Software Development and Customer Satisfaction: a Systematic Literature Review

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Abstract. *Background:* Customer satisfaction is one of the vital components of a successful software company. It is not possible to develop successful products with functional and/or non-functional properties that are not able to satisfy the customer's needs. To this end, it is important to identify factors that affect customer satisfaction and approaches to measure them also in relation with the adopted development methodology.
Goals: The purpose of this work is to provide an extensive investigation of the existing studies related to evaluation of customer satisfaction and analyze them.
Method: The Systematic Literature Review approach was applied. We have identified an initial set of 310 studies obtained from the three largest digital libraries that was reduced to 34 after the application of a number of filters. These studies were analyzed in depth in this paper.
Results: The analysis performed points out that in the majority of the identified studies, one of the main factor that affects customer satisfaction is related to the application of Agile Software Development approaches due to their deep involvement of the customer in the development process.

Keywords: Customer satisfaction · Agile · Systematic literature review.

1 Introduction

Software companies typically focus on technological aspects and innovation promoting their point of view in how systems should be developed and used. Even if this approach could provide advantages in the development of new products and services forcing customers to adopt some technologies and methods, the approach does not fit the development of the majority of software systems that are not at the edge of the technology but they need to address more traditional needs.

Developing a software product is more difficult than developing products in more mature industries where the technological environment is more stable as well as the development approaches. Moreover, due to the increasing level of competition among software producers identifying approaches to attract more customers and improve their loyalty is of paramount importance. Customer satisfaction provides a leading indicator of consumer purchase intentions and loyalty

[6]. When organizations attempt to create a more customer-focused environment, they need to consider strategies such as:

- Identifying the perceived role of customer.
- Collaborating with customer.
- Active involvement of customer in quality improvements.
- Customer integration in developing new products.
- Designing feedback loops between the customer and the engineering team.

These are just an example of possible strategies that can be implemented to improve customer involvement but they provide a basic overview of the aspects to be considered when creating a proper strategy.

The main goal of this systematic literature review is to understand whether there are common approaches to establish collaborations with customers, the main challenges, the main factors that affect the customer satisfaction, and whether the chosen software development methodology plays any role.

The paper is organized as follows: Section 2 and subsections describe the adopted approach and protocol; Sections 3 and 4 present and analyze the results obtained; Section 5 discusses the threats to validity of the research; finally, Section 6 draws the conclusions and introduces future work.

2 Adopted Approach

2.1 Goals of the Research

Due to the increasing number of software producers, there is a need for them to measure the degree of customers satisfaction and find ways to improve. For this reason, it is important to understand the factors that affect customer satisfaction and methods for measuring it. Literature in this field is both fragmented and unvaried. In this paper, we look at how previous reviews within Agile Software Development (ASD) and other software development methodologies considered customer satisfaction and we use these insights to identify common aspects.

2.2 Research Questions

This study aims to answer two following questions:

- RQ1: Which are the factors that affect customer satisfaction?
- RQ2: How can we measure the factors that affect customer satisfaction?
- RQ3: How can we evaluate customer satisfaction for a project?

2.3 Search Process

This section describes the search process activities considering the resources and keywords used, and example of search queries.

Resources In our research, we used three largest digital libraries available: ACM Digital Library, IEEE Xplore Digital Library, and Google Scholar. As many other studies pointed out, we have realized that Google Scholar includes all the publications listed in the other repositories considered here and in other smaller ones such as the ones of Elsevier, Wiley, etc.

Keywords We used research questions RQ1, RQ2 also to identify the search keywords. Table 1 lists the keywords identified.

Table 1. Keywords identified.

Area	**Keywords**
Factors that affect customer satisfaction	customer satisfaction
Customer satisfaction measurement	
Software development methodology	software development, agile, scrum, extreme programming, xp, kanban, lean, plan based, traditional, waterfall, rup, spiral, iterative, v-shape

Queries Proper search queries have been defined for each digital library. As an example, one of the quesry defined for the ACM Digital Library is the following:

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acmdlTitle:(software development) AND
acmdlTitle:(customer satisfaction) AND
acmdlTitle:(waterfall agile xp scrum extreme plan based
traditional kanban lean programming rup spiral iterartive
v-shape)
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2.4 Selection Process

The following sections are used to determine which studies are included and excluded through the definition of inclusion and exclusion criteria, an implementation of data extraction strategy, and data synthesis method.

