CHALMERS
UNIVERSITY OF TECHNOLOGY

Hardware is Hard

An exploration of why developers fail to deliver crowdfunded products on time

Master's thesis in Mechanical Engineering

MY BERGLUND

DEPARTMENT OF MATERIALS AND
INDUSTRIAL SCIENCE

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Abstract

Few developers successfully manage to crowdfund hardware products. And those who accomplish such a feat face another challenge – fulfilment. Despite their initial success many developers failed to deliver products on time. This study explores these failures. Successfully funded but delayed hardware projects from Kickstarter were identified using a web scraped dataset. A qualitative content analysis was carried out on the projects to explore what affects timeliness. Three themes were established based on the findings; quality of partnerships, developers' knowledge, and the extent of uncertainty. The findings were furthermore compared to two previous research streams; traditionally funded product developments and crowdfunded product development. This comparison showed that the study's findings aligned well with previous research. A notable point of difference was DFM, design for manufacturability practices. Whereas this DFM is understood and practised within traditionally funded product development, in the crowdfunding context it was given surprisingly little regard. Consequently, the results indicate that developers choosing to crowdfund could benefit from applying traditional strategies to mitigate and eliminate delay, especially in the area of manufacturability.

Keywords: Crowdfunding, New Product Development, Kickstarter, Delays, Timeliness

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1. Introduction

This chapter provides an introduction to the study. To begin with, a background to the research topic is presented. The study's aims, research questions, and limitations are outlined. And lastly, a discussion on ethical considerations is provided.

1.1. Background

This background to crowdfunding and product development delays begins by discussing various definitions of crowdfunding, followed by a brief account of various motivations to crowdfund and the history of modern crowdfunding. Thereafter, crowdfunding is described on a market level and from the perspective of the individual crowdfunding effort. Thirdly, the prevalence of delayed projects is described.

1.1.1. The History of Crowdfunding

One of the ways entrepreneurs and start-ups choose to finance new product development is through crowdfunding. This practice can be understood as the accumulation of several, but small, financial contributions. However, the micro-financing aspect does not fully capture the act of crowdfunding (Mollick, 2014b; Belleflamme et al., 2014). Crowdfunding also involves the use of intermediaries, usually online platforms, where those willing to fund can find those seeking funding (Huhtamäki et al., 2015). In the research community, there are currently two prominent ways of defining crowdfunding. The first steam from the definition of crowdsourcing which Kleemann et al. (2008) formulated. Both Lambert and Schwienbacher (2010), and Belleflamme et al. (2014) have adapted the original crowdsourcing definition to form a definition of crowdfunding. Lambert and Schwienbacher (2010) definiens crowdfunding as: "an open call, essentially through the Internet, for the provision of financial resources either in form of donation or in exchange for some form of reward and/or voting rights in order to support initiatives for specific purposes". The version proposed by Belleflamme et al. is only marginally different. The second established definition is that formulated by Mollick (2014b). Mollick (2014b) suggests that a more narrow definition will be of greater value when applied in an entrepreneurial context, and defines crowdfunding as follows: "Crowdfunding refers to the efforts by entrepreneurial individuals and groups – cultural, social, and for-profit – to fund their ventures by drawing on relatively small contributions from a relatively large number of individuals using the internet, without standard financial intermediaries" (Mollick, 2014b).

Although the act of fundraising is central in all definition of crowdfunding, there are reasons beyond raising capital to launch a crowdfunding effort. Crowdfunding can build a customer base, create a sense of community, and function as a pre-ordering service (Gerber et al., 2012; Cumming et al., 2015). The diversity in the reasons to crowdfund is mirrored in the diversity of the projects and endeavours that are crowdfunded (Mollick, 2014b; Gerber et al., 2012). Software and hardware, social events, and art can all be crowdfunded (Mollick, 2014b). There is furthermore great variance in scope, complexity, timeline, and funding goals (Mollick, 2014b).

The product that moved crowdfunding online was music. ArtistShare launched in 2003 and Sellaband launched in 2006, where two early online platforms that enabled crowdfunding of music (Moritz & Block, 2016). The term "crowdfunding" was coined by Michael Sullivan (Gobble, 2012) in an attempt to describe his platform where the general public was invited to fund video projects. In a literary review, Kuppuswamy and Bayus (2015) conclude that academic research on crowdfunding is still very limited. And if the practice of crowdfunding is broken down into pre-launch, campaign, post-campaign – it is the first two steps which have been the object of most research (Schiavone, 2017).

1.1.2. The Crowdfunding Market

Schwienbacher and Lambert (2010) identify the crowdfunding market on digital platforms as very young. Nevertheless, the market is big and growing (Schwienbacher & Lambert, 2010). The global crowdfunding market exceeded 30 billion dollars in 2015 (Chang, 2016) and the total amount of crowdfunding intermediaries is in the hundreds (Kuppuswamy et al., 2015). The only digital crowdfunding platform based in Sweden is called FundedByMe. The two most prominent crowdfunding platforms of hardware products are Indiegogo and Kickstarter, a selection of other platforms is presented in table 1.

According to Mollick (2014a), the crowdfunding market can be regarded as fourfold. Crowdfunding campaigns are either equity-, donation-, reward- or lending-based. The reward-based projects can offer the backers branded merchandise such as t-shirts, but it can also operate as a pre-order scheme. This study will focus solely on the latter – crowdfunding campaigns with a pre-ordering element.

A large number of intermediaries have chosen not to coordinate their terminology. Therefore, there is no standardized terminology to describe the aspects of crowdfunding. Both Indiegogo and Kickstarter refer to efforts to crowdfund as a "campaign". Those initiating a campaign are called "creators" on Kickstarter and "Campaign Owners" on Indiegogo. The next element of a crowdfunding campaign is the funders, on Kickstarter they are called "backers" and their financial contribution - a "pledge". On Indiegogo the backers are referred to as "Contributors" and their financial contributions "Contributions". As this study approaches crowdfunding delays from a product development point of view, those initiating a campaign will be referred to as "developers".

Another point of difference between the actors on the market is the funding mechanism. Crowdfunding intermediaries can offer all-or-nothing (where the money is exchanged upon successfully reaching the funding goal) and keep-it-all (where money may be received although the goal was not reached) campaigns. Some choose to specialize in one, whereas a few offer both.

Table 1: A selection of crowdfunding platforms, their funding mechanism, project types, and restrictions.

Platform	Funding Mechanism	Project type	Restrictions
Kickstarter (USA)	AON*	Reward	Manufacturing plan required
IndieGoGo (USA)	AON KIA*	Reward Donation	Creator owns intellectual-property
Fundedbyme	AON	Equity	
Patreon	KIA	Reward	Subscription-based
Mightycause (formerly Razoo)	KIA	Donation	Nonprofit fundraising
Crowdfunder	KIA	Reward	
GoFundMe	KIA	Donation	No legal defences
Investor	AON	Equity	The minimum goal is €20,000
Investment	AON	Equity	Only for technology start-ups and German nationals

*AON- All or Nothing; KIA – Keep it all.
Source: Adapted from Huhtamäki et al. (2015)

1.1.3. The Kickstarter Campaign

Each campaign launched on Kickstarter must be associated with one category: Art, Comics, Dance, Design, Fashion, Film, Food, Games, Music, Photography, Publishing, Technology, and Theatre. In 2011 Kickstarter also introduced optional subcategories, for the Technology category these are: 3D Printing, Apps, Camera Equipment, DIY Electronics, Fabrication Tools, Flight, Gadgets, Hardware, Makerspaces, Robots Software, Sound, Space Exploration, Wearables, Web (Stewart, 2014).

