LightCDD: A Lightweight Capability-Driven Development Method for Start-Ups

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Abstract. Novice innovators and entrepreneurs face the risk of designing naive business models. In fact, lack of realism and failing to envision contextual constraints is one of the main threats to start-up success. Both the literature and the responses we gathered from experts in incubation confirm this problem. Capability Driven Development (CDD) is an integrated approach consisting of a method, tools, and best practices. It has proved to be successful when applied to mature enterprises that intend to become context-aware and adaptive. In this paper we report on the application of CDD to two start-up projects and how, despite being useful in making the entrepreneurs aware of dynamic business environments and constraints, a trade-off analysis showed that a simpler version of the method was necessary. Therefore, we present LightCDD, a context-aware enterprise modelling method that is tailored for business model generation. It reduces the set of modelling constructs and guidelines to facilitate its adoption by entrepreneurs, yet keeping it expressive enough for their purposes and, at the same time, compatible with CDD methodology. We also discuss what implications this simplification has with regard to the CDD tool environment.

Keywords: Capability-driven development · Entrepreneurship · Context-aware business model · Start-up incubation · Business model generation

1 Introduction

By exploiting the niches and offering novel products and services, enterprising individuals with economic initiatives may create the resource for further employment. Hence the entrepreneurship and innovative activities is perceived to be a key factor in economic development [1]. However, the failure risks of start-ups are high and among the indicated reasons are the lack of realism in business ideas [2], i.e. not enough

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examination of end user needs, which are prone to change rapidly and neglect of the real world context. The lack of realism when modelling business ideas needs to be tackled by the enterprise modelling community. One way to bridge this gap could be the application of a modelling method that allows an integral view and supports different business perspectives, such as the needs of the entrepreneurs and end users, the sequence of activities to be followed to fulfil the needs, as well as the contextual factors influencing the procedures.

Recently, modelling and management of capabilities have been proposed as a way to cope with the challenges in dynamic environments. In that respect, a EU-FP7 project Capability as a Service in Digital Enterprises (CaaS) addresses methods and approaches with which the organisations may adapt to the changes and secure a competitive advantage [3]. To enable digital enterprises to sense and take advantage of changes in business context, CaaS engineers the Capability Driven Development (CDD) method. The CDD has been applied in various case studies for the evolution of information systems that need to incorporate context aware capabilities. Osterwalder & Pigneur states that "a business model describes the rationale of how an organisation creates, delivers and captures value" [4]. By adopting this definition, organisations are start-ups. Concerning the value creation part, we focus on the specification of business processes, goals, business capabilities, and contextual constraints for venues. In this paper we present the application of CDD for helping entrepreneurs in the analysis, design and specification of start-ups. We explore CDD as a business tool that can complement current suites of business tools like the ones proposed in [4].

To shape our research, we conduct a design science project [5]. We perform the first iteration of a design cycle from the problem investigation to the design validation (see Fig. 1). The first step is the problem investigation, which investigates the lack of

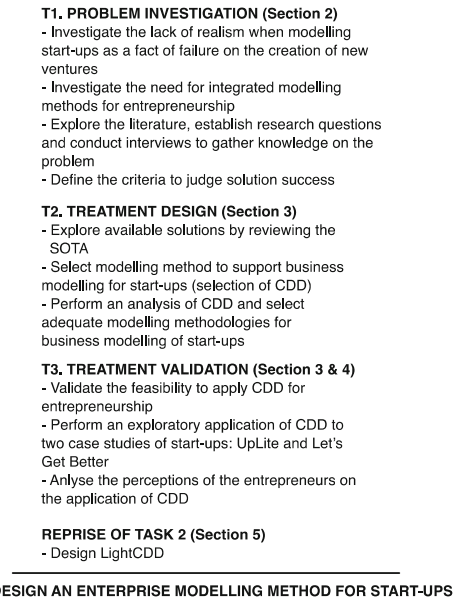


Fig. 1. Overview of the research methodology

modelling methods as a threat of start-ups shutdown. The second step corresponds to the treatment design, in which an exploratory exercise to apply CDD for entrepreneurship is performed. The third step corresponds to the treatment validation, which applies the CDD to two case studies of start-ups. Following the results, a reprise of the treatment design step is performed by creating LightCDD.