Studies Selection Procedures The selection criteria are applied to the identified papers by one author and then verified by the other authors in accordance with the following criteria:

- Inclusion criteria
  - Available online to ensure paper accessibility
  - Focused on customer satisfaction factors to ensure its relevance
  - Focused on software development process to ensure its compliance with the study

  - Publication format of research paper (books, thesis, posts, videos, etc. are not included)
  - Written in English
- Exclusion criteria
  - Any paper that does not satisfy any of the inclusion criteria.
  - Papers written by the same authors describing the same factors.

Quality Assessment Procedures The following aspects where considered for assessing the quality of the individual studies:

- QA1: Is the study based on a focused question that is adequately formulated and described?
- QA2: Were inclusion and exclusion criteria for investigated studies predefined and specified?

The purpose of the quality assessment criteria is to develop a checklists to define the inclusion or exclusion of the identified studies.

Data Extraction Strategy To avoid errors and bias of the results, data extraction forms are used. These forms include:

1. General information
   - A date of Data extraction
   - A title and authors
   - Name of publication, year and other publication details
2. Study characteristics
   - Study design
   - Outcomes and interventions (if applicable)
   - Comments on limitations and generalisability that reviewers can identity after reading the paper

Synthesis of the Extracted Data The narrative synthesis includes:

- Study type (e.g., intervention, observational)
- Number and characteristics of participants (e.g., age, specialization, etc.)
- Description of interventions and/or outcome measures
- Study quality
- Discussion of heterogeneity (differences across studies)

3 Results

This section presents the quantitative results of this study. It starts with an overview of the sources where the studies were found (Figure 1). Then, it provides an overview of the included studies according to the year of publication (Figure 2). Finally, it discusses the results of studies classification, which show numerical results our SLR.

Search was executed in January 2019 and covered the years between 1985-2018. The final number of papers that were included for data analysis was 34 and a total of 276 papers were excluded (Table 2).

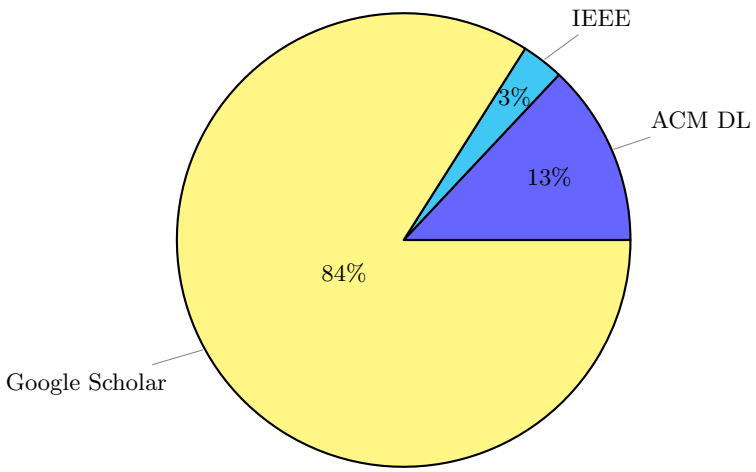

Fig. 1. Papers sources.

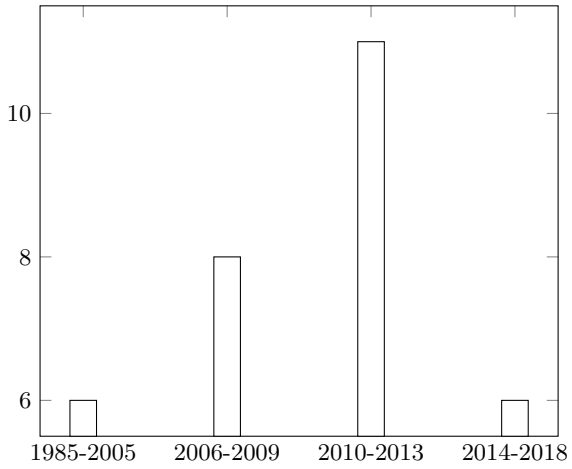

Fig. 2. Distribution of papers over the years

Table 2. Excluded papers.

