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Agile Research - Getting beyond the Buzzword

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Abstract: *“Oh yeah, we’re an Agile shop, we gave up Waterfall years ago.” – product owners, managers, or could be anyone else. You will seldom have a conversation with a product or software development team member without the agile buzzword thrown at you at the drop of a hat. It would not be an oversell to say that Agile software development has been adopted at a large scale across several big and small organizations. Clearly, Agile is an ideology that is working, which made me explore more on its applicability in research. As someone who has been in the Information Technology sector for more than a decade and a half, and a new entrant in the research community, I am inclined to uplift the best practices from my IT experience and evaluate implementing them in research. The idea is to assess the provocative metaphor of “agile research” and the different research philosophies around the concept. The aim is to explore Agile research methodology, its applicability and find the scenarios where it can add value and those where it may not.*

Keywords: Agile Research; Spiral model; Cyclic research method; Grounded theory of research; Action research

1. Introduction

One of the reasons Agile works well with software development is that the design questions are ‘loosely - structured’: these are the problems with no clear solution or a well - defined path. or where all constraints are known from the onset. The framing of the initial ‘problem’ expressed by users will most probably (if not certainly) change over the course of the project. Likewise, in a research initiative, a research direction may likely change over time since researchers do not know in advance what their findings will be. Their way of addressing a problem may change as they get a better understanding of it. So, in all likelihood, agile research must have been explored in the past already. If so, in what forms and shapes and in what context has it succeeded? This study is towards exploring these dimensions.

The four pillars on which Agile is built are value, feasibility, usability, and demand. Agile is about conversation, feedback, adjustments, and ultimately, and most importantly, about innovation. An Agile research approach would use interdisciplinary techniques to devise low cost and high – speed methods to better understand the system and its needs to design more effective systems. Agile methods demonstrate high levels of collaboration and flexibility as well as an iterative environment in which requirements evolve alongside changing needs. The primary aim of Agile methods is to provide early and continuous delivery of artifacts in an iterative fashion to incorporate incremental customer/end - user feedback into subsequent iterations to welcome change in requirements and system dynamics. (Knowles, 2020b) highlights a use case of agile research in market research industry where there is an elevated ask for faster market insights than what the traditional research cycle can deliver. Knowles sees Agile research as approach research rooted in iteration, continuous testing, and learning, wherein questions are asked on an ongoing basis. Hypotheses are tested, refined, and retested. Data collected delivers guidance and direction for next steps in understanding the (potentially changing) questions at hand - along with uncovering new ones.

Agile research works well when we have research questions that requires frequent directional feedback. The goal of each iteration needs to adapt to iterative findings from the previous iterations. In his blog (Knowles, 2020a) , Roddy Knowles highlights the two key situational traits to consider while deciding to choose Agile research. These are as below:

- 1) Type 1 errors (false positives) are more acceptable than type 2 errors (false negatives). It is more important to detect an effect that is happening than to screen out one due to chance.
- 2) Lower - fidelity, directionally correct data delivered sooner is more useful than higher - fidelity data delivered later.
- 3) Agile research works well in situations that have either one or both traits.

In subsequent sections, the research questions are formulated, followed by a brief literature review and evaluation of different Agile Research methods at a programmatic level along with the potential issues where agile research might not work.

2. Research Question

- 1) How might we take the ideas, the methods and the underlying philosophy behind agile software development and explore applying them in the context of doing research?
- 2) What is agile research? When might it be useful and when might it be problematic?
- 3) Are there existing research methods/methodologies that are based on Agile philosophies?

3. Literature Review

Agile methods are not new. Agile Software Development Methodology is in practice for more than two decades after being popularized in the 2001 through the Manifesto for Agile Software Development (Beck *et al.*, 2001) . Since the Manifesto for agile software development has been published, agile methods have been practiced across many software development teams across different companies.

