

A THEORETICAL FRAMEWORK FOR ADDRESSING LITTLE DESIGN UP-FRONT IN AGILE PROJECTS SETTINGS

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ABSTRACT

Agile paradigm, due to its historical proximity with software's world, finds itself mostly connected only with some areas within design field, such as Interaction Design and Usability. This is the reason why the scope of this investigation will try to widen it to Design Thinking, which is underexplored nowadays and will enable us to focus more on conceptual phases of product creation. A really relevant theme from the design and agile conjunction is Little Design Up-Front, LDUF, which corresponds to the minimum amount of design to be developed in each project cycle in order to prevent waste generation in the future. In spite of its mentioned relevance throughout literature, this issue is still not addressed in a full methodical form by design. We hypothesize that it can be addressed through the exploitation of a theoretical foundation for LDUF in three dimensions: Lean Thinking, Incremental Innovation and Design Thinking. Here we will develop a theoretical comparative analysis within this framework, which will enable to come up with preliminary theoretical implications for design field in further studies regarding Little Design Up-Front. This study is part of an ongoing larger research that aims to promote strategic alignment between design activity and the context of agile software development.

Keywords: design thinking; design methods; agile methodology; incremental innovation; lean thinking.

INTRODUCTION

The process of “new product development” must integrate activities from its conception until its marketing, containing, among others, a process of design^{1 2}. That said, what might be the implications for design when the management model of its activities shall be based on short and highly iterative cycles aimed at innovation as in the case of agile methodologies? On a more immediate and initial analysis, agile paradigm can supposedly address the need raised by Reid and colleagues³ of a flexible and dynamic model to respond quickly to changes tactics in design’s activities. Moreover, it is interesting to note that the integration of design with agile methodologies opens up a perspective to develop an evolutionary product where success is measured not only by “software testing”, but also by incorporating proper changes due to the impossibility of predicting user behavior in the beginning of the project⁴.

While traditional management methods, such as Project Management Body of Knowledge, PMBOK⁵, focus on long planning, the framework proposed by Scrum (and other agile methodologies) brings an iterative way for products development, aiming primarily at speed and flexibility⁶. It arises from companies’ need of innovation where, consequently, the variability of planning and execution for a given problem is very large⁷. Iterative models work with short-term planning, allowing the team to focus more efforts on the understanding and development of a problem⁸.

As agile, design practice is also usually conducted in a highly iterative way⁹. Despite this overall synergy, it is necessary to explore their conflicts as opportunities for scientific contributions. It also is important to expand their relationship, especially when considering the process of “new product development” as a whole, an initiative that can naturally integrate teams of various backgrounds. This argument is endorsed by the fact that 36% of companies adopting Scrum are already located in areas not linked to technology¹⁰. The immediate consequence of having a technology-oriented focus for design is the occurrence of little to no discussion on the steps of problem definition or “product discovery”¹¹. That is to say, to explore the possibility of using a different design perspective (other than Usability or Interaction Design) that delves strongly in conceptual stages while still allows multidisciplinary work, as expected by agile methodologies. Therefore, we will make use of Design Thinking^{12 13 14} as our design perspective, so it can embed meaning during product development^{15 16}.

Among the most relevant topics in the conjunction of design and agile paradigm, Little Design Up-front, LDUF, is currently one of the foremost concerns, whereby design work should be conducted in small portions throughout the project especially the beginning of the project^{17 18}. On the one hand, design classically expects to generate all or most of its specifications early in the project^{19 20}. On the other hand, the expectation of agile methodologies with LDUF is to minimize waste generation during project execution — large amount of designs being discarded in the future. It is expected that all development activities, including design’s ones, to be conducted in an emerging way.

Considering all the arguments presented, it is clearly necessary to widen the understand and update the connection of design with agile product development scenario, especially with regard to the ability to integrate multidisciplinary practices and deepen the product discovery phase in the light of organizations' contextual restrictions²¹. More specifically, we will deal with the formulation and discussion of a theoretical framework to address Little Design Up-Front in the context of agile project through a currently overlooked design facet that is Design Thinking (for product perspective), complemented by Incremental Innovation (for business perspective) and Lean Thinking (for process perspective).