When a campaign is launched it will be published on a Kickstarter webpage devoted to the particular project. Campaign webpages can include five parts; information about the Campaign, FAQ (Frequently asked questions), Updates from the developers, Comments from the backers, and a presentation of the Community (the backers). The main part of the pages is the campaign-section, and this is also were the product-pitch can be found. On Kickstarter, creators are able to tell their stories and discuss risks and challenges with words, images, and video. The campaign-Section also included the various reward tiers, that developers offer, these tiers can vary in price and reward. The developers can also decide how many backers are eligible for a particular tier. Each reward level is also assigned and estimated delivery date, given to the nearest month. The second section the developers can use is the FAQ-section, which allows developers to streamline communication by providing answers to the most common questions. The third section, the

updates, is where the developers provide the most up to date information to backers and potential backers once the project is underway. Important to note is that updates are not always public. Developers can choose to make updates only for those who have backer the project, or even a specific reward tier. This channel is also were developers communicate if the project has been hit by delays. Fourthly, there is a Comment-section where the backers have a public channel to the developers (they can also use direct messaging) to offer feedback and/or support. Finally, each page also includes a Community-section which presents the backers and insights about them.

1.1.4. Product Development Timeliness

Crowdfunding platforms are full of new ideas. This novelty is leveraged to create interest and ultimately financial contributions. However, the majority of successfully funded campaigns do not ship the product on time (Mollick & Kuppuswamy, 2014; Mollick, 2014). Mollick (2013) found that the number of delayed projects on Kickstarter in the Technology and Design categories exceeded 75%. Mollick's study (2013) is one of the first instances where analysis of crowdfunding is based on a crawled dataset (Menon et al., 2018). The mean delay in the project Mollick (2013) studied was 2.4 months.

This is notable since a short time-to-market, TTM, has become central for traditionally funded product development. A short TTM will give the product a longer lifetime and a faster payback time. The trend towards increasing product complexity would if unaddressed, make TTM longer. However, most companies actively work to shorten the product development cycle to ensure the product is still relevant once realized. The need to shorten product development cycles has been exacerbated further by global competition (Wheelwright & Clark, 1992). Further potential advantages of a short and timely development effort are first-mover advantages and time-based competition benefits (Chen et al., 2010).

However, when surveying American product managers, the research and advisory company Gartner found that 45% of products are delayed (Gartner, 2020). And these delays are costly. If a pre-announced product is late to launch, the firms' market value will be significantly weakened (Hendricks & Singhal, 1997; Chen et al., 2007). Delays of pre-announced products are especially common in technology-intensive industries (Wu et al., 2004). In a study of 450 firms that missed the pre-announced launch, the firms' profitability suffered statistically significant negative effects due to the delays (Hendricks & Singhal, 2008). The study also indicated that smaller firms experience these effects to a greater extent (Hendricks & Singhal, 2008).

1.2. Aim and Research Questions

The purpose of this thesis is to explore the reasons why successfully crowdfunded hardware products are delayed. It further seeks to investigate what actions can be taken to mitigate or prevent delays. These areas will be achieved by first developing a theoretical framework of causes for delay and mitigating actions. Thereafter successfully crowdfunded hardware projects that have suffered delays will need to be identified. The reasons for the subsequent delays mapped, categorized and

their frequency noted. If applicable support functions offered by crowdfunding platforms will also be identified. And finally, the current context will be synthesized with the theoretical framework. The study is designed to answer the two following research questions:

RQ 1: What can cause or drive delays in successfully crowdfunding hardware projects?
RQ 2: What can mitigate or eliminate delays in successfully crowdfunded hardware projects?

1.3. Limitations

Only the development of physical products will be examined. All digital, social, or cultural products will be excluded from the data set and the analysis. Even with this initial limitation, the sheer availability of data is vast. To code and analyze the entire data set would require additional resources. Therefore, not all physical products on the platform will be considered, the study is instead limited to crowdfunding products categorized as "hardware".

If product descriptions and product development updates are not available in Swedish, English, or French, the sites will be processed by a digital translation before analysis. If the translation is deemed of too poor quality, the project will be disregarded.

Previous literature indicates that the complexity of the products would be a highly interesting variable to study in the context of product delays. However, no data categorizing the complexity of the product is readily available.

The project is limited in time to a period of approximately 20 weeks.

1.4. Ethical considerations

The study has been conducted in accordance with the principles for researchers described by The Swedish Research Council in the report "God Forskningsed" (2010). As a consequence of this, the initial method was modified to better respect the rights of the crowdfunding projects studied. Although updates on a crowdfunded product's progress can be locked for the general public, these still are readily available. It is a common practice for these updates to be shared by individuals who have funded the project and subsequently gained access. Nevertheless, the initial intent was for these updates to be private and they will therefore not be considered in the analysis.

1.5. Outline of the thesis

Chapter 1. Introduction
The thesis begins by introducing the topic of study. It serves to place the thesis in a context and provide the necessary background information for a reader to engage in the research. This chapter also includes the research questions and the aim driving the study, as well as limitations, ethical considerations, and an outline of the report.

Chapter 2. Methodology
The second chapter outlines and motivates the methodological choices that make up the study's design. This chapter is suitable for readers that potentially wish to replicate the study. An evaluation of the methodology is found in chapter 5. Discussion.

Chapter 3. Theoretical Framework
The third chapter contains the theoretical framework. The framework used to establish themes in the qualitative content analysis in chapter 4. Results.

Chapter 4. Results
The fourth chapter is where the results are found and where the reader is introduced to the patterns in the empirical data. The identified themes and their related subthemes are presented one by one. The chapter is finished with a summary of the findings and their frequency.

Chapter 5. Discussion
The fifth chapter breaks down the results and their implications in a greater context. It provides a reflection of the findings and how they related to the research aim.

Chapter 6. Conclusion and Future Research
In this chapter conclusions from the research are examined, followed by opportunities for future research.

References and Appendix
A compilation of all references used in the thesis is presented in the penultimate part and the last part of the thesis is an appendix. The appendix features parts of the empirical data used to carry out the content analysis.

2. Methodology

This chapter describes and motivates the research methodology. The methodology is discussed in two parts. Section 2.1 concerns the literature review and section 2.2 the method for gathering and analyzing data from the crowdfunding platform.

2.1. Literature review

The literature review was carried out in two steps, a scoping search, and a systematized review. The databases used where: Google Scholar, Mendeley, and SCOPUS. Resources were also gathered from the websites Kickstarter, IndieGogo, and Reddit.

2.1.1. Scoping Search

A scoping search initiated the study. The scoping search was conducted in order to develop an initial understanding of the study's context, to justify the study's rationale, and to inform the selection of keywords for the subsequent systematized review (Booth & Grant, 2009). This part of the search was carried out in Google Scholar. Only top-cited authors were considered at this point. This part of the search was then concluded by scanning the reference list of the identified studies to discover additional material (Booth et al., 2016).

2.1.2. Systematized Review

The systematized review was carried out in the database SCOPUS and is illustrated in figure 1. This step was guided by keywords related to the first research questions, generated from the preceding scoping search. The keywords were chosen with the aim of answering the questions: What is the context of manufacturing a crowdfunded product? What theories could explain the prevalence of delays in the shipping of crowdfunded products? What theories offer suggestions as to how to mitigate or eliminate said delays?