“Agile methods seem to work by acknowledging human fallibilities — the difficulties that clients have in knowing what they want and articulating it, the difficulties that developers have in completely understanding those wants and needs, the errors that inevitably arise in software development, and everyone’s inability to predict future needs. The Manifesto proposes that the way to address all these problems is to focus on tight iteration loops” - (Twidale and Hansen-Preben, 2019) . Agile research is about shaping the research roadmap as you go. The key question or the destination is defined, but journey and what the outcome actually looks like is initially unknown.

(Hidalgo, 2018) presents how agile methods can contribute to task coordination in scientific research and highlights key factors for successful adoption of the agile framework in collaborative research projects. This study highlights the importance of involvement of the principal investigator and the role of a facilitator. This is in line with the scrum adoption of agile methods and the roles of a product owner and a scrum master. (West *et al.*, 2010; Rigby and Hirotaka, 2016) reaffirm how the adoption of agile methods has expanded to contexts beyond software development.

(Barroca *et al.*, 2018) provides some useful insights into Research methods in the Agile space and elaborate into existing literature available. Several research methods have been used to explore the practice of agile development (Dybå and Dingsøy, 2008) . Surveys (Murphy *et al.*, 2013; Doyle *et al.*, 2014) and case studies (Laanti, Salo and Abrahamsson, 2011; Lagerberg *et al.*, 2013) are among the common ones. While surveys are often used to quantify patterns across research participants, case studies look at specific contexts to understand the impact of agile adoption. Qualitative research methods are used to study social practice within a natural setting, and therefore allow for a richer understanding of what participants do and how things uncover as they do it while building the theory.

As agile methods are used in complex environments, qualitative approaches are often found using specific methods such as Ethnography (Sharp and Robinson, 2004) , Grounded theory (Baskerville, Pries - Heje and Madsen, 2011; Van Waardenburg and Van Vliet, 2013) , Interaction analysis (Plonka *et al.*, 2015) and Action research (Svejvig and Ann - Dorte Fladkj, 2010) . Another approach that is quantitative in nature is the Experimental research methodology (Mendes, Al - Fakhri and Luxton - Reilly, 2005) .

4. Agile Research Methodologies

Before getting into the details of the methodologies, it is worth noting that none of the below methodologies are exclusively used only in Agile research, but these are the methodologies that are or can be commonly used in most Agile research initiatives. Agile research aims to remove impediments that slow down traditional research studies by trading off pinpointed precision with continuous feedback enabling iterative findings. Agile research does not intend to and cannot replace Exploratory Data Analysis (EDA) or Confirmatory Data Analysis (CDA). Agile Research uses both these techniques and more towards studying the

research questions. The key difference does not lie in how data analysis is used or what data is analyzed, but how the research question is looked at from different perspectives. Agile research uses both quantitative and qualitative research methods.

4.1 Ethnographic Research

Ethnography is a modern research methodology used in many social science research studies. Ethnography is the case study of a culture, subculture, or micro - culture with the researcher immersing themselves in said culture. Ethnography, or the immersive method of case study research, must lead to a much deeper understanding of cultures through great effort. Ethnography is thus the accepted method for coming to understand culture. Classic systematic ethnographic methods relied on the investigator becoming immersed in a distant culture for extended periods of time, during which observation, interview, and artifact review were conducted as methods to obtain information for subsequent analysis (Elizabeth and Gitlin, 2016).

Contemporary ethnography retains some of the tenets and practices of classical methods but is enacted in diverse groups with essential characteristics that no longer are defined by geography. Given the ubiquity of the Internet and virtual worlds, it is not surprising that many investigators activate ethnographic methods to discover interactive constructions of electronic, social media, and gaming cultures among others located online.

4.2 Grounded theory

The term “Grounded theory” is related to different research elements. Grounded theory is characterized by an iterative process and the interrelatedness of planning, data collection, data analysis, and theory development (Vollstedt and Rezat, 2019) . In 1967, sociologists Barney Glaser and Anselm Strauss published the ground - breaking book “The discovery of grounded theory: Strategies for qualitative research” (Glaser and Strauss, 1967) . With their focus on theory development, they detached themselves from mere theory verification and the associated separation of the context of theory discovery and the context of theory justification. Soon after their joint publication in 1967, Glaser and Strauss developed grounded theory in different directions and started to argue their own understanding of grounded theory methodology and methods apart from each other in different ways. Later, students of Glaser and Strauss further developed the different interpretations of grounded theory methodology.