METHODOLOGY

The research developed here brings an initial review of the literature²² and a theoretical reflection centered in the context of placing design activities within Agile projects, with particular interest in the topic of the Little Design Up-Front. By summarizing actual findings made by other researchers, the goal is to identify proper and relevant research questions by searching gaps, which will clearly characterize the scientific opportunity to be addressed by us.

Following the descriptive theory's construction cycle (observation, classification and defining relationships)²³, we will note by our review of the literature to which extent the issue of Little Design Up-Front is "observed". Beyond that, our contribution mainly focuses in the stage of "classification", where frameworks are built to categorize the observed phenomenon²⁴. We did so because it was identified an explicit need to provide a theoretical component to define the perspective under which the issue of LDUF would be analyzed, Bhrel and colleagues²⁵ denoted that as "contingency factors". So we synthesized and compared three complementary perspectives that can possibly address the identified research problem. We chose the dimensions of: product, business and process on LDUF to be viewed through the lens of Design Thinking, Incremental Innovation and Lean Thinking (our theoretical framework).

Not limited to describe and further theorize on LDUF's phenomenon, our research also aims to provide a methodical solution for it, so we found suitable to follow the phases of Design Science Research methodology, DSRM, as it serves for the creation of things for human purposes²⁶. These authors divided the steps of DSRM in: Problem identification and motivation; Define the objectives; Design and development; Demonstration; Evaluation and Communication. For now, what we aim with this work is to address DSRM's initial two steps, as we will characterize the problem with a review of the literature and derive our objectives through a specific set of criteria based on our theoretical framework.

It is important to note that design by itself, which may occasionally be one of Design Science's

interpretation, is not inherently scientific²⁷. So it should be emphasized that for the completion of descriptive theory's construction cycle, and especially its transition to a normative theory²⁸, there are still steps to be further addressed in the future. The work presented here is part of a larger ongoing PhD research, so preliminary results obtained here will enable further developments to be validated by empirical works later.

RESEARCH PROBLEM

The conjoint context of design and agile paradigm as a research topic is highly relevant and prevailing, especially considering the discussion of one of its most prominent themes, which is Little Design Up-Front, introduced previously. The issue is still open and there is room for new contributions, as some researchers report that there should not be room for much design at the outset^{29 30}, while others making the case where a certain amount of design should be conducted earlier in the project^{31 32}, and others bringing a combination of the two, with design going a cycle ahead of development³³. The incorporation of LDUF concept in the product development process results in better products perceived from usability's perspective — easier to use, learn and require less support in use³⁴. Being conflicting with a traditional view of design, the theme of Little Design Up-Front is very relevant with regard to the implementation of design activities in agile context, as can be seen by the occurrences ranking in Figure 1 (similar finding noted by Silva and colleagues³⁵).

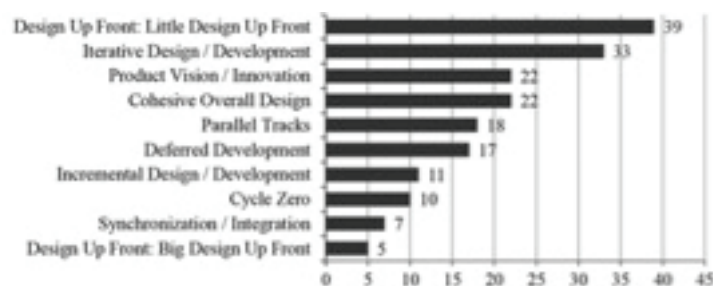


Figure 1 - Frequency of mentions in related works (Brhel et al., 2015)

