

Software Development in Practice: An Overview of Chilean Industry

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Abstract—Hybrid approaches are a combination of different practices of agile and traditional processes in software development. Using hybrid approaches is an international controversial trend as a means for adapting to fast technological and market changes without losing control over projects. The “Hybrid dEveLopmENt Approaches in software systems development” (HELENA) study performed a large-scale international survey in order to understand the approaches actually applied in practice, how are they combined, and what contextual factors influence this combination in applying hybrid approaches. Considering HELENA results, several works analyzing the situation in different countries have been published. However, there is still no analysis of the Chilean situation. This research intends to present a first description of traditional and agile software development in the Chilean industry, and to compare it with the results obtained in the rest of the world.

Index Terms—agile software development; software process; hybrid development approaches; traditional software development

I. INTRODUCTION

Since the beginning, software processes have been used to collect and organize knowledge about software development and, since then, a large number of approaches compete for “the users’ favor” [1]. However, practice has proven that there is no unique process or particular approach that offers a set of principles or practices equally suitable for any purpose or be flexible enough to be applicable in any type of project [2], [3].

Different aspects such as the benefits brought by the agile philosophy and its difficulties in domains where traditional approaches still work fine, as well as the variable characteristics of different contexts, has led to defend the idea of combining both approaches [1], [3], [4], [5], [6], [7]. According to Boehm and Turner [3], discipline without agility results in an inflexible hierarchy while agility without discipline “leads to the heady, unencumbered enthusiasm of a start-up company—before it has to turn a profit”.

Scientific literature [1], [6], [7], [8], [9], [10], [11], [12], [13] use the term “hybrid software development approach” to refer to the balance between agility and discipline. According to Kuhrmann et al. [6], “a hybrid software development approach is any combination of agile and traditional approaches that an organizational unit adopts and customizes to its own context needs (e.g., application domain, culture, processes, project, organizational structure, techniques, technologies, etc.)”.

Problem Statement: For the last years, industry has shown special interest in hybrid approaches. An example of

this, is the creation of the HELENA project (Hybrid dEveLopmENt Approaches in software systems development) [14]. As part of this project, a survey was created to seek to know which development approaches are used in practice, how and why are these approaches combined with each other, and how standards, norms and regulations impact the design and implementation of agile methods in practice. The first stage of HELENA survey [6] obtained answers from around 15 countries, mostly from Europe and North America. HELENA’s stage 2 [15] obtained answers from 31 countries, and Chile among them. Using this data, surveys about the situation in some countries have been already published. However, there is no public evidence about traditional and agile development practice in Chile, and if there is any correspondence with the international scene.

Objective: The objective of this research is to describe the development approaches used in practice in the Chilean industry, and to identify similarities and differences with respect to the international scene.

Outline: The rest of the paper is structured as follows. Section II presents some related work. The research is described in Sec. III. Results are presented in Sec. IV and discussed in Sec. V. Finally, conclusions are presented in Sec. VI.

II. RELATED WORK

According to Boehm and Turner [3] and Kruchten [16], one of the main causes of failure in software development is the application of processes in contexts that are, at least in some dimensions, far from those for which they were created.

Literature [1], [3], [5], [17] states that traditional development is desirable when requirements are stable and predictable, as well as when the project is large, critical and complex. However, research such as [1], [5], [16], [17], [18], [19] argue that agile software development is considered more flexible and adaptable in contexts where client’s needs change frequently and collaboration is constant, as well as for small collocated teams. According to Highsmith [20], the more volatile the requirements are and the more experimental technology is, the higher success possibilities agile methods provide.

In spite of that, several scientific works agree that agile methods have serious limitations in safety-critical domains (e.g., military or health care where the software needs to be of the highest quality possible) and legacy systems [3], [8], [18]. Furthermore, according to [5], [18], agility provides limited support for distributed environments.

Furthermore, according to scientific literature, agile methods are very demanding when considering professional skills in order to be successful [3], [18], [21]. Creating an effective agile team is a challenging task [18]. In addition, another limitation of agile methods extensively mentioned in the literature [3], [16], [21] is the lack of attention received by design and architecture.

Boehm and Turner [3] propose five critical factors for deciding between following a traditional or agile approach depending on the particular project situation: size, criticality, dynamism, personnel and culture. According to this research, a project that adjusts to four of these agile or traditional factors, but does not satisfy the fifth, is a project that requires risk evaluation and probably a combination of both approaches is the most appropriate way to follow.