The paper explores of the suitability of the CDD for start-ups, i.e. whether it helps the entrepreneurs to reason on their business ideas and design. For this, we report on the application of the CDD in two exploratory case studies of start-ups, present the results of a survey regarding the method support for start-ups and then present the LightCDD, which is a simplified version of CDD aimed at the enterprise modelling activities of start-ups. The paper is structured as follows. Section 2 discusses the main threats on start-up failures, outlines the related work, and presents the performed survey. Section 3 begins with the background information on the CDD paradigm, details its application in two case studies, and reports from the experiences gained during the application of CDD in practice, which motivates the LightCDD. Section 4 introduces the LightCDD and Sect. 5 concludes the work.

2 Problem Investigation

The problem investigation is centred on the research about the lack of realism and the risks of not considering contextual and operative constraints for start-ups. We performed a literature review to investigate about the reasons of start-ups' failure. Also, we conducted a structured interview to investigate start-up failure reasons from the point of view of counsellors or managers of start-ups incubators.

Studies and analysis show that encouraging the entrepreneurship and innovative activities in small businesses is a key factor in economic development [6]. By exploiting the niches and offering novel products/services, enterprising individuals with economic initiatives sustain high level of profitability, which may create the resource for further employment [7]. Based on this fact, the legislative bodies support the entrepreneurs to set up their own companies and consequently, the number of start–ups raise rapidly worldwide. However, the high start-up birth rates go hand in hand with a great risk of failure, it's estimated that nine out of 10 start-ups fail [8]. As stated in [9] "*the failure often surrounds five key dimensions: customers, business model, product, financials and team*". Chorev & Anderson identify 8 top key topics and reports that team commitment, team expertise, marketing, customer relationships, core team expertise and management, strategy, R&D and idea have high effect factors on start-ups success [10].

Among the various factors leading to the start-up failures, wrong estimations on the market need is one of the most important cause. Many start-ups focus too much on product, and not enough on examining the needs of the end user, which is prone to change rapidly. Another observed cause for failure is that the entrepreneurs underestimate the importance of planning, before entering the market [11]. Hence, due to the lack of realism in business ideas, many start–ups fail. To be more specific, different scenarios are neglected; the activities are captured in a single high-level process and the processes are not specified. Moreover, the objectives motivating the ideas and wishes

are not captured, which should help to find a proper solution. Instead, the entrepreneurs rely on the subjective, and often biased, perceptions when creating a new business [12]. As such, business planning may help as a decisive factor for the success of the start-ups.

We have asked two experts in enterprise incubation to answer our questions on the reasons for start-up failure[1]. The respondents were the manager of a start-up school

<table>
<tr><th colspan="2">Factors that influence start-ups' failure</th></tr>
<tr><td>Entrepreneurs' goals and characteristics.
- Most of people that are part of start-ups creation are not entrepreneurs. People belonging to start-ups might be smart and have vision statement, but "entrepreneurship is a trait".
- "Entrepreneurs are not addicted to cash", they do not envision how to profit from their business ideas. For entrepreneurs it is easy to preach their ideas, but later they are not eager to work on them.</td><td>Entrepreneurs' environment.
- It is difficult to set-up a team to run a start-up; a poor team is a high risk for start-ups' failure.
- There are to many jobs prospects in IT, most of the start-ups just shutdown due to teams get job offers that are more attractive than pursue the success of a venture.
- Start-ups are set-up "at the wrong time in the wrong place".</td></tr>
<tr><td colspan="2">The behaviour of young entrepreneurs and their lack of realism when modelling business ideas
By young entrepreneurs we refer to entrepreneurs without experience for designing start-ups. The interviewees somewhat agree on the idea that entrepreneurs tend to oversimplify the key activities when designing business processes. Nevertheless, they argue "no entrepreneurs would go through the creation of a new enterprise if they knew how hard it is".
On the other hand, the interviewees completely disagree with our hypothesis that "the younger the entrepreneur is, the more naive s/he tends to be while conceiving business ideas". It is clear that practice makes the master, but some entrepreneurs during her/his first attempt to set-up a company get successful.</td></tr>
<tr><td colspan="2">Lack of realism of business ideas
The interviewees agree on the fact that entrepreneurs are more focused in the design than in the analysis during the development process of their ventures. This lack of proportion is a cause of failure. On the other hand, opinions of the interviewees are opposite regarding to how realistic are entrepreneurs' initial business ideas.</td></tr>
<tr><td colspan="2">Methods and instruments to support entrepreneurship
Interviewees perceive that existing methods and instruments are appropriate to think about contextual constraints of the real world, and then entrepreneurs come up with realistic business plans.
Perceptions are divided when analysing current methods. One of the interviewees perceives that current methods do not allow the entrepreneurs have an integral view of their goals, activities, and, contextual constraints. For that reason, providing mechanisms to represent contextual constraints and to reason about goals and processes would help entrepreneurs to anticipate and mitigate risks. Both of the interviewees agree on methods that provide separate specifications of enterprise models could help entrepreneurs to understand their business context. In addition, one interviewee indicates that modelling methods for entrepreneurs should be "graphical, technical and lightweight. Different perspectives should be possible". Regarding to the needed perspectives for modelling business ideas, they mention that it is important to provide various like the ones supported in the CDD methodology, but they claim on the need to "keep it simple". Despite the fact modelling is important for entrepreneurs, one of the interviewees comment that "it is the art of entrepreneurship to not get trapped in analysis paralysis and still having sufficient insight to take the right decisions".</td></tr>
</table>