- Crowdfunding
- All or Nothing OR AON
- Pre-order OR Rewards
- Product OR Technology OR Tech OR Hardware OR Physical Product
- Delays OR Deferment OR Late OR Timeliness OR Shipping OR Fulfilment

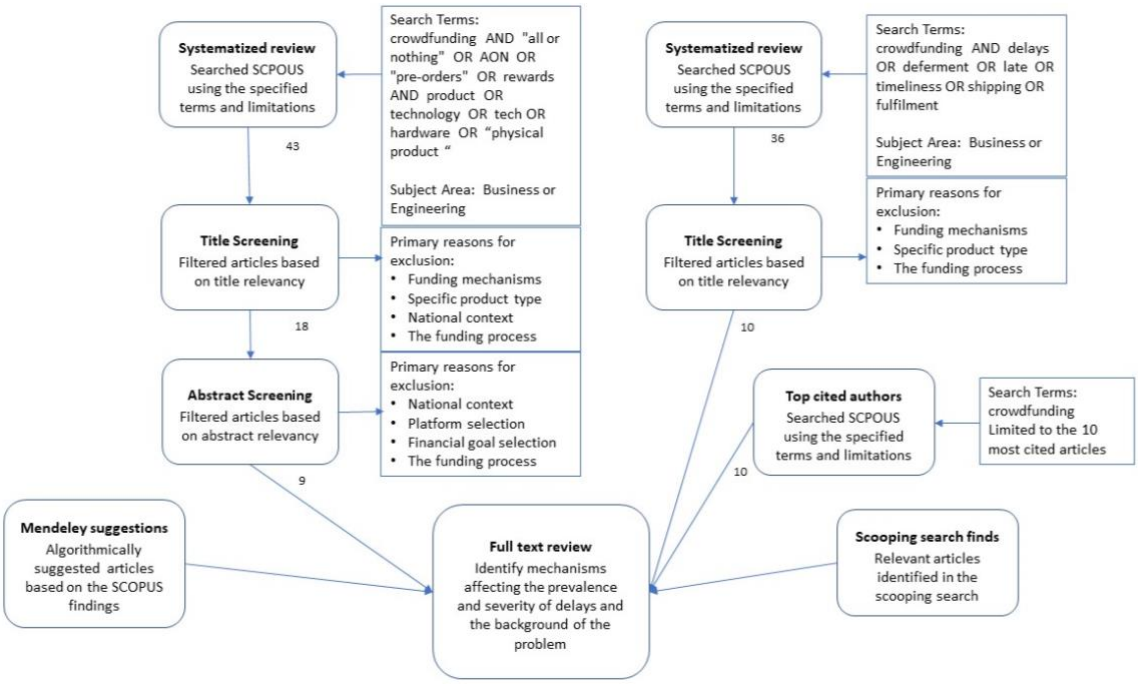

Figure 1: Diagram illustrating the main effort of identifying relevant literature on crowdfunding

The keywords were combined in two different ways. The first keyword combination (crowdfunding AND "all or Nothing" OR AON OR "pre-order" OR rewards AND product OR technology OR tech OR hardware OR "physical product") was primarily chosen in order to gain a better understanding of the context of the projects to be studied. The second keyword combination (crowdfunding AND delays OR deferment OR late OR timeliness OR shipping OR fulfilment) was chosen to discover what had previously been written about the prevalence and causes of delays.

As stated in the background the full set of crowdfunding endeavours is very divers. The development of some of the objects for crowdfunding, such as pieces of art, differs greatly from that of hardware consumer products. Delimitations were made to only focus on articles in the subject area of engineering and business. This would also minimize the inclusion of articles related to products who were fully digital. Furthermore, only articles written in English were considered.

To increase the search's comprehensiveness relevant findings from the scooping search were included as well as algorithmically suggested articles from the database Mendeley were the relevant articles were collected.

From the two SCOPUS searches, 79 articles were identified. Both searches were then screened based on the relevancy of the title. After the first screening, the 18 remaining articles of the context-search were screening by reading the abstracts. This left 9 articles to progress to full-text review with the purpose of improving and developing the study's background. The delay-specific search resulted in 10 articles, all of which were progressed to full-text review since they were central to the research. The causes for delay and the mitigation or elimination strategies identified in these articles are presented narratively in section 3.2 Drivers of delay in crowdfunded new product development.

Due to the nature of crowdfunding, founded on the presence of an engaged and active community, the search was further expanded. Additional sources and grey literature were also consulted to provide a good understanding of the crowdfunding context. I.e. the websites Kickstarter and

Indiegogo and the subforums Crowdfunding, Kickstarter, and IndieGoGo on the website Reddit. However, upon finding information though these forums that the developers had not intended to be published, the findings from this part of the search were omitted. A discussion on this decision is available in section 1.4 Ethical considerations.

The second set of keywords was developed to answer the following question: Which theories have been used to explain the phenomenon of new product development delays with traditional funding models?

- New Product Development OR NPD
- Product OR Technology OR Tech OR Hardware OR Physical Product
- Delays OR Deferment OR Late OR Timeliness OR Shipping OR Fulfilment
- Challenges OR Issues OR Obstacles OR Problems OR Best Practise

The research body on traditionally funded product development is vast compared to that of crowdfunded product development. It was therefore not possible to conduct a systematized review of a similar comprehensiveness level within the boundaries of the study. Instead, the author drew on previous knowledge and created the theoretical framework base on the important text within the product development research bod; Product Design and Development (2015) by Ulrich and Eppinger and Revolutionizing product development: quantum leaps in speed, efficiency, and quality (1992) by Wheelwright and Clark. To widen the search scope slightly more, the ten most cited articles of two keyword combinations were also considered. ("new product development" OR npd AND delays OR deferment OR late OR timeliness OR shipping OR fulfilment AND product OR technology OR hardware OR physical product) and ("new product development" OR npd AND challenges OR issues OR obstacles OR problems OR “best practice” AND product OR technology OR hardware OR “physical product”) Also in this search delimitations were made to only focus on articles in the subject area of engineering and business as well as only include articles written in English.

The causes for delay and the mitigation or elimination strategies identified in these articles are presented narratively in section 3.1 Drivers of delay in traditionally funded new product development. However, when compiling the findings, reasons for product development delays that clearly would not transfer to a crowdfunding context were disregarded. Two examples of such reasons were “lack of senior management support” (Gupta & Wilemon, 1990) and “a strong market orientation” (Cooper & Kleinschmidt, 1994). The former was omitted as crowdfunding developers rarely have senior management and the later because market orientation can be assumed if the project has been successfully funded.

2.2. Primary data

In order to understand why hardware projects face delays even after successfully reaching their crowdfunding goals the self-reported reasons for these relays where studied. The method of which is presented in this section.

2.2.1. Data Collection

The scoping search revealed a number of possible data collection methods. The most suitable of which was a crawler and scraper developed by Huhtamäki et al. (2015). It had been developed for the explicit purpose of providing an up-to-date dataset for research on Indiegogo campaigns, produced in an academic context, and published in a journal. However, a closer evaluation showed that the script was no longer functional due to changes in Indiegogo's architecture.

