Managing Uncertainty in Requirements: a Survey in Documentation-driven and Agile Companies

Alberto Sillitti, Martina Ceschi, Barbara Russo, Giancarlo Succi
Center for Applied Software Engineering
Free University of Bozen
{Alberto.Sillitti, Martina.Ceschi, Barbara.Russo, Giancarlo.Succi}@unibz.it

Abstract

This paper investigates commonalities and differences between Agile and Documentation-driven approaches in managing uncertainty in requirement gathering.

The research method is a survey collected interviewing sixteen project managers of Italian software companies, 8 using Agile Methods, and 8 using Documentation-driven methods.

The results show that Agile and Document-driven companies consider in a different way the problem of changing requirements and the related uncertainty; thus, they manage differently requirements gathering and the relationship with the customer.

1. Introduction

Uncertainty is one of the main problems in the software industry. Understanding the level of existing uncertainty during the development process is important since it influences:

- The ability of managers to plan and organize the development process
- The probability to proceed according to the plan
- The possibility of developing the product within the contractual constraints
- The success of the project

A relevant part of uncertainty in software projects deals with unexpected changes inside or outside the organization.

The requirements variability can be external or internal. The former involves all the "external" sources not connected directly to the identification, gathering, and specification of the user requests. Neither the customer nor the development team can control them. These include changes in technology, regulations, or in company factors, such as corporate politics, marketing plans, financial conditions etc.

The latter involves all the problems, obstacles, and constraints "internal" to the activities related to requirements. Since these sources of variability are related mainly to the relationship between the development team and the customer, they might be able to control or manage them.

Some of the main "internal" sources identified in this study are:

- Limited knowledge of the application domain distributed across the actors involved in the project.
- Customer's initial uncertainty. The customer is not able to define a complete set of requirements at the beginning of the project.
- Relational and communication problems among the subjects involved in a project. In particular among:
  1. Subjects belonging to different organizations (e.g., between the customer and the analyst/developer).
  2. Subjects belonging to the same organization (e.g., among internal subjects belonging to different hierarchical levels or functions and developers).

This paper is organized as follows: section 2 describes the background of the study; section 3 presents the related work; section 4 and subsections outline the structure of the research activity performed; section 5 and subsections show the collected data; section 6 identifies the main results; finally, section 7 draws the conclusions.

2. Background of the study

A basic hypothesis of the Document-driven approach is that time and money required for any corrective action dramatically increase during the implementation of a product. Hence, after the early stages, changes have to be avoided since they affect the schedule and the costs of the projects [6] [11].

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As a result, Document-driven firms spend a lot of effort in forecasting the user needs in order to reduce the number of changes. In this way, their first implementation should already include the support for future requests.

These companies focus on "anticipation abilities": the abilities to anticipate information into the early phases of the product development. Therefore, they act according to the principles of stability and controllability of the context [20] [27].

As a result, the following aspects characterize the gathering and management of requirements in Document-driven firms:

- Most of the requirements are gathered at the beginning of the process. The customer should be able to specify all its needs in the initial phase [6] [14].
- In order to freeze the requirements and guarantee results to the customer, these firms use rigid fixed price/fixed scope contracts [21].
- One specific person, the analyst or the project manager, is in charge of the requirement gathering activity. The customer seldom interacts directly with developers.
- The interaction with the customers occurs in the initial phase of the project. Firms using this approach suppose that they can immediately understand the customer needs, without further clarifications.
- Usually, the structure of these companies is hierarchical and there is a sharp separation of the different functions. This separation generates communication barriers that produce conflicts in the requirements gathering [2].

Compared to Document-driven companies, Agile firms have a different attitude towards change; as a matter of fact, they consider it an normal condition that characterizes every software development project.

Unlike the other kind of firms, they focus on "reaction abilities": the abilities to include changes late in the process rapidly and with low costs. Agile methods are adaptive rather than predictive, they include the management of frequent changes in the process itself [21].

Thus, they consider every change request as an opportunity to improve the system in order increase the customer satisfaction. Agile firms do not try to avoid the changes but they seek to "embrace" them [5] [11].