[1] The questions can be found at https://goo.gl/92IekF.

(pre-accelerator), and the manager of an incubator who is also lecturer of a course named ICT Entrepreneurship. Both managers have from 3–10 years of experience running incubators. We now elaborate on the findings.

To conclude, we found various evidences on the need to provide lightweight and integrative modelling supports for start-ups. In the following sections we explore the applicability of CDD for entrepreneurship support and start-up modelling.

3 First Experiences on Applying CDD for Enterprise Development

3.1 Capability as a Service in a Nutshell

CaaS project aims to create an integrated approach consisting of a method, tools, and best practices that enable digital enterprises to sense and take advantage of changes in business context. The CaaS methodology for capability- driven development (CDD) consists of various components addressing different modelling aspects, such as context modelling, business process modelling, pattern modelling, and adjustments modelling. The method is supported by the CDD environment, which comprises of a Capability Design Tool (CDT) incorporating a context modelling module, a Capability Context Platform (CCP) to monitor the contextual values at run-time as well as a Capability Delivery Navigation Application (CNA), which enables adjustments in line with the service delivery context and reusable best practices [3].

Three use cases in the sectors of e-government [3], energy [13] and insurance [14] prove that the methodology is successful when applied to full-fledged enterprises that intend to become more context-aware and adaptive. However, studies on the application of the CDD and its effects in innovative start-up projects in entrepreneurial settings are missing.

3.2 Two Practical Start-up Cases

Digital technology powered by the growth in the digital economy caused an increase in the number of young entrepreneurs and innovative ideas. This specifically can be observed between the two main sectors, namely telecommunications and IT [7]. We have launched the yes!PoEM[2] seminar for entrepreneurs, in which the DELITELABS[3] start-up school has participated. This section focuses on the two innovative start-ups in IT field for which we apply the CDD paradigm[4]:

[2] http://www.pros.upv.es/en/yespoem.

[3] http://delitelabs.com.

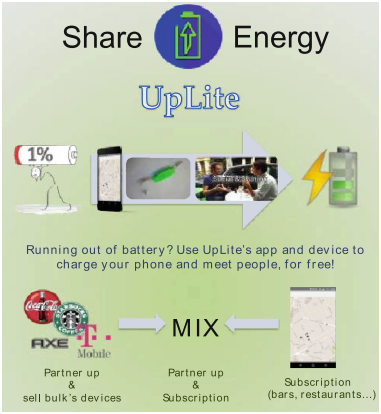
[4] The posters with the projects' descriptions can be found at https://goo.gl/92IekF.

Case 1: Let´s Get Better

Let's Get Better is an online platform that provides users with a health coach in their pocket. The main motivation of the project is that an active and healthy life is the key to a well-balanced life but the people struggle adopting healthy habits, since they are busy with their work and social life. As a solution, the platform takes advantage of digital technology and offers 1:1 professional coaching through instant messaging and weekly video calls, progress tracking and peer-to-peer networks. To further support and encourage users, a social media will allow people to share their story, gain further support, and build common-interest relationships.

Case 2: UpLite

UpLite is a start-up project, where the entrepreneurs propose new way of charging smartphones by improving social contacts. The motivation behind the project is that difficulties arise when one looses the online connectivity, i.e. people feel lost and unsecure when these devices run out of battery and they are limited in terms of their reaching their contacts and information supply. As a solution, the digital entrepreneurs produced a hardware, which connects two mobile devices, allowing them to exchange battery life. In addition to that, they developed a mobile application, which supports such exchange by showing the energy providers and their locations on a map.