Instead, a pre-existing data set was chosen as the basis for the study. The data set is available free of charge to the public. It is provided by Webrobots, a company offering web crawling and scraping services. Both a Kickstarter and an Indiegogo data set were available. The Kickstarter data set was chosen as the platform's funding mechanism (AON) distinguishes successfully funded campaigns from unsuccessful ones. The data set appears to have been made available to demonstrate the company's competency and thereby drive sales of additional web scraping services. This indicates that the providers have had great motivation to produce a high-quality data set. Furthermore, the same data set has previously been used in other research studies. However, the providers do not provide the XPath, the code, and offer little insight as to how the data is gathered.

Therefore, two different approaches were utilized to verifying the data set's authenticity. The first approach was to compare the number of campaigns in the data set, to the number of campaigns on Kickstarter. However, this comparison did not result in an exact match. The data set providers give the following reason for this:

> *"From April 2015 we noticed that Kickstarter started limiting how many projects users can view in a single category. This limits the amount of historic projects we can get in a single scrape run. But recent and active projects are always included."*

As a consequence of this finding, the method was altered to focus on more recent campaigns and thus counteract this data set deficiency.

The purpose of the second verification method was to ensure that the campaigns in the set were authentic. 10 random campaigns were selected from the data set and identified on Kickstarter. Reversely, 10 campaigns were selected from Kickstarter and identified in the data set. All 20 pairs were identified, and the values of the pairs were an exact match.

The chosen data set contained the necessary variables to identify which of the campaigns launched on Kickstarter were suitable to study. Though it did not provide any insight into potential delays. When campaigns suffer delays, information is communicated to the backers through the update section, and backers tend to express their dissatisfaction using the comment section. Therefore, a Python script created by Nick Day (2019) was used to add the updates and comments associated with the campaigns to the initial data set. However, many updates were multi-media and therefore all campaigns were also identified in their full form on Kickstarter.

Table 2: Describing the characteristics of the criteria that projects were filtered against.

State	Campaign deadline	Category	Backers
Successfully funded	1420070400 – 1483228800	Technology: Hardware	≥100

2.2.2. Data Selection and Data Processing

The Kickstarter dataset contained 222,659 campaigned in total, between the years of 2009 and 2020. From the full dataset 277 campaigns with the characteristics presented in table 2 were identified. Whereas the state criterion was binary, the deadline span was chosen to allow plenty of time for the delays to occur +3yrs but not old enough for the projects to avoid the problems reported with the web scraper above. The deadline span is given with its UNIX timestamp and represents the time between January 1st, 2015, and January 1st, 2017. Thirdly, projects had to be entered as "Hardware", a subcategory to Technology, to be selected. To ensure that the product development was sizable, the final criterion was that the project must have been backed by more than 100 people.

Once the projects had been identified projects that had met their estimated delivery date were excluded. This was done by studying the updates and comment section and identifying updates claiming all products were successfully delivered as well as comments supporting this claim. Projects that lacked information to verify whether all the rewards were sent on time or not were also excluded.

2.2.3. Data Analysis

On the projects that had not met their estimated delivery date, a qualitative content analysis was carried out. The methodology adopted was that described by Graneheim and Lundberg (2004). First, meaning units were extracted from the full unit of analysis, in this case, the campaign page. The meaning units were then expressed in a shorter form, a condensed meaning unit, and finally transformed into code (Graneheim & Lundberg 2004). In table 3, two examples of the coding process have been provided. The motivation behind using a qualitative content analysis is that it provides relevant information from the full unit of analysis. In this study, the relevant information was self-reported descriptions of actions taken because of delays or actions described to cause delays. This in order to explore what can cause, exhibited, mitigate, or eliminate delays.

The content analysis was done campaign by campaign. Every time 10 projects had been identified as delayed and included explanations as to why an attempt to create subthemes from the codes was made (Graneheim & Lundberg 2004). The purpose of this was to explore patterns in the data. In the creation of subthemes, an abductive research approach was adopted. That is to say, the subthemes were created by drawing from the theoretical framework as well as considering possible new findings from the data set. This process was iterative, with revisions made as necessary to simultaneously explore and integrate the data patterns with the theory. The guiding principle was to ensure a good degree of internal homogeneity and external heterogeneity. This process was repeated until the subthemes had been set and theoretical saturation was reached. E.g., the stage where no new ideas were introduced. This occurred after 40 projects had been identified as fulfilling the above criteria out of 65 analyzed.

After the point of theoretical saturation, the subthemes were then used to look for patterns on an overarching level, and thereby creating themes. Graneheim and Lundberg (2004) suggest that it is also possible to begin by creating themes and deconstruct these into subthemes. However, the integration of the theoretical framework was better suited to first establish subthemes and then creating themes.

Table 3: Examples from the content analysis

Meaning Unit	Condensed meaning unit	Code
"All of our vendors read public (and often private) updates as well as our Slack channels - one of the downsides of having a public campaign."	Sensitive information communicated between backers and developers is open to all.	Sensitive information unprotected
"To keep the factory accountable and make sure any 'fires' get put out immediately, we packed our bags and moved the entire team to live at the factory (we're still here as this update is written)."	The team moved operations to the factory to monitor work and solve problems.	Pro-active onsite presence

3. Theoretical Framework

This chapter presents potential reasons for delays as well as mitigating actions discovered in the systematized review. Section 3.1 discusses this topic from the point of traditionally funded product development and section 3.2 discusses the context of crowdfunded and reward-based projects.

3.1. Drivers of delay in traditionally funded new product development

The literary review revealed several drivers of delays in traditionally funded new product development, NPD, five of which are presented in this section; preparative product development work, technical proficiency, technological uncertainties, product development management, and design for manufacturability. The rationale behind the selection was that these drivers are likely to also affect the development of products in a crowdfunding context.

3.1.1. Preparative work

Several researchers identify preparative work as a driver for the delay. Gupta and Wilemon (1990) discuss pre-development work in terms of product requirements. In their study of reasons for product development delays - poorly defined requirements were the most cited reason (Gupta & Wilemon, 1990). These poorly formulated requirements can be a result of insufficient knowledge about the customer's needs, the technology involved in the product and market forces (competition, suppliers, and distributors) Cooper and Kleinschmidt (1994) bring up the same aspect of preparative product development work but choose to call it "up-front homework". Like Gupta and Wilemon (1990), Cooper and Kleinschmidt (1994) describe the need to study market forces, assess the technical context, and initial screening of the product to improve timeliness.

3.1.2. Technical proficiency

In their study of the product development projects with very high and very low levels of timeliness, a lack of technical proficiency was also identified as a driver of delays (Cooper & Kleinschmidt, 1994). Naturally, to carry out technical tasks, be it proactive or reactive, the developers need to know-how. Ulrich and Eppinger (2015) also describe inadequate technical skills as an organizational challenge to successful product development. One example of technical proficiency is knowing if, how, and when to utilize prototypes in order to reduce risk. As with DFM, prototyping activates must be weight against the development time. Noteworthy is that Ulrich and Eppinger (2015) notes that prototypes, and especially comprehensive prototypes, are especially beneficial for products that have a high cost of failure, includes cutting edge technology or is revolutionary in another way. Characteristics that can be applied to several successfully crowdfunded hardware projects.

3.1.3. Technological uncertainties

Another driver of delay identified by Gupta and Wilemon (1990) was the extent of technical uncertainty. The technological landscape is always evolving and in some industries, this rate of change is especially fast. A consequence of this, Gupta and Wilemon (1990) found, was that when projects were delayed, developers where likely to take stock of the current technological landscape and adjust the project – further exacerbating the delays. This desire to constantly change, adjust or postpone finalizing decisions Gupta and Wilemon (1990) call "creeping elegance" or "might as well". This tenancy is also described in Wheelwright and Clark's book Revolutionizing product development: quantum leaps in speed, efficiency, and quality (1992), under the name of "the moving target".