Exclusion criterion	**Papers**	**%**
Lack of focus on customer satisfaction	99	34%
Lack of focus on software development	92	31%
Paper format	67	22%
Total	310	100%
Included	34	10%

4 Discussion

This section focuses on reporting the results of the SLR research questions. It reports on factors that affect customer satisfaction and how customer satisfaction is measured and evaluated.

4.1 RQ1: Factors that Affect Customer Satisfaction

This section shows what factors affect the Customer Satisfaction in Agile, focusing on SCRUM, ACRUM, and XP, and in traditional software development processes.

ASD One way to achieve a high level of customer satisfaction using Agile software development methodology is to increase the level of customer confidence. This can be done by:

- Clearly identifying the customer and their role [18].
- Characterising customers to enable the development team to manage better their expectations [18].
- Active client participation during the project [10] [1] [8] and active communication with customers and team members [3]. This increases the satisfaction, enhances the level of trust between the parties, and creates a feeling of "personal touch".
- Introduce practices such as on-site customer, planning, small release, customer usage test, etc. Where the customers can join the development process and identify problems and the product is modified or rebuilt iteratively to maximize its satisfaction with the final product [26].
- Ability to incorporate early and continuous customer feedback, thus better tailoring to features that are really used by customers and not to the features planned up-front [15].
- Ability to deliver meaningful functionality to the customer and get immediate feedback [21] [24] [23].
- Strong support after delivery [10].
- Understand how customer use a feature [10].
- Ability to deliver what customers want when they want [10].
- Establishing long lasting relationships between the development team and the customer [18]. [5] suggests also that a strong relationship has a long term economic value in terms of continuity of cash flows and saving in time and resources for starting new projects.

Several papers consider five characteristics of agile development (iteration, continuous integration, test-driven design, feedback and collective ownership) strictly linked to the customer satisfaction measuring satisfaction with the development process and with the development outcome (Table 3).

All the five characteristics have strong direct effects on both process and outcome customer satisfaction. According to [28], factors that affect customer satisfaction are:

Table 3. Development characteristics linked to customer satisfaction.

Characteristic	**Description**	**Correlation with process satisfaction**	**Correlation with outcome**
Iterative development	Quick delivery of small working (and tested) software releases at regular intervals or cycles [2]	0.75	0.81
Continuous integration	New code is integrated into the production base code continuously, ideally after each task is completed [2] [27]	0.65	0.74
Collective code ownership	Any developer has the right to add or maintain the code anywhere in the system at any time [2]	0.75	0.81
Test-driven development	Developers write tests before they code [2]	0.66	0.67
Feedback	Frequent feedback loop with customers allows developers to ascertain the accuracy of the functionality [9]	0.60	0.66

- Increase
  - Focus on shortening overall project duration.
  - Good communication (e.g., no last minute surprises).
  - Collaboration.
- Decrease
  - Late delivery and long project duration.
  - Defects.
  - Issues with testing and deployment.
  - Unclear requirements.
  - Bad documentation.
  - Hidden business rules.
  - Bad communication.

Notably, the project cost seems not an important issue for customers.

SCRUM There are mixed findings in this area. In [19], authors found that daily SCRUM meetings and planning meetings are helpful since they keep customers up-to-date and reduce the confusion about what should be developed increasing customer satisfaction. However, [4] reports that it was not possible to establish any evidence that using SCRUM may help to improve customer satisfaction and, consequently, increase the success rates of software projects.

XP All of the included papers dealing with XP show that introducing this technique makes a good impact on customer satisfaction.

- Factors that increase Customer Satisfaction
  - unit testing, refactoring, and feedback during the project [14]
  - acceptance tests and tracking [14]
- Factors that decrease Customer Satisfaction
  - Attempting to increase customer satisfaction through marketing and incentives, rather than based on true satisfaction with the product can actually harm the organisation in the long term [7].
  - The greater the customer involvement, the greater the potential for customer dissatisfaction [7].
  - Close customer involvement cannot make up for the failings of a development team. Instead of the customer perceiving that the involvement is helping the team meet the customers needs, the customer may feel obliged to exert authority over internal development decisions and may also feel mistreated by perceiving that the team is not delivering a valuable product [7].