Furthermore, according to this approach, early decisions are taken without anticipating information and many binding choices are delayed until more information is available. In this way the level of uncertainty decreases. Therefore, it is not required to spend effort forecasting possible user requests the beginning of the process [27].

For all these reasons, the following features describe the requirements gathering approach in Agile companies:

- Requirements are gathered in every iteration because Agile firms recognize the high level of customer uncertainty at the beginning of the project.
- Agile firms use contracts based on time and expenses, without a fixed scope. They seek to create trust integrating the customer into the development process [27].
- In order to avoid misunderstandings and to establish trusted relationships, Agile companies emphasize the direct interaction between the customer and the development team. Thus, there are no intermediaries between them.
- A key point of the agile approaches is the customer involvement. These firms consider very important having the customer "on site" during the whole development process. The customer is an active part of the development team [11] [27].
- Interaction and communication among people involved in the requirement gathering have a paramount role. As a result, they take place during every phases of the life cycle, not only at the beginning of the project [1].

3. Related work

There are several case studies reporting experiences from the application of Agile Methods in different settings. However, most of them focus on the problems encountered in the introduction of the Agile Methods in real contexts.

In particular, Karlstrom [15], Grenning [10], Poole and Huisman [22] report their experiences related to the introduction of the XP practices respectively in a project at Online Telemarketing, in a process-intensive organization, and in a project at Iona Technologies.

Cohn and Ford [7] discuss the lessons learned with introducing Scrum into seven organizations over a period of four years. Finally, Ambler [3] presents a case study of the introduction of a combination of Agile Modeling and Rational Unified Process.

Besides these, there are quantitative surveys in companies already using Agile Methods that evaluate the effectiveness of such methods and their potential problems [24], [23]. Finally, there are some experiments [17], [12] that compare projects using XP

with projects adopting more traditional development methods.

This study is part of the last category of surveys but the specific point of view is different. It compares companies adopting Agile Methods (mainly XP) with companies using document-driven approaches from a well-defined point of view: requirements management and uncertainty management.

4. Structure of the investigation

4.1 Goal, Questions, and Metrics of the research

The overall structure of this study is based on the GQM approach by Basili *et al.* [4].

Goal:
Investigate commonalities and differences between Agile and Document-driven approaches in managing uncertainty in software development.

Perspective:
- Requirements gathering
- Change management

Context:
- 16 Italian companies: 8 Agile and 8 Document-driven

Question:
- Do Agile and Document-driven companies manage requirements variability in different ways?
- Do Agile and Document-driven companies approach requirements gathering in different ways?

Metrics:
- Requirements gathering:
  - Requirements gathering process: Who, When, and How
  - Main problems/solutions
- Change management:
  - Frequency, source, and impact of requirements changes
  - Solutions adopted to manage changing requirements

4.2 Survey design

The design of the survey is based on the approach of Silverman [26]. In such approach, the design of a structured and formalized research involves two initial and partially correlated decisions:

- the *method*, that is, if performing a quantitative or a qualitative investigation
- the *methodology*, that is, the specific technique for gathering data (interview, questionnaire, case study, survey etc.)

Such decisions are based on an accurate evaluation of the goal of the survey, the kind of information required and the existing constraints. Since this study is a pilot investigation, the number of companies involved is limited.

Due to the amount and the type of data available, we have adopted a qualitative research method. Such a method allows us to gather a lot of information about the opinions, attitudes, and perceptions of the respondents [19].

The choice of the research method influences and guides the data collection methodology. We have adopted a semi-structured questionnaire as research methodology, that is, a questionnaire with multi-choice questions and some open-ended questions.

Given the nominal nature of most variables used in the questionnaire, the suitable statistics are mode, frequency count, and the relative frequency distribution.

Data measured by nominal scales must be analyzed by non-parametric methods. Nevertheless, the suitable non-parametric statistical tests (e.g., binomial test and chi-square test) cannot be used due to the structure of the questionnaire. In particular, the characteristics of the questions and the low number of data gathered do not satisfy the hypothesis of the tests [25].