3.1.4. Product development management

Failing to effectively organize is another potential drive or product development delays (Gupta & Wilemon, 1990; Cooper & Kleinschmidt, 1994). Examples of organizational actives would be to develop, update and work by a good product development plan, with an accompanying control system, clearly defined roles and authority amongst the developer,s and good communication structures (Gupta & Wilemon, 1990; Cooper & Kleinschmidt, 1994).

3.1.5. Design for Manufacturability, DFM

In their book Product Design and Development Ulrich and Eppinger (2015) discuss the merits of designing for manufacturability. Failing to consider a product's manufacturability can cause development delays (Ulrich & Eppinger, 2015). Since DFM consideration swept the traditional product development industry in the 1980s, Ulrich and Eppinger have found that DFM is now commonplace. Newer products tend to have lesser parts than their predecessors, utilized standardized parts to a greater extent, and be easier to assemble (Ulrich & Eppinger, 2015). However, Ulrich and Eppinger (2015) note that the relationship between DFM efforts and development time is complex. The potential of making the design more suitable for manufacturing must be weighed against the time needed to develop such a design (Ulrich & Eppinger, 2015).

3.2. Drivers of delay in crowdfunded new product development

The literary review revealed some drivers of delays in crowdfunded NPD; size, over-optimism, knowledge of necessary skills, knowledge of laws, rules, and regulations. Furthermore, fraud was identified as a variable that the general public assumed drove delays. However, nobody of the research identified fraud as a significant driver of delays.

3.2.1. Size

In "The dynamics of crowdfunding: An explorative study" Mollick (2013) found that the size of the project indicated how substantial a delay would be. In crowdfunding, literature size refers to the size of the funds a project raises. And the larger the project, the longer the delay. Belleflamme

and Lambert (2014) touch especially on projects that end up much larger than anticipated. Initial estimates might need to be completely revised Belleflamme and Lambert (2014). How to ensure sufficient manufacturing capacity, warehouses space, or addressing administrative challenges will be different depending on the project scale.

3.2.2. Over-optimism

All entrepreneurs can benefit from impression management, which potentially increases the chances of successful funding (Bird & Jelinek, 1988). Base on this insight Randolf Luttner (2014) has suggested that those creating a crowdfunding campaign might deliberately present an over-optimistic case. A persuasive and optimistic language can make for a successfully funded campaign but ultimately cause delivery delays. However, Belleflamme and Lambert (2014) suggest that this over-optimism is not deliberate. Instead, they argue that the majority of those creating a crowdfunding campaign is unknowingly overoptimistic and harbour unrealistic views of their abilities and the project's prospect.

3.2.3. Fraud

The legal framework for crowdfunding actives does not mandate income statements or profit or loss accounts (Belleflamme & Lambert 2014). Such a context could be prone to fraudulent activity. In "Disentangling Crowdfunding from Fraudfunding" (Cumming et al., 2016) conclude, that backers tend to regard projects fraudulent when rewards are significantly delayed, communication has sized, no refunds have been offered and rewards have not been delivered. Although such projects are not considered fraudulent from a legal perspective, this might explain the current assumption that crowdfunding delays are due to fraud. However, the current research finds little evidence of such activity (Mollick 2014; Belleflamme & Lambert 2014). In the Design and Technology category, Mollick found only 14 potentially fraudulent projects out of 381 studied.

3.2.4. Insight into what skills are needed (and seek those skills amongst backers)

In "Handbook of Entrepreneurial Finances" Schwienbacher and Larralde (2010) present good crowdfunding practices. The study aimed to provide a guide for how to successfully reach a crowdfunding goal. The study primarily focused on smaller ventures. One of these good practices can also mitigate or eliminate product delays; identify what skills and the findings were based on a literary review and case study. One of the good practices identified could also serve to mitigate or eliminate product delays; identify what skills the crowdfunding endeavour will require and look for those skills in the backers. This advice is twofold, firstly the developers need to know what skills are required, or else be caught out not able to proceed in the development process. The second part refers to the fact that the backers can be seen as a resource. If an unforeseen skill is discovered to be necessary, a backer with this skill might be willing to support in order to mitigate or prevent delays.

3.2.5. Laws, rules, and regulations

In order to gain the trust of potential backers, crowdfunding campaigns can reputation signalling through the use of certifications (Agrawa et al., 2016). This process can be done prior to the launch

of the crowdfunding campaign or be included in the product development plan after successful funding. Furthermore, the production and shipping of certain products, e.g. lithium batteries. Lacking understanding of how these certifications work, and what they require can potentially cause delays. Similarly, Schwienbacher and Larralde (2010) advise that knowledge of the law, rule, and regulations, in general, is necessary for a successful crowdfunding campaign. When applied, this advice also has the potential to eliminate delays.

4. Results

This chapter presents 15 subthemes, summarizes in table 4, that affect the timeliness and groups them into three themes; quality of partnerships, developers' knowledge, and the extent of uncertainty. Each subtheme introduced is related to the theoretical framework. A summary of the findings can be found in Table 4 and **Error! Reference source not found.**.

4.1. Quality of partnerships

To realize their crowdfunded products all developers in the projects studied, worked with external partners. In this subchapter delays attributed to manufacturing and supplier partners' actions or lack thereof are presented. The proximity to these collaborative partners was also identified as a subtheme and described here. Lastly, findings related to delays caused by prioritizing strategically important partnerships over finalizing the development are outlined.

4.1.1. Manufacturing

Most projects suffered delays as a result of poor collaborations with manufacturers. It was common for projects to change manufacturers during the project, sometimes these changes were made multiple times. Often the issues and fall outs were caused by contract breaches or other agreement violations. A frequent point of disagreement was product quality. Many developers also received faulty or outright wrong parts. In most instances, the external partner was blamed, but a few developers did describe a situation of miscommunication thus implying a shared responsibility. Another issue developers faced in their collaborations with manufacturers was timeliness. Manufactures would fail to meet agreed delivery dates and the project would subsequently be pushed forward.

There were some positive descriptions of the collaborations with the manufacturers, but they were never explicitly linked to mitigating or eliminating delays. Two developers mentioned that having a team member who shared a language (Mandarin and German) with the manufacturing partner greatly improved communication and collaboration.

4.1.2. Suppliers

Poor collaborations with suppliers was another cause and exacerbator of delays. As was the case for the collaborations with manufacturers, contract breaches or other agreement violations were frequent and resulted in faulty or wrong parts. One such example was the XSHIFTER, a wireless bike gear shifter (Gallagher, 2016). During functional testing of the final product, a drive screw unexpectedly broke. Upon investigation, it was determined that "the screw was improperly manufactured. The supplier [had] made the shaft from 2 pieces and glued it together." It was also common for parts to arrive with measurements other than the ones that had been specified.

There were no instances where good collaboration with suppliers was linked to mitigating or eliminating delays. The team behind Voltus, a power bank (Boehler-Boch, 2015), did, however, make an effort to mitigate the effects of poor collaborations. They anticipated supplier delays

and therefore sourced the same part from several suppliers. In case one of the suppliers would fall behind, manufacturing could still begin with the parts that had been delivered. However, all of their suppliers suffered delays.