As a separate factor, which negatively impact on customer satisfaction is changing requirements. However, [26], propose Agile practices such as positive work climate, final product adaptability, and willingness to change positively could mitigate this negative effect.

Table 4. Measurement approaches for customer satisfaction.

Approach	Description	Study
Rates	Evaluating the satisfaction on a Likert scale	[16] [22] [27]
Interviews	Semi-structured interviews with open-ended questions	[8] [10] [17]
Web analytic tools	Automatic mechanism for the evaluation of customer focus	[18] [23] [27]
Feedback reports	Acquired rapidly and at minimal cost	[18] [20] [22] [23] [28]
Meetings	Face-to-face discussion activities (often in a formal setting)	[8] [23]
Brainstorming	A group creativity activity to identify new features	[28]
Questionnaires and surveys	Set of questions with different formats	[11] [20] [22] [25] [27] [28]
Consultants, representatives	The most interested persons are chosen	[18] [22]

4.2 RQ2: Measurement of Customer Satisfaction

This section describes the approaches used to measure customer satisfaction in the included papers (Table 4).

Customer satisfaction measurement activities are impossible without consideration communication channels. [13] describes all common channels of communication and gives recommendations on their usage: Face-to-face communication is the default communication method in agile development. It has proven to be effective, so it should be applied whenever possible. Videoconferencing comes second in richness and the study suggests using videoconferencing in situations when effective customer communication and feedback is needed and the customer is not available on-site. Phone is not capable of transmitting visual cues, but it enables instant feedback. It can be useful for example for negotiating schedules with the customer. Emails are suitable for communicating well-understood issues.

4.3 RQ3: Evaluation of Customer Satisfaction

The most straightforward way for the evaluation of customer satisfaction is through interrogating them in a direct way through popular approaches such as interviews, questionnaires, meetings, and combinations of them. Within the 34 reviewed studies, we analyzed these approaches by the following criteria: the way of defining questions, collecting and analyzing information. This allowed us to define initial models for the evaluation of the customer satisfaction.

Interviews [17] used subjective means – customer interviews and surveys – which were structured to reduce the effect of influencing factors beyond the XP practices as much as possible. [16] collected information based on on-site observations, a research diary, and interviews. [23] conducted semi-structured interviews with open-ended questions. During 24 interviews, an interview guide consisting of three predefined themes: an organisation and current way of working, a customer interaction mechanisms/models and strengths & weaknesses in ways of working. In [10], the authors interviewed the team leader, the system manager, the system designer, and the function tester. At each customer unit they interviewed the person with which the customer-specific teams interact, and who has direct contact with the customer. Finally, they conducted interviews with a program manager, a product manager and an integration leader at the main development site to capture the context in which the customer-specific teams operate. In [1], researchers collected information using interviews with representatives of two North-European software companies: one is relatively young company and the second one is plan-driven organization with a long business history. They interviewed the developers and the project manager from the first company and the lead architect and technical manager from the second company in separate interviews that lasted about 60 minutes each. During the interviews, they asked narrative-pointed questions related to clients involvement and its impact on it that both covered a longer period of time and focused on specific events. The collected data were analyzed by means of thematic analysis techniques, because of the flexibility it offers to researchers. In [16], in each company, the project managers were questioned about their last completed projects, which had to be as the complete system for an external client or another department inside the company. Data collection was carried out by phone interviews with a web-aided questionnaire. Study participants were asked to rate the level of satisfaction of the projects customer using a 7-point Likert scale. In addition to the quantitative research data, qualitative data was also used. In [22], the interviewees were selected by key contact persons from each company, who were asked to nominate experts from Product Management, R&D, Validation&Verification and Sales&Marketing. All interviewees had a lot of experience in working in companies for long periods of time and in multiple projects.