Ferreira and colleagues³⁶ state that a certain amount of design must be conducted at the beginning of the project and that it should be primarily guided by the amount of risk introduced to the project, but it is not reported on this decision-making process in much detail. Adikari and colleagues³⁷ conducted an experiment to test specifically the inclusion of LDUF in the context of a project, which revealed the benefits indicated previously, but again it is not informed

in detail the methods to achieve it. Brhel and colleagues³⁸ suggest that a more structured way of handling the LDUF is by separating the stages of product “discovery” and “creation”, furthermore, unlike Ferreira³⁹, these authors report that there is still no clear definition on this subject with regard to the appropriate level of effort to be devoted for it in the project. This argument is partially corroborated by Silva and colleagues⁴⁰ by reporting that most of the studies reviewed by them do not state in detail the methods used to treat LDUF, limited to bringing only some examples of related efforts but that does not specifically address it. Bhrel and colleagues⁴¹ codified LDUF and design methods in different categories in his review and made no relation between them. While LDUF is important, the integration of design activities with the development ones still needs to be well addressed⁴².

With regard to the use of Design Thinking, Frye and Inge’s research⁴³ is a closer example to ours, which sought to analyze the implications of Design Thinking in an agile environment through product owners’ perspective. Other works related to ours were the ones developed by Lindberg and colleagues^{44 45}, where they performed a comparative analysis of Design Thinking and software development’s perspectives - implications, similarities and differences among them. These works certainly can provide us some guidance and deal with practices related to our research, but have different goals and focus in comparison.

Overall, the first opportunity of scientific collaboration we identify is to show clearly the concept of what would be LDUF from design’s perspective as a discipline, since the term “design” can also refer to architectural aspects of software^{46 47}. The second and most important opportunity is to develop a methodical way to establish the minimum and adequate definition for “product discovery” in agile context, that is to say, what is the ideal balance of design to be done up-front in the light of contextual organizational aspects, as suggested by Brhel and colleagues⁴⁸. As for these factors, we choose here: product, business and process dimensions, so our research works respectively under three perspectives: Design Thinking, Incremental Innovation and Lean Thinking. The purpose of making use of these areas is two-folded: provide scientific rigor in dealing with Little Design Up-Front and highlight the integrative role of design as a discipline. The developed framework will allow a theoretical analysis of implications (synergies and complementarities) in the conjunction of these three areas.

THEORETICAL FRAMEWORK

Design as a management tool has been important since the 1960s as it was perceived that, besides aesthetical benefits, it could also generate financial gains⁴⁹. Being strategic, design should primarily address needs in two vectors: users and organizations^{50 51}. Often, these dimensions may present themselves in a conflicting manner, for example, a demand

for a particular feature may increase product's costs for the developing organization. Whilst these groups of needs may be conflicting, they have a direct influence on one another⁵², so the appropriate balance between them is essential to the success of any design initiative. A designer will rarely handle a given problem without any constraint, so she should always be concerned with an assessment against contextual criteria, such as cost⁵³. But the design process should not be based only on production's cost, if that occurs, it might happen at the expense of leaving out other equally important criteria — either technical and economic — that often can not be measured financially⁵⁴. Therefore, the designer must also take into account a wide range of organizations' needs prior to evaluating and selecting a solution to a given problem⁵⁵. As stated previously, in our case we chose three dimensions to be considered while handling Little Design Up-Front: product, business and process needs, which will be further detailed in the following subsections.

Design Thinking for product dimension

Through the analysis of recent studies concerning design's execution in an agile environment, we can see that this paradigm finds a stronger connection with only a few areas within design field, such as: Usability or Interaction Design^{56 57 58 59}. Given the historical connection of agile methodologies to software development⁶⁰, it is natural to expect this specific focus inside design. But at the same time, this leads to the fact that most of the studies regarding Usability in agile projects are mostly located on more advanced project phases, such as implementation (50%) whereas only a few are done in more conceptual ones, such as requirements (22%)⁶¹. However, at the time of designing products and considering its whole lifecycle, a designer must acknowledge that its project is only a phase of alignment among stakeholders' interests and that its final result must dialog with an existing "ecologies of devices" (a concept drawn from Krippendorff⁶²)⁶³. In moving towards this direction, that is why the dimension of product will be addressed by Design Thinking in our research, which solely represents a relevant scientific advance for design in terms of a newer perspective for this discipline inside agile project environment.