4.3 Structure of the questionnaire and data gathering process

The final form of the questionnaire was achieved through several drafts.

In designing the first draft, a qualitative preliminary phase has been performed. We have interviewed informally some managers of local software companies in order to:

- verify the significance of the study
- find out the most interesting and valuable questions
- stimulate new ideas about the topic of the questionnaire

After this phase, we have designed the questionnaire in detail. First, the soundness of each question and the whole questionnaire was checked according to the principles of Marbach: simplicity, understandability, objectivity and utility [18].

Then, some members of the research center of the authors reviewed the first draft of the questionnaire and

comments were incorporated in a second draft. Finally, a set of three managers evaluated the second draft.

The questionnaire follows the psychological criteria of Converse and Presser [8]:

- The questions have been ordered from general topics to more specific.
- Data about interviewee (age, gender, etc.) have been asked in the last section to avoid encroaching upon privacy.
- Oriented questions, that could cause distorted and obvious answers, have been avoided.

The data gathering process is the following:

1. The respondents have been selected among companies that have some relationships with the research center of the authors.
2. The questionnaire has been sent by e-mail in order to verify the availability of the respondents and to present them the aim of the survey.
3. Data has been collected by personal or phone interviews.
4. The results of the interviews have then been recorded, and the interviewee has been asked for a final check.
5. Only upon a positive feedback from the interviewee, the questionnaire has been considered accepted.

The questionnaire consists of four main parts. The first deals with the firm and of the interviewee; the second describes how the company deals with changes; the third collects data regarding their approach towards the requirement gathering process; the fourth deals with the solutions adopted to address the internal sources of variability.

The questionnaires have been filled in through interviews. We interviewed managers for about 45 minutes. Participants were guaranteed anonymity and the information reported has been reviewed so that no individual person or company can be identified.

This approach could result in problems during the data gathering phase due to the bias added to the data by the participants (interviewer, interviewees). In fact, the interaction between actors might influence the respondents' opinions or answers. As a result, in the same questionnaire there could be some incoherent answers.

We attempted to minimize these problems during the design of the questionnaire, the interviews, and the data analysis. In particular, we have:

- written clear instructions for every question
- made the interviewer's explanations as objective as possible
- detected and eliminated incoherent information by deeply analyzing and comparing answers

5. Data analysis

5.1. Structure of the sample

Data presented in this study comes from questionnaires collected by interviewing 16 managers of Italian software companies: 8 of Agile companies and 8 of Document-driven companies.

All the firms considered have been founded between 1970 and 2000. Their size is very different: there is a trend toward the medium/large size (from 150 to 3000 employees) in Document-driven firms and toward the medium/small size (from 5 to 150 employees) in Agile companies. All the firms are Italian and they operate through several headquarters located all around the country. The operating areas include: system integration, software development, software services, etc. Most of the considered companies (both Agile and Document-driven) develop software for telecommunication companies or Public Administrations.

All the Agile interviewees and 85% of the Document-driven interviewees are currently project managers or project leaders. The average age of the Agile respondents is 35, while the Document-driven respondents have an average age of 44. 88% of the Agile interviewees and 75% of the Document driven ones have a university degree (most of them in engineering or computer science).

Since the sample includes a limited number of software companies (16) located in one country (Italy), it is not possible to generalize the results of this study to the whole software community, but it can be a starting point for a further and more focused investigation. Both Agile and Document-driven companies work on projects with different sizes. This study focuses on the approaches to requirements at company level, not on the specific approaches at project level. Consequently, each interviewee was asked to answer to the questionnaire referring only to his opinion and experience about all the projects he was involved, not just the current or last one.

Furthermore, they were asked to consider only the customer-specific projects and not the market-driven ones. Therefore, projects that are developed for a specific and real customer. Since these two kinds of projects have different requirement gathering approaches and problems, they cannot be considered together.

5.2. Changing requirements

According to 75% of the Agile companies and 63% of the Document-driven firms, requirements vary "often" or "always" over time (Figure 1).