3.3 Applying the CDD in Full

The CDD supports different entry points and offers three strategies for capability modelling, namely goal-based, process-based, and concept-based approaches [15]. The procedure that describes the application of CDD to the two cases (case 1: Let's Get Better and case 2: UpLite) is depicted in Fig. 2.

Before starting the modelling sessions, the authors explained the teams the CDD concepts in detail, i.e. the terms business processes, context, and capability were defined. After that, both the Let´s Get Better team and the UpLite team were asked to provide us with the business processes (see Procedure 2 in Fig. 2). The results were generic and did not quite reflect the actual implementation of their business ideas.

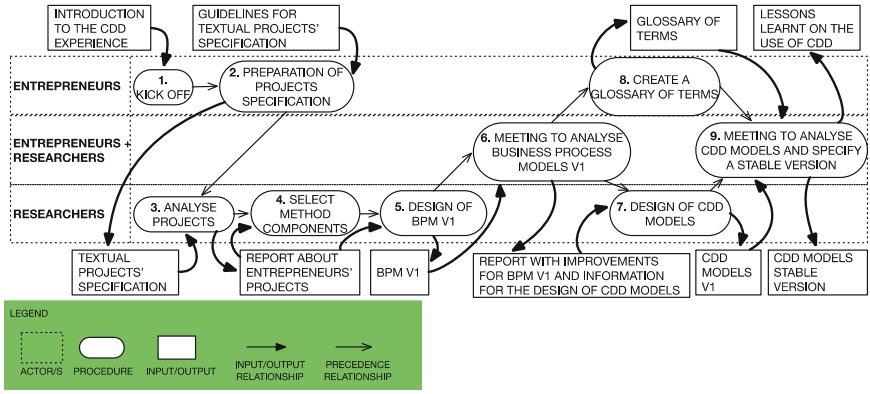


Fig. 2. CDD application procedure for the two start-up cases

CDD allows for different strategies when modelling capabilities [15]. To select the right strategy, we analysed the qualitative data provided by the entrepreneurs (see Procedure 3 in Fig. 2). The data included the descriptions of the use cases as well as the explanations of additional concepts, key activities, resources and stakeholders. Following that, we meet with the teams in an interactive group setting. Based on the gathered information, we identified that the goals were not reflected at all or only expressed ambiguously. Regarding the organizational structures, both teams had clearly defined roles and responsibilities. However, in terms of key concepts, the teams lacked a shared understanding, thus further work was needed to clarify such concepts. In this respect, the teams received an additional task to create *a glossary of terms* before starting with the capability modelling sessions. In contrast, we identified that in both use cases the teams possessed knowledge on the key activities. Consequently, the process-first capability design strategy seemed to be the most suitable one.

Using the CDD method, first the business process models were updated[5]. In the next step, we identified the core capabilities and together with the teams, we prioritized them and selected one capability per use case. Following that, the goals of the team alongside with the end user needs are analysed and modelled, these are related to the capability and to the business process models. Finally, based on the gathered information, the contextual factors that might effecting the service provision were explicated and modelled. In each iteration, additional context elements were identified and their effect on the business idea were discussed. The results were used as an input for a new interaction with the entrepreneurs, i.e. the steps regarding the modelling of the business processes and goals were revisited (see Procedure 9 in Fig. 2).

3.4 Lessons Learnt, Experiences

Looking back at the success factors as introduced in Sect. 2, the application of the CDD led to a more committed team with a shared understanding and clearly defined

[5] The respective models before and after CDD application can be found at https://goo.gl/92IekF.

objectives. In particular, the modelling activities enhanced the communication between the core team. The developed models contributed to an overview of the core product & service and how to offer it, the management had useful instruments to define their strategy. Moreover, goal models reflected not only the objectives of the start-ups, but also of the potential customers, which is expected to improve the customer relationships, probably opening new marketing channels. The whole CDD practice helped to enrich the business idea and minimize the risk of a false start.

Concerning the causes of the failure, the CDD improved the start-ups in the identification of the real world factors in the business. To exemplify, the UpLite team did not consider the context of the user in different scenarios, so their app did not incorporate the required functionalities, such as the user profiles, willingness to share, ratings from other users, distance to energy providers and battery status. For the Let´s Get Better Team, the capability model provided them with the information they needed to start developing an algorithm for the app, which was not considered before.

In line with the findings from the literature, another important failure factor was that the entrepreneurs tend to form simple processes. In both cases, the procedures were vaguely defined and many gateways were not considered explicitly. After applying the CDD, the core business process models are updated. Each meeting with the entrepreneurs resulted in a more matured process model and addressed additional discussion points for the teams in terms of a concrete implementation of the activities.