Grounded theory further provides a particular set of systematic methods, which support abstraction from the data to develop a theory that is grounded in the empirical data. These methods include different coding procedures, which are based on the method of constant comparison. New data are gathered continuously, and new cases are included in the analysis based on their potential contribution to the further development and refinement of the evolving theory. This sampling method is called theoretical sampling. The iterative process of data collection according to theoretical sampling, data analysis, and theory development is continued until new

data do not contribute any longer to a substantial development of the theory, i. e., until theoretical saturation is achieved. The theory that is the product of this process is also referred to as grounded theory.

4.3 Interaction analysis

Qualitative interaction analysis is a set of approaches that focus on language - in - use to understand how people jointly construct the meanings of their interactions. (Jordan and Henderson, 1995) . These approaches seek to identify and explain the structures and processes that enable people to produce meaningful interactions. It investigates human activities, such as talk, nonverbal interaction, and the use of artifacts and technologies, identifying routine practices and problems and the resources for their solution. This entry examines three approaches to qualitative interaction analysis—conversation analysis, discourse analysis, and critical discourse analysis.

4.3.1 Conversation analysis (CA)

Conversation analysis is a qualitative research methodology with roots in sociology, and ethno methodology. Over the past 50 years, it has developed not only within sociology but across the fields of linguistics, anthropology, and psychology (White, 2019) . Conversation analysis is the detailed microanalysis of talk - in - interaction, examined in order to provide insight into the structures of action that are usually (or normatively) oriented to by conversational participants. If the goal of the research is to understand how people are doing things using talk. Any claim in conversation analytic research must be supported by actual examples found in natural conversation. Therefore, CA is rigorous in the collection of data and its analyses.

4.3.2 Disclosure analysis (DA)

Discourse analysis (DA) is the analysis of written, vocal, or sign language, or any significant semiotic event. The objects of discourse analysis are variously defined in terms of coherent sequences of sentences, propositions, speech, or turns - at - talk. Text linguistics is a closely related field. The essential difference between discourse analysis and text linguistics is that discourse analysis aims at revealing socio - psychological characteristics of a person/persons rather than text structure.

4.3.3 Critical disclosure analysis (CDA)

Critical discourse analysis is a methodology that enables a vigorous assessment of what is meant when language is used to describe and explain. Critical discourse analysis (CDA) is a growing interdisciplinary research movement composed of multiple distinct theoretical and methodological approaches to the study of language (Slembrouck, 2019) . Each has its own agenda. Despite this diversity, CDA scholars commonly view language as a form of social practice and are concerned with systematically investigating hidden power relations and ideologies embedded in discourse. They are likewise dedicated to examining the social and material consequences of discourse.

4.4 Action Research

Action Research as a scientific method that can be expressed as being based on three fundamental principles which characterize it and give it its power: reductionism, repeatability, and refutation (Butera - Prinzi *et al.*, 2010) . Researchers select a portion of the world to investigate and carry out disciplined observations in experiments. If the results of the experiments are repeatable, they count as part of the body of knowledge. Progress can be made in sequences of experiments through the testing to destruction of hypotheses. Scientific knowledge is then the accumulation of hypotheses which have not (yet) been refuted. This method of inquiry has been so successful that, in Western culture, to declare some putative knowledge as "unscientific" is often to justify dismissing it as irrelevant.

4.5 Experimental Research

Experimental research is a study that strictly adheres to a scientific research design. It includes a hypothesis, a variable that can be manipulated by the researcher, and variables that can be measured, calculated, and compared. Most importantly, experimental research is completed in a controlled environment. The researcher collects data and results will either support or reject the hypothesis. This method of research is referred to a hypothesis testing or a deductive research method. The power of experimental research is that it can be and is repeated in iterations with changing values of the control variable.