4.1.3. Geographical proximity to partners

It was especially common for the collaboration with partners to be challenging when the developer was physically separated from them. The developers of the Manga Screen 2 found themselves in a situation where either the products or the testing jig was broken. To investigate this a set of sample products and testing jig had to be shipped back from the manufacture (in Asia) to the developers (In Europe), thus delaying the progress. The developer reflecting on this situation wrote: "There are times you wish you had a manufacture in the same time zone and a plane ride away" (Bakken, 2018)

Some developers choose manufacturers and suppliers based on proximity and others travelled to the location of their partners to be present on site. Such decisions were motivated by proactively or reactively seeking to eliminate or mitigate delays. After being severely delayed due to quality issues the developers of Auroma, a coffeemaker, offered the following updates to backers: "To keep the factory accountable and make sure any 'fires' get put out immediately, we packed our bags and moved the entire team to live at the factory (we're still here as this update is written)" (Narchi, 2016).

4.1.4. Long term priorities

Prioritizing the long term over product development (and consequently a timely launch) was explicitly mentioned twice. In both cases, the developers sacrificed timeliness of business longevity. One developer described delaying development work to focus on the Consumer Electronics Show, CES, to connect with future partners. Many other developers describe attending similar tradeshows, courting traditional retail channels, and applying to a retail accelerator, but never explicitly link these commitments to delays. Another developer claimed it was necessary to refocus all development work to another product sold through traditional channels to maintain economic sustainability, but there were no other examples of similar practices.

There were no explicit mentions of sacrificing long term interest of the company in order to deliver the product to backers on time.

4.2. Developers' knowledge

The extent to which the developers possess the necessary knowledge to bring a new product to market effected timeliness. Developers who lacked technical proficiency, understanding of the procurement process practices or knowledge of laws, rules, and regulations were prone to delays. However, a lack of knowledge did not always lead to delays. If aware of their insufficient knowledge, developers took action to procure this knowledge from outside experts. In some projects, this expertise was successfully secured amongst the backers.

4.2.1. Knowing your needs

There were few explicit accounts of delays caused by failing to foresee what knowledge a project would require. But many updates focused on how to remedy delays already caused by a lack of foresight. Several developers described eliminating or mitigating delays by sourcing knowledge that the developer team lacked but needed to succeed. This was demonstrated in developers proactively or reactively sourcing external expertise. Examples of expert roles that were consulted where: customs brokers, project managers, and quality engineers. These findings support the existing research on the developer's insight into what skills will be needed affecting timeliness. When developers displayed a good understanding of what resources and knowledge were required, it was often a result of learnings from the backers. Firstly, in terms of experienced backers, who have followed the development of several new products would offer advice to the developers. And secondly in terms of knowledge and insight gathered in user tests. Since many backers are highly engaged in the product development process the developers found beta testers with ease. There were also some crowdfunding campaigns where a reward level was to receive a beta product. Furthermore, many developers successfully looked to their backers to provide the necessary knowledge which also aligns with the ideas presented in the theoretical framework. Such was the case with the makers of PaPiRus, who successfully reached out to backers with experience of spring-loaded pogo pins and where to source them (Shaw, 2015).

4.2.2. Procurement

The procurement process challenged many developers. Developers not only underestimated the time need for procurement and contracting, but they were also inept in the procurement practice itself. As is evident from the issues with manufacturers and suppliers, few developers practised effective service procurement strategies. Unsatisfactory results from the procurement would often be named as a reason for delays. At times the quality would be so poor or the delivery so late that developers would drop the service provider and re-start the procurement process.

The developer's procurement struggles also involved with the procurement of parts and raw materials. Many products had been designed around components with great functionality or at best a good price. Developers had however often failed to consider the availability of said parts and would, therefore, suffer availability issues of key components. As a consequence, developers often found themselves waiting for backorder components or reinitiating a procurement process. In the worst-case scenarios, components would be discontinued altogether, forcing the developers to return to the drawing board. There was one suggestion that the procurement process is especially difficult for developers who have crowdfunded their products. Since crowdfunding updates are easily accessible the developers have a more difficult negotiation position than developers of traditionally financed products.

There were no mentions of actions to improve the understating of the procurement process or explicit claims that a good understanding of the processes might have mitigated or eliminated delays.

4.2.3. Technical proficiency

In some projects, delays occurred due to a lack of technical proficiency. One specific area where developers struggled was test design. One of the tests carried out on the PiTouch (2014) was carried out at a level below the load that the product would be subjected to under normal use. When two backers were given an early sample of the product to use, they found it did not function. The developers admitted the fault would have been discovered had the test load been higher. The most common area where developers lacked technical proficiency was tolerancing. Upon discovering in practice that tolerance stack developers would have to rework the design or quote the manufactures for a production run with finer tolerances. In a few projects, delays were caused by discovering that the strength of materials was not enough. The findings on technical proficiency mirror the existing research on technical proficiency presented in the theoretical framework.

When moving into the production phase, many developers also discovered that their designs were ill-suited for manufacturing. These shortcomings were not only common but considerably severe. One set of developers set out to realize their design consisting of 202 elements. They reported being shocked when learning that it would require 44 separate injection moulds and carry a very high manufacturing cost (Foster, 2015). The frequency and severity of the manufacturability neglect suggest that developers do not consider manufacturability aspects prior to initiating a crowdfunding campaign. These were, however, some explicit descriptions of carrying out a DFM-analysis but only after the crowdfunding campaign. However, these practices are far less common than within traditionally funded product development. In contrast to the theoretical framework, there is no evidence of excessive use of DFM-practices as a cause for delays.

Mitigation and elimination of delays were reversely achieved by developers with sufficient technical proficient. This was expressed in the descriptions effective use of tools such as prototypes and soft tools. In combinations with successfully designed tests, the developers were able to identify problems early and thus mitigate or eliminate delays that might have occurred where these issues discovered later.

4.2.4. Laws, rules, and regulations

Insufficient knowledge of laws, rules, and regulations was, as suggested by the theoretical framework, a cause of delays in the projects analyzed. Hardware projects are subject to plenty of regulations and certifications, the latter was an especially common cause of delays. Developers lacked insight as to how long a certification process was or what was required of the product. Failing a certification would require design changes and subsequent re-drafting, re-submitting paperwork, and re-testing. A particular point of difficulty was manoeuvring Apple's MFi licensing program and app review process. When moving into the certification phase the developers of Vivi, a music reactive led controller, were delayed and explained that there was "[…] a lot more paperwork involved in FCC/CE testing than we expected" (Kachur, 2016). The Vivi was delayed further by another aspect of laws, rules, and regulations - taxes. Crowdfunded product developers may be overwhelmed by the administrative burden of filing taxes, but only the Vivi developers cited it as a reason for delay. Another delay driver only mentioned by one product development team was facing trademark issues. The Pijuice, a raspberry pie platform, reported facing a 2-year

long legal process to be freed of accusations. They also described how "shipping laws changed regarding the shipping of all lithium Ion batteries" during the time they worked on bringing the product to market which delayed the development. Similarly, other projects reported delays caused by customs holding or returning components and products due to insufficient knowledge of import and export laws.

Three approaches to avoiding or mitigating certification delays were discovered in the projects studied. The first was to contract a certification specialist as Fishbit (Levine, 2016), choose to do. The second was to replicate the tests included in the certification process before sending in the product, like Realiser A16, a 3D headphone system did. Thirdly, as the makers of Nero, an Arduino, choose to do – develop an early, but comprehensive, prototype to pass certification and use as a reference point to assume that the final design will also be approved.