Questionnaires In [5], to develop the survey instrument, the authors performed an extensive literature review to derive an initial pool of scale items. Then a structured questionnaire was constructed to capture information from an appropriate key informant within each organisation. The key informant was asked about the extent to which they agreed with a number of statements reflecting the use of the five agile characteristics in their most recently completed software development project, as well as the level of stakeholder satisfaction with that project. The instrument used was a five-point Likert type scale. The questionnaire, accompanied by a covering letter, was emailed to the listed contact in each organisation. A survey methodology to gather the information was used. The target population of this study consists of firms that use agile soft-

ware development methodologies. The respondents was obtained from the social network Linkedin. Then authors interviewed three experienced professionals working in software development with agile methodologies and two experienced researchers. The interviewees critiqued the questionnaire with regard to its clarity, completeness and the appropriateness of its measures. Researchers collected 102 valid questionnaires and analyzed them through hierarchical multiple regression. They used two regression models. First model was created by entering five control variables: organization size, project size, agility, customer collaborative attitude, and customer active participation. In the second model, they included the predictor (control and independent) variables. The results of the regression analysis show that the active participation of the customer was the most important factor. In [20], a survey composed of rapid customer-focused iterations was used. This survey constituted a guideline on developing their application based on customers feedback. The authors got in contact with 15 potential customers to gain insights from their feedback. They used a questionnaire based survey on 204 respondents to investigate Greek consumers familiarity with electronic food ordering and its applications. Their main goal was to understand customers opinion on what features an application should have so to increase their satisfaction.

Meetings In [26], customer collaboration improved by continuous meetings. In arranged meetings, customer represents or amends requirements. Also customers themselves decide whether they should submit some important changes. In [8], evolutionary project management is a highly scheduled process where weekly iterations follow a fixed schedule that defines responsibilities per day. For example, "on Fridays there is a management design review meeting for iteration N, on Mondays stakeholders test the product of iteration N-1". In [18], the authors attended daily team meetings, iteration sessions and training sessions. Such observations showed that there were large discrepancies between the document the team were working on and the actual user stories being discussed at these meetings. To establish the reliability and validity of the case study, researchers followed the three principles of data collection: use multiple sources of evidence, create a case study database, maintain a chain of evidence.

Combination of Methods In [18], data were collected through a variety of methods: unstructured and semi-structured interviewing, document review and observation. In [28], the authors used a formal and informal channels of communication. Formal: letters and documentation exchanges. According to this channel, everyone could communicate regularly. So that the organizational structure and management processes of the parties are well known to project developers. Project progress were reported weekly. Customer satisfaction surveys were carried out yearly. Then there is the informal communication way. The common ways are after-meals dinner, send birthday gifts, and group activities. In these ways, developers could understand customers situation, the progress of customer

care, customer satisfaction processes, and to understand the customer's internal culture.

5 Threats to Validity

Customer satisfaction and customer relationships tend to be a sorely unexplored and largely misunderstood aspect of software engineering [7]. Here we list three major threats, which can affect to our findings:

1. **Papers sources:** although the applied guideline recommends to consider about seven digital libraries for performing an exhaustive search, in our case only three beginning ones have been chosen. The reason of it is that the rest sources contain quite few amount of unique papers, so majority of them is overlapping in ACM DL and IEEE. Nevertheless, to extend the set of publications, also Google Scholar was used.
2. **Handling query results:** a way of automatically merging the outcome lists from that libraries is risky, because even single differing symbol in title might affect a lot. For that reason, 310 repeating papers were identified and eliminated manually for obtaining a merged list.
3. **Keeping results up-to-date:** it may happen that some information has not been included in the final table concerning empirical studies either because it was accidentally skipped or new studies appeared.

6 Conclusions

This SLR aimed to identify factors that affect customer satisfaction in Agile Software Development and explore the ways to increase it. The SLR included a total of 34 papers and excluded 276 papers that were published from the year 1985 till 2018 (33 years). The findings were quantitatively classified. Industrial practitioners can use the obtained information for their work to improve the level of customer satisfaction and increase the demand for their products. This study pointed out that there are a number of ways for measuring the level of customer satisfaction (Table 4). However, there is a lack of a comprehensive framework for measuring the different aspects of the customer satisfaction focusing also on the practices and approaches that can be actually adopted by practitioners in real projects.

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