Recent results from surveys applied in software industry indicate that the combination of both approaches for development as a reality in practice for most organizations and projects:

- Vijayarathy and Butler [11] researched about contextual factors that influence the choice of different software processes. To this end, they performed an anonymous on line survey where 153 people took part, mostly from North America. This study did not count on the participation of any Latin American country. The authors highlight that the most relevant finding was that hybrid approaches are those that prevail for software processes.
- The “11th Annual State of Agile Report” [22] with representation from all continents (mostly North America), confirms that the adoption of Agile continues to grow. The 94% of the respondents claimed that their organizations practice agile, although they also say that more than half of the teams in their organizations still do not practice agile. This study suggests there are challenges to agile scaling such as the disagreement of the organizational culture with agile values and the lack of skills or experience with the methods.
- The “Status Quo Agile 2016/17” [12] was conducted through a survey where more than 1000 people from more than 30 countries took part, mostly from Europe. Results of this study show that agile methods are frequently used for managing traditional projects to complement or extend existing techniques. The study concludes that there is a trend to apply hybrid approaches more than purely agile. There is no Chilean counterpart for this report.
- HELENA Survey stage 1 [6] took place in 2016 world wide; it included 69 answers from 15 countries. Chile did not participate in this stage. The survey results conclude that companies tend to implement a balanced software approach that includes both methods traditional and agile. The general trend was to apply traditional processes and frameworks to support “classic” managerial activities, while activities relating requirements engineering, implementation, integration and testing are addressed in a more agile fashion. They also found that

the use of hybrid approaches are applied regardless of the company’s size or the industrial sector but they are a natural evolution driven by experience and pragmatism.

- HELENA Survey stage 2 [15] completed 501 answers from all continents (31 countries, including Chile). A general overview of the way the SWEBoK standard disciplines [23] are implemented show a balanced process ecosystem, yet with a strong tendency toward agile. These results differ from those obtained in the first stage where the managerial activities tend to follow a traditional approach. Six regional and cross-regional reports have already been published [24], [25], [26], [27], [28], [29], but the Chilean situation has not been analyzed yet.

III. RESEARCH DESIGN

This work assumes that both, traditional and agile development, present strengths and weaknesses in different development contexts and thus the software process that should be followed needs to adapt to contextual factors of the organization and the project. Therefore, the research seeks to know how software development in Chile behaves and how it correlates with the international scene. To this end, the following research questions are stated:

- RQ1 What approaches does Chilean industry apply in practice for performing managerial and engineering activities in software development?
- RQ2 How does Chile compare with the rest of the world with respect to agile and traditional approaches of software development?

A. Data collection in Chile

HELENA¹ is an international study on the use of Hybrid dEveLopmENt Approaches in software systems development. Its goal is to determine which development approaches (traditional, agile, main-stream, or home-grown) are used in practice and how they are combined, how such combinations were developed over time, and if and how standards affect the development process and the methods applied. Currently, HELENA is in its second stage: “Main data collection in an international consortium”. As part of this stage, a survey was distributed and data collected from May through September 2017, and final data was made available in November 2017.

University of Chile coordinated Chilean participation in the HELENA survey². Around 35 software companies that collaborated with the university in the past were invited to take part in the survey. Invitations were issued through email, and 22 of the companies answered the survey. All Chilean answers were received in August, 2017.

After the survey closing, HELENA coordinators cleaned data and made them available for network participants; in the future, this data will be made public. This study is based on this initial data. The analysis here included considers the 11 items in question PU05: “For the following standard

¹<https://helenastudy.wordpress.com/>.

²The list of HELENA contributors can be found in: <https://helenastudy.wordpress.com/helena-team/>.

activities in the project or product development, please indicate to which degree...”.

B. Data analysis procedure

First, general characteristics of the respondents are analyzed in order to understand information such as role, experience, industrial sector, criticality of the projects or the products, and geographical distribution. Then, specific answers are analyzed in depth. A descriptive analysis is performed, presenting results in the form of tables and charts. Empty or incomplete answers were not considered: there were 22 Chilean participants, but only 19 of them completed the items of interest for this research.

IV. RESULTS

This section presents some results from the survey. First, an overview of the population is presented and then the findings according to the research questions.

A. Study population

Table I shows the relationship between the role and the experience of Chilean respondents participating in the survey. Most of them coincide with the roles defined as part of the survey; only 3 defined them as “other”. Results show that project/team manager is the most frequent role with 22.73%, followed by 13.64% for product manager/owner, and c-level management (e.g., CIO, CTO, etc.). Roles declared as other (13.64%) are: owner, technical leader and area manager. The roles corresponding to quality manager, tester and trainer did not have any representation. Most surveyed people count on more than ten, or between six and ten years of experience developing software, with 40.9% and 36.4%, respectively.

