

Lean UX: A Systematic Literature Review

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Abstract. The software industries often look for ways to remain competitive in terms of cost and time to market. Lean UX is a methodology aiming to achieve this. In this paper, by means of a Systematic Literature Review, authors outline the evolution of Lean UX since its origins, its challenges and benefits, and its definition by means of a systematic literature review. Results showed similarities of the definition of Lean UX, challenges and benefits regarding communication, user testing, team collaboration and the adoption of the concept.

Keywords: Systematic literature review · Lean UX · Lean User Experience

1 Introduction

Many software companies have started looking for newer and more effective methods to make software development more efficient [1] in order to preserve their competitive advantage [2]. Thus, organizations worldwide have keenly accepted agile development methods such as extreme programming (XP), SCRUM and lean software development [3–5]. Focusing on the later, the concept of "Lean" dates back to the manufacturing environments and is described with different synonyms such as: Lean Manufacturing, Lean Production, or Toyota Production System [6]. Ebert et al. [1] cite from [7] that Lean was first used in manufacturing to empower teams, reduce waste, optimize work streams, and keep the market and customer needs as the main source of decision-making.

In the software industry, further adaptations to lean methodologies have also appeared in recent years, and Lean UX is one of these adaptations. According to the Jeff Gothelf [8], the author of the seminal book "Lean UX: Applying Lean Principles to Improve User Experience", Lean UX consists of a combination of three fundamentals: Lean startup, Design Thinking and Agile Development philosophies. Lean Startup, the first pillar is presented in the book as a method for reducing project risk, by means of rapid development and learning using the feedback loop called "build-measure-learn". Like the lean principles, Lean startup focus on reducing wasteful innovations by solving problems for the real users with user-centered methodologies. The core concept of lean startup is that, in order to develop an efficient product, there must be a demand for it from the potential users [9]. To achieve this in Lean UX, the teams builds Minimum Viable Products (MVP) to answer hypothesis about the customer needs then learn from the feedback by the users testing the MVP [8]. Gothelf [8] describes Design Thinking, the second pillar, as a discipline in designers can use to design technologically feasible products based on direct observations of what the users want or need in

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their lives. Another description by Brown et al. [10] define design thinking as a method for designing solutions to problems by relying on the human minds capabilities to identify patterns, and the ability to form ideas with meaning and functionality. Gothelf [8] outlines the importance of Design Thinking in Lean UX, as this discipline encourages designers and non-designers to investigate every aspect, instead of a constrained environment. Furthermore, Gothelf [8] describes in his book that agile software development is a method for delivering working software continuously to the customers. He also explains that Lean UX applies four core principles of Agile development to product design. These principles are as follows:

- Individuals and interactions over process and tools: generate solutions rapidly by conversing and exchanging ideas with colleagues.
- Working software over comprehensive documentation: build solutions early and asses the solution for market fit and viability.
- Customer collaboration over contract negotiation: collaborate with colleagues and customers to build a shared understanding of the product. Reducing documentation, as team members have participated in the decisions.
- Responding to change over following a plan: Once developers discovers what's working or not, adjustments are made to test again with the market, keeping the development agile as market feedback pivot development in the right direction.

The goal of Lean UX is to produce products fitted for the consumer market, as fast and cheap as possible. This seems to be more important than ever, as the consumer market increasingly expects higher standards of user experience, and traditional development practices often won't fulfil these demands [11].

Lean UX is, taking all these aspects into account, a relevant concept for software workers. Moreover, to the best of authors' knowledge, there has not been conducted a systematic literature review (SLR) on Lean UX. In order to fill this gap, in this paper authors present a SLR to investigate the current definition and evolution of the Lean UX methodology, its challenges and reported benefits.

The rest of the paper is presented as follows: in Sect. 2, the authors present the methods for research. In what follows, the authors present and discuss the results or the tertiary study. Lastly, the authors conclude and present suggestions for future work in Sect. 4.

2 Research Methodology

2.1 Systematic Literature Review

To obtain an overview of the current literature, a SLR will be performed and presented in this paper. A SLR involves several activities for systematically extracting information about a chosen topic, and is defined as three stages, namely: Planning the review, Conducting the Review, and Reporting the Review [12]. These stages will be presented more thoroughly in this section. According to the literature, before starting a SLR, it is a prerequisite to identify if there is a need for such a literature review, by

investigating if it has been previously conducted [12]. As mentioned in the Introduction section, to the best of our knowledge there are not previous SLRs in the topic.