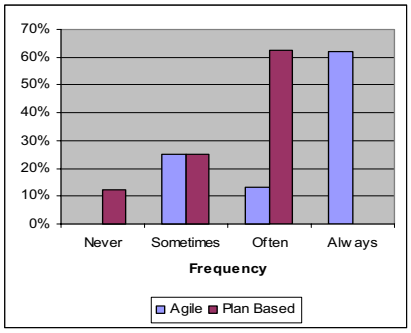


Figure 1: Frequency of requirements variability

88% of the Document-driven companies and 13% of the Agile firms consider the requirements variability the most difficult problem to deal with during the requirements gathering process (Figure 2). Several studies have highlighted the problem of changing requirements. In particular, a study based on 17 large projects considers the "*fluctuation and conflicting requirements*" one of the three most salient problems in designing large systems [9]. In another recent study on requirements engineering, all the interviewees (87) reported a situation in which "*the requirements changes do not cease once the design phase had begun*" [16].

Most Agile and Document-driven firms consider the improvement/deepening of the knowledge, the main source of requirements variability (Figure 3).

This result is compliant with the studies mentioned above. The "*lack of domain knowledge is a significant problem on many software development projects*", "*requirements will appear to fluctuate when the development team lacks application knowledge*" [9]. "*It is vital to understand the problem domain both in market-driven and in customer-specific projects*" [16].

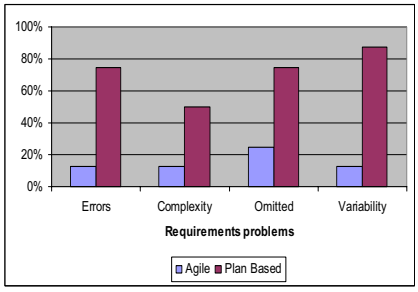
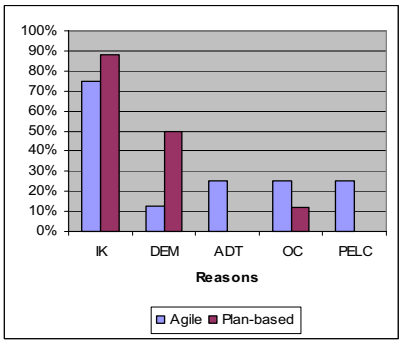


Figure 2: Requirements problems

During software development, both the customer and the developers learn more about the application domain. Consequently, requirements cannot be stable.

Errors and misunderstandings in requirements are important for most of the Document-driven firms (50%). Studies about this aspect present opposite results. Some of them do not consider it a major problem in the requirement gathering process [16], others identify this as a problem [9].



Legend:
IK: Improvement/Deepening of the knowledge
DEM: Discovery of errors or misunderstandings
ADT: Ability of the development team
OC: Creation or resolution of organizational conflicts
PELC: Changes in the political, economical/legal context

Figure 3: Main reason for requirements variability

This difference between Agile and Document-driven companies might be due to the way they communicate with the customer. Since Document-driven companies mainly communicate through documents, the probability to introduce errors in the specification and misinterpret requirements is higher than in Agile companies.

Moreover, Agile companies consider important the ability of the development team, the creation or resolution of organizational conflicts, and the change in the external context.

For all the companies the main consequences of the requirements variability deal with the contractual aspects and the final customer satisfaction.

The most interesting differences in the solutions adopted for the changing requirements are in the contractual aspects and in the architecture of the developed systems.

75% of the Document-driven companies regularly use rigid contracts with a specific regulation to support predictable requests for modification. In case of unpredictable changes, they negotiate again the time and the costs of the project.

On the contrary, 80% of the Agile firms use "variable scope" contracts. They do not set all the requirements at the beginning of the process, therefore the customer can specify, at every iteration, what (s)he wants.

Half of the Document-driven firms use flexible architectures in order to respond to predictable changes in the requirements. Nevertheless, if unexpected important changes take place, they have to start from scratch to redesign and implement again the application.

The basic idea is to spend additional effort to create an architecture able to support the predictable changes. This solution has been highlighted also by the study of Curtis *et al.* [9].