There are three primary types of experimental design: pre - experimental research design, true experimental research design, and quasi - experimental research design. The way you classify research subjects, based on conditions or groups, determines the type of design.

5. Approach

5.1 Spiral Model

Spiral model can be appropriate with methodologies such as Grounded theory, Interaction Analysis, and Action Research. With this agile research approach, the aim is to iteratively deliver on the research questions in a spiral fashion with stages: Reflect, Plan, Act and Observe. The aim is to remove the rigidity around research questions as these can change over the course of time based on the observations on the current findings and their feedback at each turn of the spiral. It could also help remove the pressure of identifying the whole research scenario before starting the work and collecting the data. It could go a long way for new researchers finding their way through researching and enable them to contribute in a meaningful way giving them a window to make a few mistakes that can be easily brought to their notice without considerable damage in terms of rework. At its best, spiral agile research is about active learning through data collection and analysis.

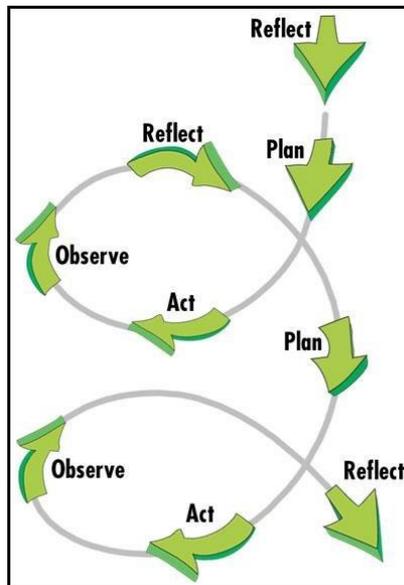


Figure 1 : Action research spiral, *Source:* (Kemmis, McTaggart and Nixon, 2014)

The Spiral agile research approach would include the below steps:

- 1) Reflect on the knowledge you currently have on the research question
- 2) Devise a research plan.
- 3) Address the research question through data collection and analysis. Use the methods and methodology that is best suited for it.
- 4) Observe to arrive to a conclusion. Look for any major changes in the research question or direction.
- 5) Repeat from step 1. Continue until enough knowledge is generated and no further fundamental improvements are possible or no changes are identified to research questions.
- 6) At this stage, the problem converges, and iterations reduce to only incorporate cosmetic improvements if any.

5.2 Unidirectional feedback Model: *Research the Scrum way*

One of the most famous agile software development methodologies, Scrum, offers a well - defined way of dividing and planning work into short time frames called “sprints”. Scrum is a lightweight framework that helps people, teams and organizations generate value through adaptive solutions for complex problems (Scrum. org, 2016) . In Agile, acceptance criteria refer to a set of predefined requirements that must be met to mark a user story complete. Acceptance criteria are also sometimes called the “definition of done” because they determine the scope and requirements that must be executed by developers to consider the user story finished. In Agile Research, the key research question can be scoped as multiple questions or objectives that are tested out sequentially such that outcome of the preceding objective is used to devise the next objective will all the objectives collectively marching towards the research question.

In a nutshell, Scrum requires a Scrum Master to foster an environment where:

- 1) A Product Owner orders the work for a complex problem into multiple user stories in a Product Backlog.
- 2) Each sprint, subset of user stories from the product backlog are selected based on the order.
- 3) The Scrum Team turns a selection of the work into an increment of value during a sprint.
- 4) The Scrum Team and its stakeholders inspect the results and if the done criteria are met, the product owner accepts the user story as complete.
- 5) If there are suggested changes and feedback, new user stories are created with this feedback, product backlog is adjusted, and the process is repeated in the next sprint with the adjusted backlog.

In Agile Research the scrum way, similar steps can be followed. These steps are briefly highlighted below.