2.2 Review Protocol

A review protocol is a set of specified methods which is necessary for a literature review to reduce bias [12]. This subsection will present a review plan protocol based on the guidelines of "Procedures for performing systematic reviews" [12].

2.3 Research Questions

Four research questions are defined to investigate Lean UX. These are as follows:

- **Research question 1:** How is Lean UX defined in the literature?
- **Research question 2:** What are the reported benefits of Lean UX?
- **Research question 3:** What are the reported challenges of Lean UX?
- **Research question 4:** How has Lean UX evolved overtime?

2.4 Study Selection

This section describes the steps applied to find the literature in this study, such as which online databases are used in the search for literature, the search strategy, and the inclusion and exclusion criteria used to find the most relevant literature to this review.

Databases: The following databases were selected by recommendations of the library of Østfold University College for relevant databases in computing. The following databases were used to identify the current literature:

- ACM
- IEEE
- Springer
- Science Direct
- Google Scholar

As the first four listed above are large databases, they were used as main source of studies retrieved. But in order to identify other relevant studies conducted in the topic, Google Scholar was used to cross-examine.

Search Terms: To specify the relevance of each study to the research question, a specified search term was created. After a few trial runs, it was discovered "Lean UX" was defined differently such as "Lean UX", "LeanUX" and "Lean User Experience". Therefore, all these were included in the search term. The rest of the search string includes keywords relevant to the research questions and is presented as following: ("Lean UX" OR "LeanUX" OR "Lean User Experience") AND ("Definition" OR "Challenges" OR "Benefits" OR "Limitations" OR "Advantages").

Inclusion and Exclusion Criteria: After the search results were retrieved, a list of specified inclusion and exclusion criteria were applied to filter the most relevant studies. These are the following:

Inclusion Criteria:

- Literature that specifically discuss Lean UX at a theoretical or practical level.
- Literature that discuss advantages/benefits of Lean UX.
- Literature that discuss challenges/limitations of Lean UX.
- Literature that provide a definition of Lean UX.
- Literature only retrieved from the first 15 pages of google scholar.

Exclusion Criteria:

- Papers that are inaccessible.
- Books.
- Duplicates found in Google Scholar.
- Literature not written in English.

2.5 Literature Retrieval

In order to search and retrieve the relevant literature in an efficient and structured way, four stages were defined: The first stage was documenting the number of papers found in each database and google scholar. In the second stage authors retrieved the relevant articles based on the exclusion and inclusion criteria (accessible, not books, English written papers and matched with keyword Lean UX). In the third stage, authors read the title, abstract and keywords of each paper and selected the relevant papers. In the fourth and last stage, authors selected the primary studies after reading full text.

2.6 Data Storage

The retrieved literature was systematically organized in the program Zotero (reference manager). Furthermore, a table with a list of the retrieved literature was used to highlight the importance of each paper with color codes.

3 Results

In this section, the results from the review protocol will be presented and discussed to answer the research questions previously defined.

3.1 Studies Retrieved

In Table 1, the number of papers retrieved are displayed from the different stages of literature retrieval. Stage 1 displays how many results appeared in the search results, stage 2 is the number of results when excluding books, and locked articles. Stage 3 are the number of selected papers based on title, abstract, keywords and conclusion, and stage 4 is the number of selected papers after a full text read had been conducted. 11 papers were left to present in the results from the literature relevant to this systematic literature review. The literature review was performed in the first quarter of 2020.

Table 1. Number of papers considered per round

Source	1	2	3	4
ACM	83	35	9	4
IEEE	35	20	6	5
Springer	73	14	2	1
Science Direct	30	5	1	0
Google Scholar	820	25	11	2
Total	***1041***	***99***	***29***	***12***

3.2 RQ1: How Is Lean UX Defined in the Literature?

In the reviewed literature [9, 13–16], the contextual background of Lean UX are mostly taken from the definition of Lean UX from the seminal book [8] by Jeff Gothelf. The content of this book will not be presented as this book not part of the primary studies. Instead, to answer this research question, this paper will present the most presented and described aspects of Lean UX retrieved from the literature.

Liikkanen et al. [14] state that Lean UX is defined as a fast user-centered approach for development, especially for startups. Furthermore, Liikkanen et al. add that the goal of Lean UX is to produce a product with minimal resources used as fast as possible, that will satisfy the customer needs. Tonkin et al. [16] provide a similar definition, in which Lean UX is a fast and cheap methodology, with less focus on detailed documents or long user studies, focusing rather on creating minimum viable product(MVP) prototypes to be rapidly and iteratively released and tested with the representative users, with hypothesis to validate the MVP created. This form of iterative deployment and feedback provide knowledge from the users to guide the design process. [17] also provides a description of the concept of the MVP cited from [18], as launching something smaller to start learning early instead of creating a product for months with an extensive number of features that the end user might not even want then launching. [14] also claims that the MVP is the core concept of Lean UX, where the idea is to build the most basic version of the product to test, and if the MVP gives no viable results, then the idea should pivot.

