for a release date or milestone. This continuous approach also promotes transparency to stakeholders, who are constantly seeing progress, understood as return of investment."* (P13)

Improved code quality was also mentioned as a side ef-fect of adopting practices from Extreme Programming such as Test-Driven Development, Pair Programming, Continuous Integration, and Code Refactoring − *"We always watch out for good code quality, but this is different from Scrum. XP offers a new mindset on software development."* (P4)

*C. What are the challenges on the combined adoption of UCD and Lean Startup with Agile Development? (RQ3)*

**Mindset and Cultural Changes** Middle-management is used to be the focal point for negotiations with in-house customers. ORG is working towards a more flat organization. Participants believe that taking away middle-management power might be, at least in the long-run, of great need for discussion − *"We are now going straight to the customers and end users. The middle-management, at some point, will realize that their main job is relocated."* (P1, P12) Some are concerned with the challenge it will likely be to changing working habits [to the new combined approach] − *"We have colleagues that are here for over 20 years. It was challenging enough to introduce agile to these guys. Things are way more dynamic and less structured (in the good sense, I mean) than before. We have to go slow."* (P14) Introducing the role of Product Designer at large is one of the main challenges ahead, considers a Product Designer − *"ORG doesn't have a company-wide job position for Product Designers. In fact, now that we are working with this role, I cannot grasp how we survived without it for this long."* (P5)

**Organizational Issues** The challenge of institutionalizing the Product Designer role was also seen as an organizational issue − *"It will be a long run to show the value of having this role and defining how it will be part of the ORG structure. For starters, we need to convince the CIO office."* (P5) A Software Engineer brings to attention the coordination need with infrastructure personnel when going company-wide with the transformation − *"We got the 'free pass' from our middle-management regarding infrastructure for continuous deployment and delivery. They gave us the resources we needed. But usually we have to go through the release management people to have access granted to put new code in production."* (P9) Funding for portfolio management is yet another major issue company-wide − *"Nowadays, we receive a certain amount of money to fund a business area. People are allocated to projects to fit this annual budget. We need to think in terms of capacity of delivery from now on."* (P2, P15) In contrast to what is perceived by others, a Software Engineer considers that the lack of delivery dates might be an issue −*"Our stakeholders keep asking about the delivery dates. We are trying to explain that now we work based on solving issues, there is no target timeline. We are problem-solution and value-driven now."* (P6)

## IV. DISCUSSION

In this section, we answer the research questions and list some practical recommendations for software companies that are aiming or are undergoing such a combined transformation.

RQ1 asked how a combined adoption of UCD and Lean Startup with Agile Development takes place. We found that two major decisions were made: to put together a dedicated team to lead the transformation and to define a toolkit as a means to provide guidance to teams piloting and kicking-off the process. The dedicated team is composed of members from each development site to ensure representation and consideration of local sites' needs. The team decided for a gradual transformation approach [9], introducing the customized Pivotal Labs approach to a few business areas at a time. The Transformation Team had the concern of defining strategies to keep people engaged despite their role in the transformation: *workshops* to bring middle-management up to speed and gain their support, *cookbooks* to qualify development members still not working with the new approach, and *learn-on-the-job hands-on immersion* to promote culture change and new skills development to those directly appointed to kick off the transformation. This hands-on immersion strategy was considered valuable as opposed to traditional training, allowing for an easier mindset and culture change. They also defined an strategy to foster the transformation scalability given the large number of employees and the high cost of moving them to the USA site for a 12 weeks long immersion—pilot teams as enablers of newcomers; and concerned with assessing the teams' progress by using a health assessment to measure some success indicators. This immersion training, combined with the use of health-check assessments, supports continuous improvement, considered key for sustaining the introduction of new working processes and practices [7].

RQ2 asked about the perceived benefits of the combined transformation. Participants found relevant to introduce the Product Designer role to compose the cross-functional team, and that the reconsideration of responsibilities between this new role and the Product Manager the team now perceives shared responsibilities with the customer and users, and has a shared vision and knowledge [12] about the problem and product. These are considered essential for developing a problem solving-driven mindset [8]. Also key was the introduction of experimentation [14], allowing the teams to explore the problem and to pivot candidate solutions while engaging the customers and end users, resulting in added value.

RQ3 aimed to reveal perceived challenges. Interestingly, the cited challenges are mostly related to company-wide related issues, such as defining a fit strategy for IT funding, or organizational-related such as reshaping the middle-management role and finding room for the new role of Product Designer as an ORG job position. Cultural changes such as working habits [10] are part of the concerns but they are perceived as handleable at the development teams level.

*A. Recommendations for Practice*

Although we know that there is no single solution that fits it all, from the results of our study, we derive functional and practical recommendations for companies that are in a similar transformation process.

- Assign people to lead the transformation
- Provide material to educate those that are directly involved but do not forget those that will be brought together later on in a gradual transformation approach
- Define strategies to gain management support aiming to reduce resistance and facilitate role description changes
- Bring support from experts (e.g., consulting)

- Adopt a hands-on training approach to facilitate culture change and the shaping on new working skills
- Use recently trained people to train others and speed up the cultural and organizational changes
- Consider a cross-functional team composed of a Product Manager, Product Designer, and Software Engineer roles
- Seek for customer and end user engagement
- Use experimentation as a support strategy to problem-solving and value-driven mindsets transformation
- Pivot solutions and do not be afraid to fail avoiding waste
- Introduce continuous delivery as opposite to release-plan driven as yet another strategy to support the migration to value-driven development
- Empower cross-functional teams and give them autonomy to own all working processes, from problem understanding to delivering to production, reducing the need for coordination with outside teams
- Introduce agile software engineering practices (e.g., XP) to improve product quality

## V. Conclusion, Limitations, and Future Work

We presented a study to characterize the transformation process as well as capture the perceived benefits and challenges in adopting the combined approach that uses Agile, UCD, and Lean Startup. To the best of our knowledge, our study is among a few empirical reports on the use of such a combined approach. Results revealed that two major strategies were defined: to create a dedicated Transformation Team to lead the transformation and to make a Toolkit available to support teams members throughout this process. Several benefits and challenges were identified, which can serve as recommendations for industry practitioners.

Inherent to any empirical study, the present study has limitations. Construct validity regards with whether the scenario of study is representative of the real world while external validity is concerned with generalization. We observed two teams in a real setting, which offers them a new setup that aims to promote collaboration. Also, the teams are composed of members playing distinct roles and with different backgrounds and experience. Moreover, we used interchangeably and overtime multiple data sources aiming to triangulate our findings, which were constantly reviewed by senior researchers. Therefore, although we cannot claim that our results are applicable to distinct scenarios, these strategies helped reduce limitations.

Seeking to deepen the understanding of the phenomenon and expand to other scenarios, our next step has a two-folded goal: to perform a study with other four teams over the next six months aiming at identifying the effects of a long-term transformation and the opinion of stakeholders (in-house customers and users), which was out of scope this time.

## Acknowledgements

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