4.2.5. Scope

A successfully crowdfunded project will have been evaluated by a large group of people. This substantial review often manifested itself in backers suggesting changes to the original design. In the projects studied, adapting the design to incorporate these suggestions was always associated with a delay. An example of this type of backer-driven scope creep can be found in the Wired In -project (Howland et al., 2015) The original design was updated to include an additional feature (RGB-lighting) as suggested by the backers.

The projects studied also included examples of design changes made on the developer's initiative. These changes where the consequences of the developers discovering new technologies and functionalities or changing strategies. One example is the developers behind Cmoar, a virtual reality headset, who attempted to develop their way out of economic problems (Foster, 2015). The development of the original concept was severely delayed. The long development process had incurred large costs and the manufacturing cost had risen. The developers, therefore, expanded the scope of their development effort to include more products, hoping to make up for the money lost. An ultimately unsuccessful strategy. The analysis included one explicit description of developers acting on creeping elegance, as described in the theoretical framework. When the project was delayed, to rework parts of the design, the developers described this as an opportunity to add additional changes. It can also be seen as inadequate product development management. Without a good product development plan scope creep is a risk.

One approach developer used to mitigate delays was to limit the scope beyond what the initial campaign had promised. This was done by sacrificing modularity, compromising quality but most often by reducing the functionality of the accompanying software.

4.2.6. Kickstarter money transfer

When a campaign ends after having been successfully funded, developers reported being surprised by the fact that Kickstarter did not transfer the money instantaneously. Instead, Kickstarter would deliver the funds in instalments. One developer described time plans based on paying external

parties on the final day of the campaign, in order for the subsequent party to begin work. When the money is then delayed, the project progress stops.

No developers explicitly mentioned that a pro-active understanding of how and when the transfer of funds happens.

4.3. The extent of uncertainty

A number of findings were related to the theme of uncertainty. More specifically the following subthemes where identified: technological immaturity, natural disasters, personal life changes, and the inability to predict the scale of the project.

4.3.1. Technological uncertainties

As suggested by the theoretical framework the maturity of the technology involved affected when and if projects delivered were. Like the Nonda developers who reported that their products would be "the first one in the world, apart from Apple, to have found a solution to simultaneously charge the MacBook and transfer data" (Wen, 2015), many developers were attempting to bring new and innovative technologies to the market. In these projects, developers quickly ran into problems. From the developers' descriptions of these problems, it appears that their initial understanding of the project's feasibility seemed to be informed solely by the manufactures. As opposed to forming an independent understanding of the new technology's possibilities and limitations by consulting more objective sources. After successfully crowdfunding their development effort the developers would go back to the same manufacturers, to place an order, at which point the manufacturers would revise their initial optimism. These manufacturers would then conclude that this was, in fact, not something they could deliver or revise the timeframe.

There were no explicit mentions of a developer recognizing a situation where there was little of no theological uncertainty and relating the fact to mitigating or eliminating delays.

4.3.2. Holidays

One factor that never caused or drove delays but often exacerbated them was the Chinese New Year. The majority of products were entirely, or partly, manufactured in China. As a consequence, many projects would be delayed due to the industry-wide closedowns during the national holiday and the subsequent unavailability as manufacturers dealt with a long backlog of work

4.3.3. Natural disasters

Finally, some projects were delayed due to natural disasters. Typhons, snowstorms, and the COVID-19 pandemic are three of the natural disasters that disrupted the product development processes. Again, there were no instances where natural disasters eliminated or mitigated delays.

4.3.4. Personal

A few of the developers experienced unforeseen changes on a personal level. Many projects lost fellow developers, friends, or family members whereas others welcomed children during the development effort. When these events were described the developers also shared that the events had caused delays. In between life and death, there was a third cause of delay – disagreement amongst the developers. When escalated these fallouts usually ended with legal action and as a consequence little detail is shared on these issues. Albeit with little detail, lawsuits, buyouts, and re-organization were all described as reasons for project delays. The descriptions of these fallouts indicate inadequate product development management, more specifically poor communication and unclear division of authority.

There were no instances where a developer described changing personal circumstances as a reason delays where mitigated or eliminated.

4.3.5. Size

As described in the theoretical framework, the size of the funding raised was correlated with the length of the delays. However, few developers who explicitly discussed and linked project size to delays. But another interesting aspect of size and the public nature of crowdfunding was raised by the developer of Superbook, a laptop powered by smartphones:

> One of the biggest challenges of manufacturing as a startup is you need to convince dozens of vendors, manufacturers, and supply chain companies to cooperate with you, give you decent pricing, and help you succeed because it is in their best long term interest. All of our vendors read public (and often private) updates as well as our Slack channels - one of the downsides of having a public campaign.

It is possible that potential partners upon seeing the capital raised and the number of waiting customers are encouraged to negotiate harder.

Finally, there were no developers who recognized and explicitly described the size of the project as something that eliminated or mitigated delays.

Table 4: Subthemes and related causes and drivers of delays

Subtheme	Causes and exacerbations of delays
Manufacturing	Poor collaboration with manufacturers
Suppliers	Poor collaboration with suppliers
Geographical proximity to partners	Geographically distant from partners
Long term priorities	Re-allocating resources to seize or ensure long term profitability at the expense of timeliness.
Knowing your needs	Poor understanding of what resources and knowledge are required
Procurement	Poor understanding of the procurement process
Technical proficiency	Insufficient technical proficiency
Laws, rules, and regulations	Poor understanding of laws, rules, and regulations
Scope	Scope creep
Kickstarter money transfer	Underestimating the time involved before the transfer of funds is complete.
Technological uncertainty	Technological immaturity
Holidays	Stakeholder delaying progress due to holidays
Natural disasters	Stakeholder delaying progress due to natural disasters
Personal	Stakeholder delaying progress due to personal reasons
Size	A large number of backers and/or products ordered

Table 5: Subthemes and related mitigations and preventions of delays

Subtheme	Mitigations and preventions of delays
Manufacturing	Good collaborations with manufacturer
Suppliers	Good collaborations with supplier
Geographical proximity to partners	Partners within close geographical proximity
Long term priorities	-
Knowing your needs	Good understanding of what resources and knowledge are required
Procurement	Good understanding of the procurement process
Technical proficiency	Technical proficiency
Laws, rules, and regulations	Good understanding of laws, rules, and regulations
Scope	Scope reduction
Kickstarter money transfer	-
Technological uncertainty	-
Holidays	-
Natural disasters	-
Personal	-
Size	A small number of backers and/or products ordered

4.4. Code frequency

The full set of codes used in this study amounts to 221 and the distribution between codes related to causes and exacerbations, and mitigating and preventative actions are presented in Figure 2. The majority of the codes, 82%, are related to causes and drivers. Codes related to mitigation or elimination of delays only made up 18% of the total set.

In Table 5 the code frequency of codes related to causes and exacerbations of delays are presented. The most common subtheme for a code to fall into was manufacturing. 33 codes fell into this subtheme. The least frequent was Kickstarter money transfer, long term priorities, and geographical proximity to partners, with two codes each.

Table 6 breaks down the code frequency for codes related to actions mitigating or eliminating delays. The most common subtheme was knowing your needs and 14 codes fell into this category. The least frequent subthemes were laws, rules and regulations, and suppliers with only one code per subtheme.