Other definitions are also provided by papers such as [14], in which the authors pointed to the community that has created a Lean UX manifesto [19], in the way of the Agile manifesto [20], where they present six key principles of Lean UX:

- "Early customer validation vs. releasing products with unknown end-user value,
- Collaborative cross-functional design vs. lonely hero design,
- Solving user problems vs. adding cool features,
- Measuring key performance indicators vs. undefined success metrics,
- Applying appropriate tools flexibly vs. following a rigid methodology,
- and Nimble design vs. heavy wireframes or specifications."

Even though the primary studies provide proper definitions of Lean UX, they still have most of its content extracted from the book [8] suggesting that the book is the main source of information regarding Lean UX in terms of its definition. Other sources,

such as the Lean UX manifesto, also cited in one of the primary studies, suggests that other sources of information could be interesting to investigate to broaden the definition of the term.

3.3 RQ2: What Are the Benefits of Lean UX?

Better Market Fit: Beverley Cook and Philip Twidle state that applying Lean UX highlighted early assumptions about their game design and allowed for continuous changes throughout the development fitted for the user [21]. This form of continuous user-validation led to a mobile game achieving its goal by altering and validating the game-design according to the user feedback. Contrary, [22] reported that lack of testing resulted in loss of UX and challenging technology to work with. As a result, this project chose a technology stack three times expensive to develop and time to reach the market. [23] promotes Lean UX as beneficial for businesses to understand the product value as early as possible, and further states that traditional UX techniques often won't apply to rapid and iterative development, because of time limits to deliver UX paralleled with a developed product. The author further suggests applying Lean UX as an alternative to solve this issue, where the MVP model is a central part of this. [24] even states that the MVP and "build-measure-learn" cycles were invaluable to find unique Russian design elements, when they applied Lean UX principles to understand the emerging market, specifically to Russia. Further, they conclude that even resources were saved when trying to answer their hypothesis, as they would only develop a simple prototype, rather than completely developed pages, with large amounts of design elements. [16] discuss in their paper that the current human-robot-interaction literature lacks guidelines for user experience for social robots. In this paper, the authors present an HRI-adapted Lean UX design methodology specifically for commercially available social robots using the MVP model to validate and invalidate design hypothesis of user needs regarding their robot. This model proved to be successful, improving user experience of the social robot placed at an airport.

Improved Team Collaboration: [13] suggests applying Lean UX to interdisciplinary student teams. They claim Lean UX to be beneficial to eliminate uneven workload as the individuals felt more certain to their project and the group discussions were more focused on the important aspects of the project. [9] adds that [8] stated that Lean UX provides methods for teams to become more cross-functional rather than separating designers from the technical implementations and business needs. In [15], authors outline that it was challenging developing good quality UX in their project if the whole team was not part of the team throughout the project. They suggested that all the team members should be involved from the beginning to end of the project to prevent this problem. [9] also suggest that Lean UX is beneficial in teaching UX. They claim that Lean UX was useful to decide what type of activities and designs were necessary for the students' progression, and that Lean UX provides foundations for interdisciplinary teams to collaborate by letting the students work together across multiple disciplines, creating a shared understanding of the design problems and preparing them for the workplace.

It would seem that Lean UX provides a great method for developing products fitted for the consumer market. Based on the findings in this SLR user testing seem to be a central part of Lean UX which provides great benefits to the business, as this part of development provides insights for which direction the product should take. Examples of this could be understanding what type of technology to use, testing design alternatives, validating whether the concept is doable or not, or even small design choices as cheap and fast as possible in throughout development. Furthermore, the findings in this SLR suggest that not testing thoroughly in a Lean environment could lead to a series of problems to the product, which could be uncovered at early stages. Indicating that testing is crucial for successful Lean UX development. Furthermore, one could argue that Lean UX is very beneficial as the product is assessed across multiple disciplines (such as designers and non-designers) which in return might lead to a high-quality product. This is, however, not always the case, and it's seen as challenging producing the same quality work when team members are missing. Lean UX is also seen as beneficial in other types of scenarios such as educational, providing new ways of teaching and learning. Another scenario could be using Lean UX principles to create new methodologies. This suggests that the principles of Lean UX can be applied to a variety of different settings.