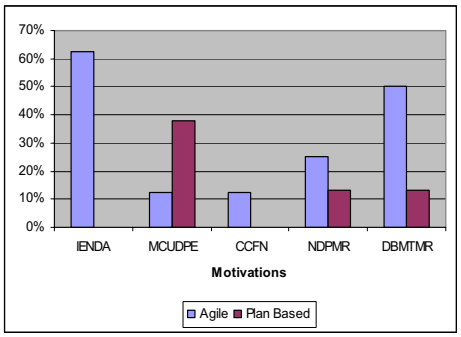
On the contrary, most of the Agile firms interviewed use a different approach. They implement the simplest architecture sufficient to implement the known requirements and they delay all the binding architectural choices until more information is available. In this way, they keep the architecture as flexible as possible.

5.3. The requirements gathering process

Almost all the companies interviewed (92%) have changed their process in order to manage and gather requirements more effectively (Figure 4).

The main motivations for the Document-driven companies are:

- 38% because of the complexity/uncertainty in the development process/environment
- 13% because of the new problems related to the management of the requirements
- 13% to discover better methods for managing/gathering requirements



Legend:
IENDA: Experimentation of new/different approaches
MCUDPE: Major complexity/uncertainty in the development process/environment
CCFN: Changes in customer features and needs
NDPMR: New or different problems related to the management of the requirements
DBMTMR: Discovery of better methods/techniques in order to manage requirements
O: Other

Figure 4: Motivation for changing the process/techniques to gather requirements

For the Agile firms the main reasons are:

- 63% because of their intent to experiment new/different approaches
- 50% to discover better methods for managing/gathering requirements.

Document-driven and Agile companies have a different approach in requirements gathering. Mainly, these differences are in when, who, and how they are collected:

- **When** (Figure 5):
  - 88% of the Document-driven companies prefer to have a complete specification of the features before the implementation. They try to understand the requirements as soon as possible, in order to freeze them.
  - 88% the Agile firms, on the other hand, gather the requirements incrementally during the development process.

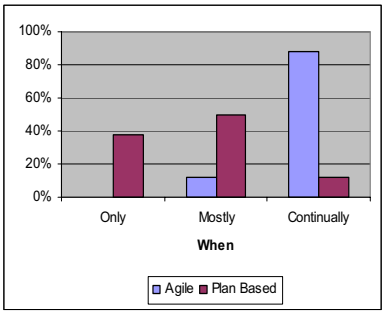


Figure 5: When gather requirements

- **Who** (Figure 6):
  - In 63% of the Document-driven companies there is a specific reference person for the requirements gathering activity, usually the analyst or the project manager.
  - In 63% of the Agile firms, developers manage directly this activity.

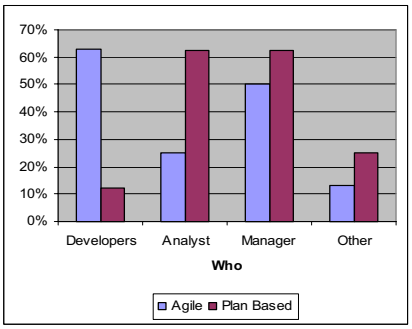


Figure 6: Who gathers requirements

- **How** (Figure 7):
  - Document-driven firms use to gather requirements the following techniques: conventional techniques such as interviews and document analysis (100%) and techniques based on simulations or models of the system such as use cases, scenarios, prototyping (50).
  - Agile firms use to gather requirements the following techniques: conventional techniques such as interviews and document analysis (75%) and the group techniques such as brainstorming, focus group (75%).

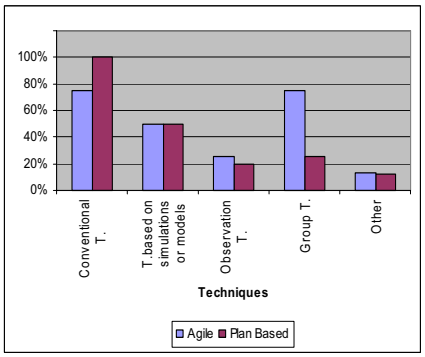


Figure 7: Techniques for gathering requirements

Half of the Document-driven and 63% of the Agile firms use some specific tool in the requirement management process.