TABLE I

OVERVIEW OF THE ROLES AND EXPERIENCE THAT PARTICIPANTS HAVE.

Role	Experience			Σ	%
	3-5 years	6-10 years	> 10 years		
Analyst/Requirements Engineer	-	2	-	2	9,09
Architect	1	-	1	2	9,09
C-level Management	1	2	-	3	13.64
Developer	-	-	2	2	9,09
Other	1	2	-	3	13.64
Product Manager/Owner	2	-	1	3	13.64
Project/Team Manager	-	2	3	5	22.73
Quality Manager	-	-	-	-	-
Scrum Master/Agile Coach	-	-	2	2	9,09
Tester	-	-	-	-	-
Trainer	-	-	-	-	-
Σ	5	8	9	22	
%	22.7	36.4	40.9		100

More than half of the surveyed people (54.5%) work locally. The rest 45.5% work distributively, in particular,

18.2% work distributed within the same country, 9.2% in the same region, and the remaining 18.2% work globally distributed. Furthermore, the business area “Software Development (custom software, i.e., individual solutions)” represents more than half of the people (54.5%), followed by “Software Development (standard software, e.g., SAP, Office)” and “IT Consulting, Training, and Services”.

Figure 1 provides an overview of the industry sectors in which the participants are active. In total, the survey returned 54 selections of Chilean industry, i.e., several participants are engaged in multiple sectors. The figure shows that 40.9% of the participants are engaged in “Web Applications and Services”, followed by “Financial Services”, and “Mobile Applications”. Among the sectors categorized as “Other”, participants named “Security”, “Data analysis”, “Web and Desktop Applications”, “Data for Education” and “Sanitary Systems”. Sectors such as “Defense Systems”, “Energy”, “Home Automation and Smart Buildings”, and others, did not have any participation among Chilean respondents.

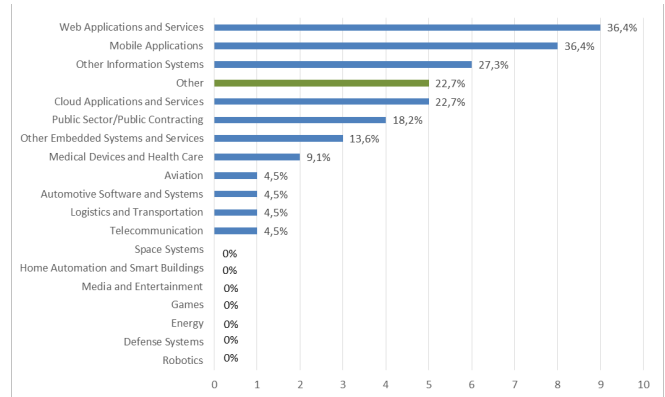


Fig. 1. Overview of the industry sectors as stated by the Chilean participants.

With respect to criticality, 81.8% of the respondents stated that software project or product failure can affect their company’s business. Other factors with high impact were company reputation and financial loss. No failure threatens human health or life, or it conduces to a complete system loss.

B. RQ1: Approaches applied in Chile

All Chilean respondents claim to apply different approaches in software development, i.e., hybrid approaches.

The first research question refers to the Chilean reality with respect to the execution of managerial and engineering activities during software development. To this end, answers are analyzed to determine to which extent the standard SWEBoK disciplines are implemented with either traditional of agile approaches. Disciplines considered are:

- Project Management
- Quality Management
- Risk Management
- Configuration Management
- Change Management

- Requirements Analysis and Engineering
- Architecture and Design
- Implementation and Coding
- Integration and Testing
- Transition and Operation
- Maintenance and Evolution

The range of considered answers is the following:

- Fully Traditional (FT)
- Mainly Traditional (MA)
- Balanced between Traditional and Agile (BTA)
- Mainly Agile (MA)
- Fully Agile (FA)
- Don't know
- Not answered

Table II shows that Chile generally follows a trend towards traditional software development, even though there is also a slight tendency to a balance between traditional and agile development. Moreover, there is no evidence of purely agile development.

TABLE II
TOTAL ANSWERS RECEIVED FOR EACH VALUE

Degree	\sum^1	%
Fully Traditional	2	18.2
Mainly Traditional	6	54.5
Balanced between Traditional and Agile	3	27.3
Mainly Agile	1	9.1
Fully Agile	-	-
Don't know	-	-
Not answered	-	-

¹ Even though there are 11 disciplines, there is a total amount of 12 values. This is because there are two modes for one discipline.