We interviewed the CEOs of the two cases that have applied CDD. Both of them did not have previous experience with enterprise modelling before the application of the CDD. Below we present the research questions that stand for the structure of the interview, and the insights providing answers to the research questions:

(RQ1) *What is the perceived usability and ease of use of CDD in start-ups projects?* - It was easy to apply and is useful to understand and design start-ups' projects. One CEO says, "CDD is a logical process, which helps to provide structure in a wildly abstract start-up". Nevertheless, the first impression that the entrepreneurs got from CDD was the uncertainty on how CDD could be applied to their projects. - Regarding the CDD's concepts: "The terminology used is still rather confusing though". The CDD's concepts need to be reviewed and tailored for end-users.
(RQ2) *What is the perceived impact after the use of CDD in start-ups projects?* - CDD would increase the chances that a start-up achieves its business goals in a changing environment. Although, one comment stands for the idea that CDD seems to be IT project-dependent. - CDD help to identify gaps in business plans. But, for future use of CDD, one CEO says that: "If I feel like there's a need to methodically define a process, then yes - definitely". - From the benefits point of view, the "CDD helped on structuring and clarifying the process" and "The business process model provided us with a clearer user journey. The capacity model provided us with the information we needed to start developing an algorithm for the app".

In general, CDD helped them to find out further configurations of their products and services by analysing their business ideas from the capability point of view. The entrepreneurs identified gaps in the distribution and revenue models, which were optimized (cf. RQ2). Nevertheless, applying the CDD in full had a few drawbacks.

First, the entrepreneurs were initially unsure on how to apply CDD to their projects, which is mainly related to the number of method components. The CDD focuses on the application scenarios of mature enterprises that intend to become context-aware and adaptive, which necessarily requires engineering of a comprehensive method with a number of components. For the two cases, the CDD was not applied in full and just some method components were selected for their application. Second, the method terminology was rather confusing for them and needed review. The teams were not able to apply the CDD by themselves, which created a complicated CDD application procedure, the intervention of the researchers to the modelling processes was required, and the created models are analysed with the entrepreneurs (cf. Fig. 2). To overcome these drawbacks, we propose the LightCDD, which balances the trade-off between the simplicity and expressiveness.

4 Light CDD for Enterprise Modelling of Start-Ups

As a result of the application of CDD in two start-up projects, we found that it is feasible to apply CDD for start-ups projects. As we presented in Sect. 2, all respondents of the questionnaire agree that the entrepreneurs are more focused in the design than in the analysis during the development process of their ventures; and this lack of proportion is a cause of failure. Thus, methods to analyse their idea should be provided to the entrepreneurs. Regarding the characteristics of such methods, they should support graphical representation of the business idea, be lightweight and simple. Moreover, it is required to provide mechanisms to represent contextual constraints that help entrepreneurs anticipate and mitigate risks of failure, and provide integrative view of goals, activities, and contextual constraints.

Taking into account the interview responses (cf. Sect. 3.4), we propose the LightCDD, which is a simplified version of CDD with a different purpose, i.e. not providing support in a full-fledged company, but rather in a start-up design. To meet the demands of the start-ups, the LightCDD incorporates the context modelling, goal modelling and business process modelling components. The important concepts that the LightCDD is based on are illustrated with a meta-model in Fig. 3. This is a simplification of the meta-model used in the CaaS project [3].

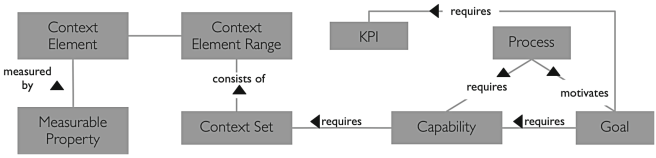


Fig. 3. The meta-model of the LightCDD

LightCDD consists of procedures that are classified into three phases, namely preparation, analysis and design phases, which are defined in the following (Fig. 4):