For both kinds of companies, the main goal of these tools is enabling the traceability of requirements (Figure 8).

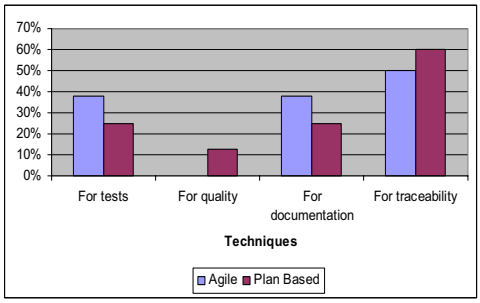


Figure 8: Goal of the tools used for managing requirements

5.4. Customer's uncertainty

75% of the Agile companies and 100% of the Document-driven ones consider the customer ability to specify completely, precisely, and correctly the requirements, at the beginning of the process, "not much satisfactory".

For all the firms, the main problems are (Table 1):

1. lack of clarity in business objectives
2. communication-language-communication channel
3. scarcity of information/knowledge

Document-driven firms handle the first one analyzing the customer needs and trying to forecast future requests before starting the implementation phase. Furthermore, they show prototypes to the customer and, sometimes, use a process of requirements validation.

Agile companies deal with the first problem just breaking up the process in small iterations. Therefore, customers can test the application at the end of every

iteration. In this way, customers are able to understand the actual needs and focus on their business objectives.

To verify the understanding of the requirements Document-driven firms describe in a very detailed way the requests and show prototypes of the final system.

Agile companies address this problem through the "customer on site" practice, involving the customer in the development team in order to clarify every possible misunderstanding.

This "agile solution" is not a new one. In fact, other studies have pointed out the importance of the direct contact between developers and customer to avoid requirements misunderstanding. "*Most informants felt that they understood the requirements best when they interacted directly with users*" [16]. "*Contact between customer and developer needed to be direct since intermediaries often had difficulty identifying the subtleties that had been misunderstood*" [9].

Table 1: Customer's inability to specify requirements

	Agile	Document-driven
Cognitive limits of the memory-attention-understanding	22%	22%
Lack of information-knowledge	38%	62%
Problems of the communication-language-communication channels	38%	68%
Emotional and relational limits or difficulties	0%	22%
Lack of clarity in business objectives	75%	84%

Document-driven firms manage the third problem spending effort upfront in order to collect all the information available. The analyst or the project manager tries to extract from the customer all the current and future requests.

Agile companies, on the contrary, are aware of the existing customer uncertainty, thus they do not spend time trying to extract all the possible requirements at the beginning of the project. They allow the customer to specify its requests at each iteration, as its understanding of its own requirements increases.

It is interesting to notice that only Document-driven firms are affected by the emotional and relational difficulties. This might be due to the different kind of relationship with the customer. The direct and frequent interaction with the development team allows the customer to feel more comfortable during the requirement gathering process. The customer is an active part of the team and he is not considered an external entity [11].

5.5. Communication problems

75% of the Agile firms consider the relationship with the customer during the requirements gathering process, "very satisfactory". Only one of the Document-driven companies agrees with this statement: in fact, 37% of them consider it "not much satisfactory" and 50% "satisfactory" (Table 2).

There are not prevalent motivations for the problems with the customer for the Document-driven companies (Table 3).

Agile firms point out, as the most important reason, the customer lack of time to dedicate to the project that is, their insufficient participation or interest in the development process (Table 3).

Table 2: Satisfaction of the relationship with the customer

	Agile	Document-driven
Not much satisfactory	12%	37%
Satisfactory	12%	50%
Very satisfactory	75%	13%

Document-driven and Agile companies adopt different solutions to this problem: the former accept and passively suffer it, the latter react actively in two ways: (1) focusing on the most valuable requirements; (2) involving the customer in the process through frequent releases of the system.