It is a useless effort to try to define Design Thinking through a single perspective⁶⁴. The way "design thinks" can be divided into two major discourses: Designerly Thinking and Design Thinking⁶⁵, a similar position is given by Kimbel⁶⁶. The first being a purer academic form, and focused on the design itself, while the second is an extension or appropriation of design thought for the segment of organizational management with less scientific rigor. For the sake of simplicity, we will use the term Design Thinking, despite our efforts point towards Designerly Thinking, according those authors' classification.

Our guidance for products conception is close to what Dorst⁶⁷ called "Abduction-2" which is

suitable when the designer still has no clear notion of the “what” (object) or the “how” (working principle) to deliver value to the user. The author mentions that it is a more complex way, but closer to the practice of design thinking, where the designer creates new “frames” for treating a particular problem (new working principles leading to new values to users). The configuration of these new frames should be guided by a number of criteria for the design product, which are usually defined by industry standards or customers, for example⁶⁸.

Regarding the location of Design Thinking activities during new product development process, our larger research in which this work is included will use the approach classified as “front-end”⁶⁹. It places Design Thinking in the beginning of the project, before any software coding, for example. According to Lindberg, this approach allows an easier integration of Design Thinking practice in software development environment, since the conflicts among domains are minimized. Linking this to Design Up-Front’s theme, a certain amount of design being done at outset has a positive impact on user satisfaction, mitigates risks and helps keep the budget and the schedule under control⁷⁰. These authors’ argument relates to Interaction Design practices, whereas ours will observe the same phenomena through Design Thinking, representing a newer perspective for design discipline.

Lean Thinking for process dimension

Lean Thinking can be understood as a set of practices that analyzes organization’s value chain and aims to maintain only what quickly creates value for the customer⁷¹. This may be of design’s interest considering Little Design Up-front’s need to generate the smallest amount of waste. Lean paradigm, with respect to process modeling, is based on systems thinking: structure guides behavior⁷², so Lean Thinking’s perspective might be relevant to observe the dimension of design process in our work. Poppendieck⁷³ listed four principles of Lean development and, due to its historical connection with manufacturing, transposed them to software development. Among four principles listed by the author, we selected three most related to product process itself:

- Add nothing, but value (eliminate waste): develop only the most important features and detail only requirements to be worked out in the current cycle.
- Flow value from demand: deliver only what is perceived as value and pulled by demand.
- Optimize across the organizations: transactions and integration between departments should be less costly as possible.

Complementarily, Reinersten⁷⁴ listed the twenty-two principles focused specifically on reducing the size of (job) batches, which may be understood in the context of our research as an attempt to address LDUF. Among those, we selected four principles more focused

on processes related to product development:

- Reduce product cycle time: get feedback more quickly and possibly increase earnings per cycle.
- Loose coupling of subsystems: the architecture should maximize to the full inclusion of new components with low impact.
- Sequence first that which adds value most cheaply: reduce the financial exposure to cumulative risk, this creates a convexity between the curves of benefits and costs accumulated over time.
- Adjust batch size to respond to economic changes: aspects that lead to the optimal batch size change over time, especially costs.

Lean Thinking evolved sufficiently to be applied across organizations and industries not directly related to manufacturing⁷⁵, moreover there is already a large number of mature enough tools associated with this paradigm that might be used when mapping value^{76 77}. In our work, the context is set by design being applied to produce digital artifacts in the agile paradigm, so it may be interesting to analyze which aspects of the design process add value to the project regarding LDUF.