3.4 RQ3: What Are the Challenges of Lean UX?

Communication: [15] discuss the importance of clear communication in Lean/agile environments as each part of the project must be consistently aligned and coordinated during the project, and the longer it takes to transfer tasks or knowledge across the team, the more context is lost. [15] also stated that they learned that poor communication often led to misunderstanding the feature requirements or the user context resulting in the team not performing as agile as possible. [25] outlines that in large organizations, with engineering as a dominating field, applying Lean UX are often challenging. Like [15], [25] suggest communication is crucial because the rapid pace of Lean UX, with team members assuming the implementations are correctly implemented by other team members if they are not present in the meetings. The challenging part of communication described by [25] is that a common notion about Lean environments from UX people is that it doesn't require design documentation, which often leads to miscommunication, especially in large, complex teams. However, in [25] authors present four communication strategies to help team members to communicate more effectively. These strategies are coined in the paper as follows:

- Employ a design framework,
- Maintain multiple prototypes,
- Use communication methods that fit your audience,
- Leverage agile use cases.

The authors suggest that these communication strategies should help UX communication be more effective without complicating the organizational structure.

Adopting Lean UX: In [14], authors present their experience adopting Lean UX in their company, an organization which delivers enterprise-ready front-end solutions. They outline small challenges such as allocating enough people to all the roles of an optimal Lean UX team, when the current team isn't large enough. To fulfill this, investments in training current UI developers on dealing with customers must be faced. Furthermore [14] states that the distribution of decision-making processes is challenging when adopting Lean UX in the case of large client organizations. The closer the client organization reaches the core business model during development, the harder it is to apply the startup mentality and pivot the business model, as more stakeholders are involved in the process.

Communication is seen as an important aspect to achieve success in Lean UX, as the development progress rapidly. If the individuals have issues with reporting their work, this could lead to fractures in the development as the team is dependent on each other's work. In organizations in which their structures are built on agile methods, adopting Lean UX in these organizations seems to be challenging, as organizational structures and mindsets must adapt accordingly.

3.5 RQ4: How Has Lean UX Evolved?

In order to investigate the evolution of the interest of Lean UX in the primary studies, in Table 2, the number of papers published each year discussing Lean UX from this systematic literature review is presented.

Table 2. Number of papers published by year

Year	#
2011	0
2012	1
2013	1
2014	2
2015	0
2016	2
2017	1
2018	4
2019	1

The results in Table 2 indicate that the evolution of the concept Lean UX has been discussed moderately over the past years, but not extensively. The results also indicate that the concept is quite new, suggesting that most of the discussion regarding Lean UX originated after the release of the book written by Gothelf [8] in 2013. [22], however, discussed UX in Lean environments in 2012, but without the definition provided by Gothelf suggesting that UX in Lean Environments have been thought of before the book. Larger corporations such as PayPal has also integrated aspects of Lean UX to their agile processes when shifting from a waterfall process [26]. In any, case the

evolution of the concept is quite moderate and apart from 2018 in which four papers were published in the topic, the rest of the years present zero, one or two papers published.

4 Conclusion

This paper presents the results coming from a SLR conducted on Lean UX, with the goal of giving an overview of how Lean UX is defined in the literature, what challenges and benefits of applying Lean UX, and its evolution in the literature since its beginning. Four literature databases (ACM, IEEE, Springer and Science Direct) and Google scholar were used to gather 12 primary studies. The origin of Lean UX was the book written by Gothelf [8], which was also the main source of reference in most of primary studies with regards to the definition of the concept. It was however apparent, that many of the primary studies provided a similar definition of Lean UX, such as it being a concept for reducing time and resources to reach the market as fast as possible, with the concept of the minimum viable product being a core aspect of achieving this, by continuously user-test the MVP with the respective user to answer design hypothesis until the product reaches its goal. It was also presented in one of the papers, that community made definitions have also been defined. Challenges and benefits of Lean UX are also presented in this paper, such as the importance of user-testing to create a product wanted by the market, the effects of team collaboration or how challenges regarding communication can affect the effectiveness of work and the challenges of adopting the concept in larger companies. It seems Lean UX is being increasingly discussed in the literature and adopted with companies such as PayPal adopting the concept.

For future work, it would be interesting to perform a multi vocal literature review, as the results of this paper are quite few, and indications for more documented definitions and guidelines of Lean UX on the internet (such as community made) are found in the results. It would also be interesting conducting case study comparing Lean UX to other methodologies, to investigate the effectiveness of Lean UX.

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