Figure 2 shows that the disciplines of *Configuration* and *Change Management* report to be “Fully Traditional”. Those implemented as “Mainly Traditional” are *Project*, *Quality* and *Risk Management*, *Transition and Operation*, and *Architecture and Design*. On the other hand, *Architecture and Design* is addressed almost equally between “Mainly Traditional” or “Balanced between Traditional and Agile”. *Integration and Testing* got the same punctuation for “Mainly Traditional” and “Mainly Agile”, and these are only slightly higher than “Balanced between Traditional and Agile”. The highest values of balanced between traditional and agile development are achieved in *Requirements Analysis/Engineering*, *Implementation/Coding*, and *Maintenance and Evolution*. Values of “Don't know” and “Not answered” were not considered for the graphical representation.

Figure 3 shows the penetration of agility in Chile for the considered disciplines. Each value in the chart is calculated as the average of the answers for the corresponding discipline, where “1” stands for “Fully Traditional” and “5” for “Fully Agile”. Therefore, higher bars indicate areas that are addressed in a more agile manner, and lower bars indicate mostly traditional approaches. In this way, we can

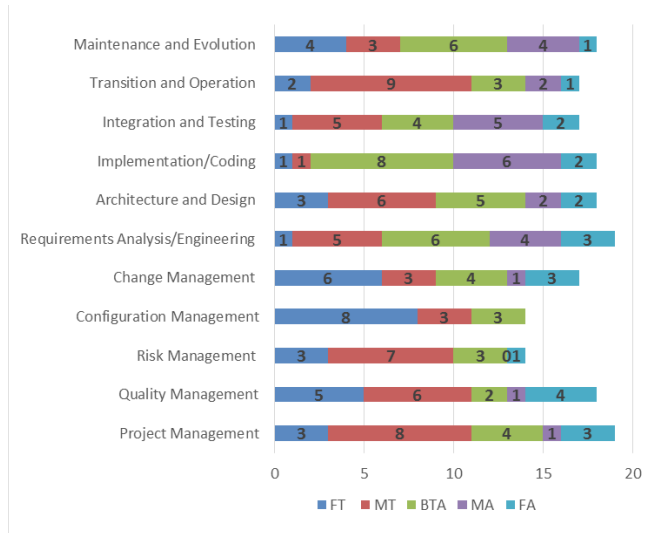


Fig. 2. Rating on the implementation of the SWEBoK disciplines – Traditional vs. Agile Approaches.

see that *Requirements Analysis/Engineering* and *Implementation/Coding* are the ones with the highest punctuation.

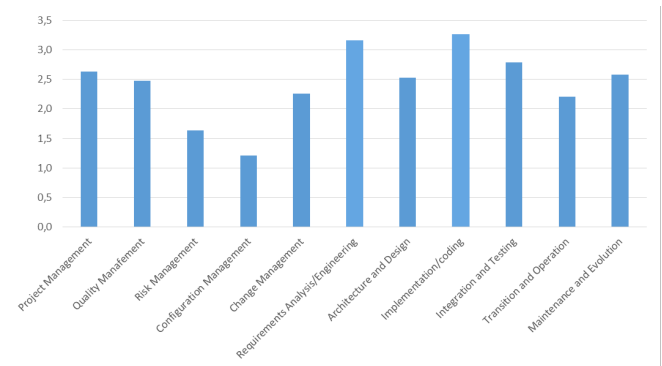


Fig. 3. Overview of agility adoption in Chile

C. RQ2: Comparison with the rest of the world

The second research question analyzes the difference between agility adoption in Chile and the rest of the world. To this end, answers from Chile (19) and the rest of the world (525) are compared. Figure 4 shows this comparison.

In a general way, agility adoption in Chile is lower than that in the rest of the world, and disciplines related to management tend to be more traditional. The most significant difference can be found in *Configuration Management*, followed by *Change Management* and *Risk Management*. On the other hand, disciplines related to engineering show a higher balance between both approaches. Moreover, *Requirements Analysis/Engineering* appears to be higher than in the rest of the world, at least in this small sample.