5.2.1 Order the research question into multiple sequential research objectives

The research question is restated into multiple sequential objectives to form an equivalent of the product backlog. The sequence of user stories is decided by the product owner in scrum. Similarly, in agile research, this role can be substituted by the research owner. This role can either be played by the funding entity, the organization responsible for the research or individual researchers based on the research stakes. The research owner does the breakdown and ordering of the research objectives. Each objective has a set role towards the overall research question and an acceptance criterion upon fulfilling which it is deemed as achieved. The research owner decides which objectives will be selected in the first sprint.

5.2.2 Determine System goals for each of these objectives

Once the research problem is broken down into interrelated research objectives, the next step is to identify the system goals for each objective towards the research question. The system goals are in line with the acceptance criteria in the scrum terminology.

5.2.3 Select objectives to be addressed in the initial sprint.

Based on the order deemed appropriate by the research owner, the researcher team selects individual research objectives. Each objective is worked upon using the research methodology appropriate for the research objective. In the unidirectional feedback model, methodologies such as Ethnographic Research, Interaction analysis, or/and Experimental Research can be used in different sprints. Ethnographic Research based sprints may take longer than the sprints in other methodologies.

5.2.4 Evaluation of Acceptance criteria

Once the solutions are devised for the research objectives, these are checked against the acceptance criteria. If the criteria are met. The research objective is marked as complete. If not, the objective is moved to the next sprint for completion.

5.2.5 Incorporate unidirectional feedback and continue to next sprint.

Feedback from research owner based on the sprint findings and any changes to existing research objectives based on the findings are incorporated. New objectives if any are added, and objective catalog is redefined and reordered. Iterate through the above steps until a concrete solution to research questions is obtained and acceptance criteria for all research objectives is met.

6. Potential Issues

6.1 Spiral model

Infinite regress: There are continuous changes to the research question as more and more information uncovers. The research problem does not converge after numerous iterations. This simply means that the researcher team may not have the right understanding of the problem statement or doesn't understand the implications of their study very clearly. This can especially be true with deductive (hypothesis generating) research but can also be applicable of confirmatory (hypothesis testing) research.

If this happens, the research team should be tasked with further elaborate literature review, problem definitions, and changes in research methods for data collection and analysis.

6.2 Unidirectional feedback model

Difficulty in establishing acceptance criteria for research objectives: If the research objective is confirmatory in nature, and there are clear ways of hypothesis testing through appropriate methodologies, establishment of acceptance criteria is easy. But for deductive research with unknowns at the start of the spring on research directions, establishing acceptance criteria may become difficult. So, the method cannot be used where acceptance criteria for all objectives cannot be clearly stated.

Continued ever changing feedback that wouldn't converge leading to infinite or large number of research cycles/sprints. In Deductive research or hypothesis generating research, there is a risk of infinite (or large number of) sprints due to continued feedback from stakeholders and their ever changing requirements. If the solution to a research problem is not deduced suitably after a set number of research sprints, a new methodology and data collection and analysis methods should be evaluated for solving the problem at hand.

7. Conclusion

It is quite clear that many people are already doing things that fit the definition of an agile research method. Just as the early advocates of agile software development were careful to note a wide range of pre-existing methods that they could fit the definition of agile, same applies to agile research. Over time we will need to collect evidence about how well it works using the pre-existing methodologies executed in a slightly different way.

One risk with agile research methods is that it can all look too easy. Just go off for an evening scroll with a research problem, collect some data and come back with what you

find. Repeat that 100 times and get a Ph. D. ? Most certainly not. Just as agile software development is not just a load of little sprints, agile research is not just a load of easy little research objective and small datasets. Agile research requires considerable planning to create a research backlog, establish the acceptance criteria, and align towards the bigger research goal. In a spiral model, reflect on the knowledge at the given instance to improvise your research problem and work on it in an iterative fashion. Agile research is about generating a series of small results working towards a final research outcome, accommodating the changing dynamics, stakeholder feedback and priorities.

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