Incremental Innovation for business dimension

Incremental innovation will serve design with specific directions regarding business viability of the product in an agile context. Conversely, Verganti⁷⁸, extending Krippendorff's perspective⁷⁹, positions design as a new meaning creation tool which is essential to innovation processes⁸⁰. Design as a practice must learn to continually integrate business needs, especially in an incremental scenario as the one set by agile projects. Norman and Verganti⁸¹ defined incremental innovation as being: 'performed as a result of a deliberate design research strategy or through a series of mutual adaptations by the product developers and the use community to bring the two into better alignment'. Regarding the extremes of radical and incremental innovation, these authors state that they are in fact complementary, since the first sets new possible limits on a product, while the latter allows better capture the full potential of this radical change. This statement is endorsed by Varadarajan⁸² who goes on to list a number of important roles of incremental innovation in the competitive strategy of companies, such as: adaption or entrance into new markets.

Some studies weigh heavily on pioneerism for success in a particular market, while others point success as strongly associated also with other factors such as lower risk and development cost, which can be obtained by "followers" more associated with the practice

of incremental innovation⁸³. During the practice of concurrent engineering — overlapping stages and functions in the development of new products (similar to agile) — incremental innovation is positively associated with superiority on the developed product and reduction of development time⁸⁴. There is a number of factors that favors the practice of incremental innovation, such as: environmental dynamism and structural linkages within an organization⁸⁵.

Incremental innovation can be classified into three types: continuous, modified or process⁸⁶. “Continuous” corresponds to the extension of existing products lines, “modified” deals with the introduction of newer technology and “process” which relates to improvements in the production of a certain product. As can be seen, incremental innovation has a set of characteristics, which can be supportive to design as being able to deliver the expected business value to its costumers in the context of an agile project.

Discussion

Tim Brown⁸⁷ defines Design Thinking as a discipline that methodically addresses people’s needs while being viable (business) and feasible (technical). From his definition, we can restate Design’s role as an integrative discipline, which is crucial for our theoretical framework as a whole. To set project context, we intend to use Scrum as agile framework⁸⁸, because it is less focused on software practices⁸⁹ and introduces new theoretical implications which are not observed in traditional project management methodologies^{90 91}.

Like Scrum, Design Thinking is an action-based practice (delivers working software and prototypes, respectively) and fosters collaboration. Despite these similarities, there are some points of discrepancy, for example, Scrum’s lack of clear distinction between users and clients roles⁹². Also, a crucial point is the transfer of design knowledge at the interface to later development stages, for which is still needed a *modus operandi*⁹³. It is in this context that the problem of the Little Design Up-Front is brought up, which we will analyze and intend to address by multiple perspectives, as depicted in Figure 2.

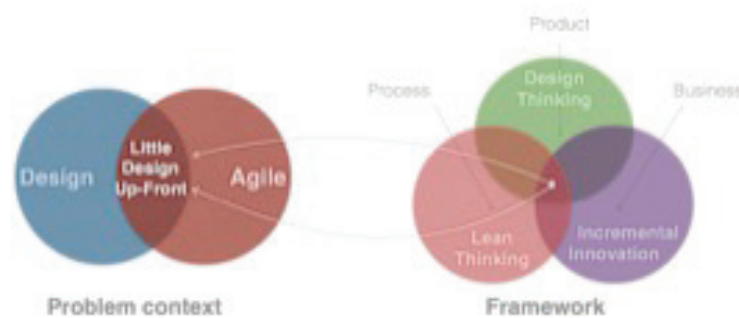


Figure 2 - Theoretical framework for addressing research problem context

Despite the fact that Design Thinking might introduce some steps or results that can be seen as “waste” by Lean, it is seen as essential to deliver higher quality results and minimize rework in the long run⁹⁴. Therefore, it is necessary to find a proper balance between market-pull (market demand) and technology-push (creating new demands) models while the artifact being created still makes sense in a wider ecosystem^{95 96}. This conflict is especially evident if we consider the principle of “abduction-2” as being closely related to Design Thinking⁹⁷, which means that designers does not always have a preview or full view of the product to be developed. This can potentially clash (and be complemented) by Lean’s principles for process efficiency. This efficiency, when considered on cross-organizational interactions, is essential to create a proper environment for innovation — either radical or incremental⁹⁸. Hence the importance of Lean paradigm principles for Design Thinking, in order to promote interdisciplinary integration in the context of Little Design Up-Front on agile projects, where designers must constantly interact with various stakeholders in many short, iterative cycles.