Table 3: Motivations for communication and relational problems

	Agile	Document-driven
Subjects diversity	75%	62%
Lack of time	100%	62%
Wrong choice of the subject to involve in the requirement gathering	75%	62%
Complex project or software	10%	62%

5.6. Conflicts in the organization

Regarding this specific internal source of variability, this study has not found out any particular difference between Agile and Document-driven companies.

In all the firms, the requirements identification process creates "sometimes" (44%), "rarely" (44%), and "often" (6%) conflicts inside their organization.

For all the companies, the main source of conflicts is the rigidity of the organizational structure/culture.

Most of the conflicts are among subjects belonging to different hierarchical levels (50%) or functions (56%).

Document-driven and Agile companies adopt two opposite approaches to address this problem.

The former handle it building multifunctional teams, in this way they seek to reduce the "physical" communication barriers.

In the latter, to put down the "mental" barriers among team members, everyone have to be able to carry out all the necessary activities to develop and design an application. This means that Agile firms build despecialized teams.

6. Results

This study has collected data regarding the approach to project management in two different sets of Italian software companies: Document-driven (8 firms) and Agile (8 firms).

According to this study Agile and Document-driven companies share quite the same view of the world but they react in different (and sometime contrasting) ways.

For instance, most of companies have to deal with requirements change (Agile: 75%, Document-driven: 63%) and are aware of the problems behind the inability of the customer to write down a complete list of requirements. Moreover, a lot of them use tools to support the requirements management and collect them in the same ways.

However, the approaches used to address this problem are contrasting.

Since AMs focus on the embrace of the changes, the structure of the Agile companies fit this basic value. All their organization and the structure of their process are based on the interaction with the customer in order to increase the level of understanding together (88% of the Agile companies collect requirements during the whole project). In this way, requirements variability is not a problem (for 87% of the Agile companies).

This tight interaction with the customer creates a very satisfactory relationship with the customer (75% of the Agile companies).

Document-driven companies consider the variability of requirements a main problem (88% of the companies). Instead of including the management of changes in their development process, 75% of the Document-driven companies use fixed cost/fixed scope contracts in order to discourage the introduction of changes. Moreover, 84% of them collect the requirements only or mostly at the beginning of the project.

Although, they are not very confident in their requirements gathering process since 51% of them have changed it because of problems with it or the increasing complexity of the process/environment.

This approach does not create a satisfactory relationship with the customer since it is not much satisfactory for 37% of the companies, satisfactory for 50%, and very satisfactory for only 13% of them.

The difference in size of Agile and Document-driven companies could affect the results. Nevertheless, we think that such difference is not the cause of the results because both the two kinds of firms work on projects with different sizes.

However, only replications of the study on larger datasets would be able to provide a more reliable answer.

7. Conclusions

This paper discussed a comparison of how Agile and Document-driven companies approach the problem of the uncertainty of the requirements.

In particular, the aim of the study was to verify through empirical data if Agile and Document-driven companies manage differently the problem of changing requirements as their theories claim.

Most of the results of the study confirm that AMs are more customer centric and flexible, than Document-driven ones. Moreover, Agile companies seams to provide better results, at least in the relationship with the customer.

Since the number of companies involved in this study is very limited, it is not possible to generalize the results but this analysis is useful as a pilot investigation.

Further investigation in the area is required, starting from:

- increase the size of the sample
- extend the questionnaire in order to include data regarding the quality of the software developed and project management issues
- investigate how customers consider and evaluate the requirements gathering approach of the Agile and Document-driven companies

7. References

[1] Abrahamsson, P., R. Salo, J. Ronkainen, J. Warsta, "*Agile software development methods: Review and analysis"*, VTT Publications, 2002.

[2] Al-Rawas, A., S. Easterbrook, "Communication problems in requirements engineering: A field study", *1st Westminster Conference on Professional Awareness in Software Engineering*, London, UK, 1 - 2 February, 1996.