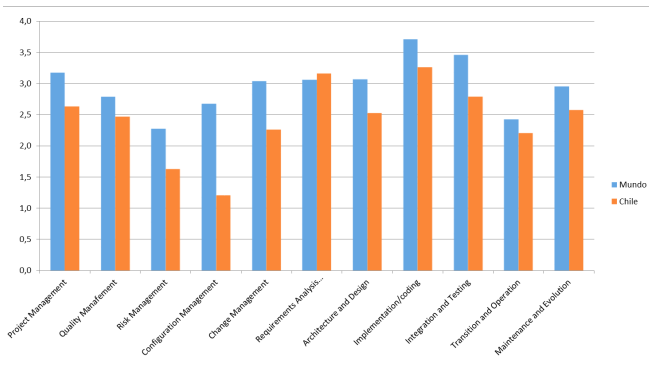


Fig. 4. Difference between agility adoption in Chile and the rest of the world.

V. DISCUSSION

Chilean survey participants do not take part in sectors related to critical systems nor other systems that may threaten human life. Moreover, most projects are locally developed. However, as shown in Tab. II and Fig. 2, software development in Chile generally follows a traditional approach while the adoption of agility is still moderate.

This differs to what is reported in [1], [3], [5], [8], [17], [18] as the best situations for applying traditional approaches. In fact, it is closer to the most desirable scenario as advised in [1], [5], [16], [17], [18], [19]. This also differs from results from HELENA Survey stage 2 [15] where agility adoption around the world is high, as also shown in Fig. 4.

However, this work shows that Chilean industry recognizes the need for balancing agility and disciplined development, as suggested by [3] and it follows a hybrid approach as in the rest of the world [6], [11], [12].

In generally, it can be said that the adoption of agility in Chile is slightly higher for engineering activities than managerial activities, as shown in Fig. 3. This coincides with the results of HELENA survey stage 1 [6]. Figure 4 shows that the rest of the world follows a similar pattern; however, this tendency is more marked in Chile. Even though the sample is small for reaching conclusive statistical significant differences, it can be said that *Configuration Management* presents the higher difference, being addressed in Chile in a much more traditional manner than in the rest of the world. Similarly, it is possible that larger samples could show significant differences in other disciplines as well.

Nevertheless, the application of agile practices in key disciplines such as *Requirements Analysis/Engineering* and *Implementation/Coding*, as shown in Fig. 3, is an important step in adopting agility for software development in Chile. Moreover, the adoption in Chile of agility in activities referring requirements, at least in this sample, is higher than the average for the rest of the world, as can be seen in Fig. 4.

On the other hand, the application of a mainly traditional approach or a balance between both approaches for implementing *Architecture and Design* is in consonance with some of the limitations of agile development [3], [16], [21]. It is also possible that low adoption of agile practices in Chile is related with the need of high professional skills imposed by

agile practices [3], [18], [21], [22] or the disagreement of the organizational culture with agile values [22].

VI. CONCLUSION

This paper presents the trends in software development approaches in the Chilean industry. To this end, we analyzed the data provided by 22 Chilean participants in the second phase HELENA survey. From this group, only 19 answers provided complete data of interest for answering the research questions. The analysis focuses mainly on the approaches applied in Chile for implementing SWEBoK standard disciplines, and their comparison with the situation in the rest of the world. Results are presented in tables and charts and they show that Chile follows an approach mainly traditional for software development, less agile than the rest of the world, even though it follows a similar trend in the use of hybrid approaches for adapting to the organization or project context.

Chile, similarly to what happens in the rest of the world but to a lower extent, is more conservative in adopting agile practices for management and less conservative for engineering activities. Also, agility is higher in (*Requirements Analysis/Engineering* and *Implementation/Coding*), i.e., those areas where agile practices have reported to be more successful. This can be considered as a step forward in agility adoption in Chile.

Limitations: The most serious limitation of this research is the size of the analyzed sample that is too small to achieve conclusive results. Not all industry sectors or roles are represented and neither are uniformly distributed. Moreover, data relating company size could not be used in the analysis because they sometimes refer to the number of people in the computer department and some other times to the people in the whole company. Nevertheless, this initial descriptive study allows us to identify certain issues that are worth researching before a generalization can be reached.

Future Work: Considering the rest of the information available as part of HELENA survey stage 2, we plan to perform other analyses: (a) which processes, methods and practices are actually applied in Chile?, (b) how are they combined?, (c) which factors influence the use of one approach or another?, (d) which application domain favors one approach or the other?, (e) what is the motivation for combining different software processes? Considering the aforementioned limitations, it is necessary to count on a larger sample, or get deeper understanding of the phenomena through interviews. It is also necessary to have more reliable information about company sizes, so that it can be analyzed if it has any influence in the choice of the approach to be followed, among others.

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