Incremental innovation should be understood as the result of, not only individual, but mainly team effort⁹⁹, which aligns with the multidisciplinary collaboration approach promoted by Design Thinking. Following Koberg and colleagues¹⁰⁰ classification for incremental innovation types, it is expected that agile project context itself strongly stimulates “continuous” incremental innovations (product improvements), so it may be essential the role of Design Thinking in promoting “modified” incremental innovation for insertion of new technologies or creation of new “frames” during problem solving, according to Dorst¹⁰¹. This meaning construction capacity introduced by Design Thinking can prove valuable, since the context of agile projects tends to prioritize mostly incremental progress, which may limit divergent thinking¹⁰².

Most organizations change in a evolutionary manner, that is, enhancing part of its activity¹⁰³. Back to the classification proposed by Koberg and colleagues¹⁰⁴, another type of incremental innovation is the “process” improvement one. This type that can be easily attached to the principles of Lean Thinking, as pointed out by Chen and Taylor¹⁰⁵: ‘the continuous improvement initiative in lean is likely to have a positive impact on incremental process innovations’. At the same time, these authors also state that Lean’s excessive need for compliance can limit innovation capacity as a whole, so they advocate a better balance between creativity (innovation) and structure (lean) to make the best of both worlds.

It is through this perspective triad (Design Thinking, Incremental Innovation and Lean Thinking) that the occurrence of Little Design Up-Front will be handled. The goal is to make use of the shown synergies, and especially exploiting their internal differences in order to provide greater balance to design activity. The construction and discussion of this theoretical framework is the first step in this direction. As stated in our methodology section, the analysis of this framework will serve as the requirements¹⁰⁶ (or meta-requirements¹⁰⁷) for defining specific objectives in addressing LDUF.

CONCLUSION AND FURTHER RESEARCH

The work presented here represents an initial effort as part of a larger research conducted by the author in order to address Little Design Up-Front in the context of agile paradigm projects. The current result is the development of a multidisciplinary theoretical framework to be used by this and possibly by other related researches to discuss ways to systematize LDUF addressing. In this present time, the framework has not been tested as a whole, but each part is much discussed and worked individually with some success. The next step is to further develop this study and assess the level of fulfillment regarding LDUF by the combination of the detailed practices.

We showed that, nowadays in the context of agile paradigm, there is a tendency to handle design's perspective only by some of its specific segments more linked to software interface development such as: Interaction design or Usability. Considering design's wider specter, this represents a gap, especially as agile methods are increasingly used out of pure software domains. Therefore, the use of Design Thinking is an advance for design as a scientific discipline, with very few related works that report its inclusion within agile context. In addition to that, we complemented it with Lean Thinking and Incremental Innovation's perspective, as these fields can offer a better balance for the process and business dimensions in dealing with LDUF.

As future work, our research will evolve towards a more empirical direction, consisting of two phases: First, evaluate the perception of agile project stakeholders on Little Design Up-Front's issue, identify whether there are and which methods are used by them for it, confront them with previous studies data and verify the applicability of our proposed framework; Second, integrate the principles of Lean Thinking and Incremental Innovation into Design Thinking's practice and conduct an experiment with software startups that use Scrum and are in the stage of conceiving a new product. They will be randomly "treated" and, finally, have each teams' perceptions compared with regard to addressing Little Design Up-Front with and without our approach. We hope to cover the remaining steps for theory building¹⁰⁸ by executing the full cycle of Design Science Research methodology¹⁰⁹, as discussed in our methodology section.

The general purpose of our research is to handle the "product discovery" stage, a need related to Little Design Up-Front as proposed by Bhrel and colleagues¹¹⁰. Furthermore, as can be seen in the categorization assembled by the these authors, LDUF has not been addressed methodically (or have its related methods made explicit), something also noticed by Silva and colleagues¹¹¹ (2011).

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