[3] Ambler, S., "Agile Modeling and the Unified Process", available at URL: http://www.agilemodeling.com/essays/agileModelingRUP.htm, 2002.
[4] Basili, V.R., "Software modeling and measurement: The Goal/Question/Metric paradigm", Technical Report CS-TR-2956, Department of Computer Science, University of Maryland, College Park, MD 20742, 1992.
[5] Beck, K., "*Extreme programming explained: Embrace change"*, Addison Wesley, 2000.
[6] Berry, D.M., "The inevitable pain of software development: Why there is no silver bullet", *Radical Innovations of Software and System Engineering in the Future*, Venice, Italy, 7 - 11 October, 2002.
[7] Cohn, M., D. Ford, "Introducing an Agile Process to an Organization", available at URL: http://www.mountaingoatsoftware.com/articles/IntroducingAnAgileProcess.pdf, 2002.
[8] Converse, J..M., S. Presser, "*Survey Questions: Handcrafting the Standardized Questionnaire"*, Sage, Beverly Hills, 1986.
[9] Curtis, B., H. Krasner, N. Iscoe, "A Field Study of the Software Design Process for Large Systems", *Communication of the ACM*, 31(11), 1988, pp. 1268-1287.
[10] Grenning, J., "Launching Extreme Programming at a Process-Intensive Company", *IEEE Software*, 18(6), 2001.
[11] Highsmith, J., A. Cockburn, "Agile software development: The business of innovation"*, IEEE Computer*, September 2001, pp. 120-122.
[12] Hodgetts, P., D. Phillips, "Extreme Adoption Experiences of a B2B Start-up". Available at URL: http://www.extremejava.com/eXtremeAdoptioneXperiencesofaB2BStartUp.pdf, 2002.
[13] Hoinville, G., R. Jowell, "*Survey Research Practice"*, SCPR, 1982.
[14] Iansiti, M., "Shooting the rapids: managing product development in turbulent environments", *California Management Review*, 38(1), 1995, pp. 37-58.
[15] Karlstrom, D., "Introducing Extreme Programming: An Experience Report", *In proceedings of 3rd International Conference on eXtreme Programming and Agile Processes in Software Engineering*, 2002.
[16] Lubars, M., C. Potts, C. Richter, "A Review of the State-of-Practice in Requirements Modeling", *In Proceedings of the First IEEE International Symposium on Requirements Engineering*, San Jose, 1993.
[17] Macias, F., M. Holcombe, M. Gheorghe, "Empirical Experiments with XP", *In proceedings of 3rd International Conference on eXtreme Programming and Agile Processes in Software Engineering- XP2002*, 2002.
[18] Marbach, G., "*Le ricerche di mercato"*, Utet, 1996.
[19] Marshall, C., G.B. Rossman, "*Designing qualitative research"*, Sage Publications, 1989.
[20] Miller, R., "*Managing Software or Growth without fear, control, and the manufacturing mindset",* Addison-Wesley, 2003.
[21] Paetsch F., A. Eberlein, F. Maurer, "Requirements engineering and agile software development", *12th IEEE International Workshops on Enabling Technologies*, Linz, Austria, 9 - 11 June, 2003.
[22] Poole, C., J. Hiusman, "Using Extreme Programming in a Maintenance Environment", *IEEE Software*, 18(6), 2001.
[23] Reifer, D., "How to Get the Most out of Extreme Programming/Agile Methods", *In proceedings of Extreme Programming and Agile Methods-XP/Agile Universe 2002*, 2002.
[24] Rumpe, B., A. Schroder, "Quantitative Survey on Extreme Programming Project", available at URL: http://www.xp2002.org/atti/Rumpe-Schroder--QuantitativeSurveyonExtremeProgrammingProjects.pdf, 2002.
[25] Siegel S., N.J. Castellan, "*Nonparametric statistics"*, McGraw-hill, 1988.
[26] Silverman, D., "*Doing qualitative research"*, Sage Publications, 2000.
[27] Verganti V., "Planned Flexibility: Linking Anticipation and Reaction in Product Development Projects", *Journal of Product Innovation Management*, 16(4), 1999, pp. 363- 370.