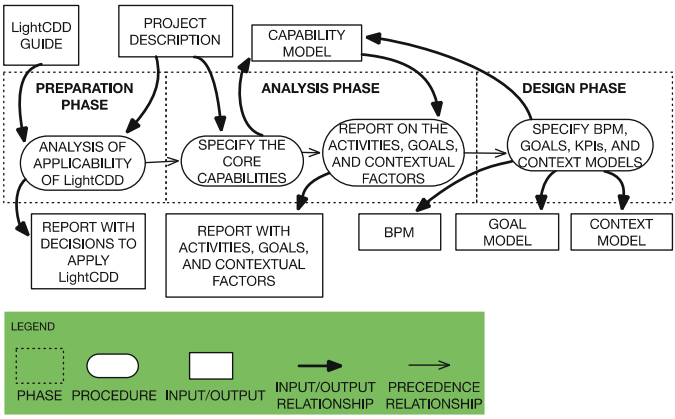


Fig. 4. LightCDD procedure

Preparation phase The entrepreneurs are provided with a LightCDD guide. The guide consists of the information, what enterprise modelling in general is, and how this could help to improve their case. Moreover, it includes the meta-model (cf. Fig. 2), the definitions of the CDD terms in a tabular form as well as a simple example, where the method is used.

Analysis phase The core proposition of the business idea is expressed as a capability. Then, key activities regarding the implementation of the capability are enumerated. Next, the goals are listed that needs to be fulfilled. Following that, the contextual factors influencing the objectives or the key activities are analysed. The gained information might require an update in the core proposition of the capability or result in additional capabilities, which is why the analysis phase may be iterated more than once.

Design phase The key activities are modelled as BPM and objectives are captured as goal models. The key performance indicators (KPI) are added to the goals. Based on the capabilities, the BPM and goal models are related to the context models, which represent the contextual constraints of the business environment.

The prerequisites for the method application are not taken into consideration. This should be fulfilled with the activities in the preparation phase. Likewise, the stakeholder types that participate to the different phases of the CDD were excluded in this version, due to the fact that the start-up teams include smaller number of individuals. As mentioned in Sect. 3, the CDD is supported by a number of tools including the CDT, CCP and CNA. For the LightCDD, the focus is on the enterprise modelling phase, hence the CDT is required for the method application, which is a graphical modelling tool for supporting the creation of models according to the simplified meta-model shown in Fig. 2.

5 Conclusions and Discussion

Studies and analysis show that the digital economy is growing worldwide and holds huge potential for European entrepreneurs. Encouraging the entrepreneurship and innovative activities in small businesses is a key factor in economic development [6]. However, the high start-up birth rates go hand in hand with a great risk of failure.

In this paper, we analysed the current problems of start-ups and focused on the lack of properly modelling methods as a threat for shutdowns. In other words, we investigated how methods and techniques for enterprise modelling could help on the development process of new ventures. We reviewed the literature and conducted a survey to know factors of failure when establishing start-ups. We have performed an exploratory application of CDD in two start-ups projects. As a result of this experience, we found that CDD is a feasible method for start-ups support. We interviewed the CEO of the two start-up projects to know their perceptions about CDD, and how it impacted their projects. Thanks to the evidences collected during the application of CDD, the survey, the interview to the CEOs, and literature related research; we found evidences on the need to design a lightweight method for start-ups. As a result, we proposed the LightCDD, a simplified version of CDD for entrepreneurship support, which is designed based on the following principles:

i. The users of LightCDD should be supplied with the information of what enterprise modelling in general is and how this could help to improve their case. Here, the specific terms regarding the capability modelling should be described. If possible, the description should be enriched with the examples from the cases.
ii. The LightCDD should focus on the goals, context and processes. The pattern modelling method component is excluded, since the business idea is somewhat unique and no best practices in the application field are expected. The adjustments modelling method component is also excluded due to its strong focus on the implementation of the business idea, which is the run-time aspect.
iii. From the CDD tool suite, CDT seems to be the only one that the entrepreneurs can use. This is advocated by the reason that for the business design, they only need CDD tools that support enterprise modelling.

We gained interesting feedback from the CEOs of the two projects in which CDD was applied, and the incubators' managers. Due to entrepreneurs' context sensitive approach, we predict that the respondents address the ability of CDD to overcome challenges in changing situations, i.e. if it is a relatively stable environment for the start-up, such as selling of a certain product with certain features, the method might be too complex to use.

LightCDD is going to be further developed and evaluated in new start-ups. In this respect, future work is going to focus on a few aspects. First, the guidelines and best practices for BPM are going to be improved and incorporated. This requirement stems from the feedback that the application of the (Light) CDD in further entrepreneurial projects depends on such support. Second, the CDD concepts are going to be refined and simplified. Third and last, important aspects such as the revenue models, channels,

key resources, and team expertise is going to be addressed, which were mentioned during the interviews, but always remained out of the CDD boundaries.

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