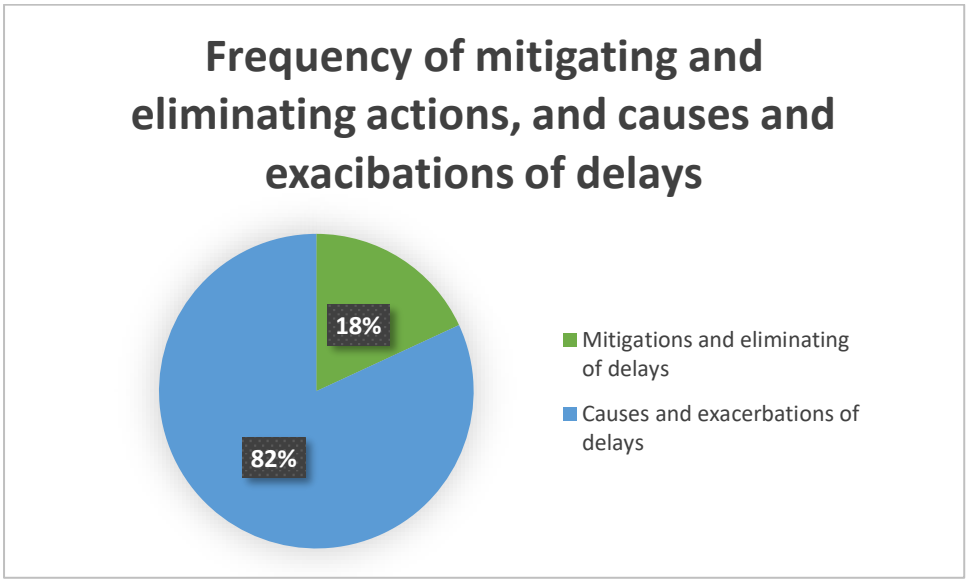

Figure 2: Frequency of mitigating and eliminating actions, and causes and exacerbations of delays

Table 5: Code frequency for codes related to causes and exacerbations of delays

Subthemes	Frequency
MANUFACTURING	33
PROCUREMENT	30
TECHNICAL PROFICIENCY	26
SUPPLIERS	21
LAWS & RULES AND REGULATIONS	17
SCOPE	12
TECHNOLOGICAL UNCERTAINTY	8
HOLIDAYS	7
KNOWING YOUR NEEDS	6
NATURAL DISASTERS	6
PERSONAL	5
SIZE	4
KICKSTARTER MONEY TRANSFER	2
LONG TERM PRIORATES	2
GEOGRAPHICAL PROXIMITY TO PARTNERS	2

Table 6: Code frequency for codes related to actions mitigating or eliminating delays

Subthemes	Frequency
KNOWING YOUR NEEDS	14
GEOGRAPHICAL PROXIMITY TO PARTNERS	10
MANUFACTURING	7
TECHNICAL PROFICIENCY	4
SCOPE	3
LAWS & RULES AND REGULATIONS	1
SUPPLIERS	1
HOLIDAYS	0
KICKSTARTER MONEY TRANSFER	0
LONG TERM PRIORATES	0
NATURAL DISASTERS	0
PERSONAL	0
PROCUREMENT	0
SIZE	0
TECHNOLOGICAL UNCERTAINTY	0

5. Discussion

The analysis part of the discussion offers interpretations and evaluations of the findings from this study. This is followed by an evaluation and review of the applied methodology's strengths and weaknesses.

5.1. Analysis

The majority of the findings affecting timeliness are consistent with past research. The study identified the following subthemes previously described in research on traditionally funded product development; technical proficiency and technological uncertainties, product development management, and design for manufacturability. Furthermore, the following subthemes, previously described in research on crowdfunded product development, were also identified; insight into what skills are needed (and utilizing backers), laws, rules and regulations, and size. In none of the delayed projects studied was there any evidence of fraud. This was another expected finding as previous research has confirmed that instances of fraud in successfully funded projects are unusual.

Some findings did however not align the previous research body. A notable point of difference was design for manufacturability practices which were practised later in the process, or not at all, in comparison to traditionally funded product development. Taken together with the frequency of collaboration, procurement, and laws, rules, and regulations issues, the data suggest that developers who chose to crowdfund their products undervalue activities not related to form and function.

Insufficient technological proficiency was a surprisingly frequent delays driver. A portion of this could be explained by the crowdfunding context encouraging innovative and cutting-edge technology. However, there were a noteworthy number of rudimentary mistakes described and many developers would be aided by a better understanding of prototyping and testing principles.

Two aspects of the theatrical framework were absent from the project studied; over-optimism and preparative work. No developers explicitly state that a delay had been caused by an overly optimistic mindset or a lack of preparative work. These are both indirect causes of delay. More reflection and abstraction is necessary to arrive at these causes for delay. This could be an explanation for their absence. However, it is also possible that preparative work, at least in part, is more common in the context of crowdfunded product development. In order to successfully crowdfund a product, it needs to appeal to the customers. An implication of this is that in successfully crowdfunded projects, preparative work has been done to identify and understand customer's needs. Their absence from the results should therefore not be a contradiction of previous research but potentially an expression of a unique characteristic of the crowdfunding context.

When analysing the findings as a whole, there is a similar absence of other high order and more abstract reflections on delays. This could be an explanation as to why the distribution between developers describing what drove delays and developers describing what hindered delays was very uneven. The most frequent subthemes related to causing and exacerbations of delays offer another

possible explanation as to why. Many of the descriptions studied are related to an aspect that was external to the developer team. This is likely another consequence of the self-reported nature of the data. Be it unconsciously or as part of deliberate impression management, placing blame with another part i.e. partners, lawmakers or other authorities is easy to do. These two aspects, the relative ease of identifying and sharing others' mistakes, are likely both contributing to the uneven distribution of the findings. However, the findings concerning geographical proximity to partners do not align with this pattern. The majority of developers only identified this problem in instances where they acted to solve it. This is likely because contracting partners (primarily manufacturers) abroad for financial reasons is seen as the norm. With fixed assumption, developers don't arrive at a conclusion linking delays to being geographically distant from partners.

Most of the subthemes housed opposing pairs, what caused and exacerbated delays would mitigate and eliminated delays in its refers. A consequence of this is that findings related to mitigating and eliminating actions can be seen as proof of the reverse situations ability to cause or exacerbate delays, and vice versa. I.e. developers moving to the site of the manufacturer or changing to a local manufacturer and successfully mitigating delays indirectly indicates that the being geographically distant from partners can cause and drive delays.

5.2. Method evaluation

Throughout the study, each methodological choice was seen as a possibility to increase or decrease the study's validity, as opposed to approaching validity as a binary concept (Yin, 2013). The methodological choices were to a great extent also motivated by the rich and readily available source material – product development updates on Kickstarter. The subsequently chosen and applied methodology, at the centre of which was an abductive research approach to a qualitative content analysis, proved effective and established several themes and patterns. The use of qualitative data allowed the practical experiences of developers to be utilized and understood in their context (Yin, 2013; Esaiasson et al., 2012).

The coding, identification, and evaluation, of themes and subthemes, was executed by only one person. This method results in a consistent but unchallenged coding. A study with multiple researchers, given that sufficient intercoder reliability, could be achieved, would have further increased the validity. Despite these delimitations, the validity of the coding was ensured by the presence of a strong and clear coding scheme (activities affecting development timeline) supported by the theoretical framework (Potter & Levine-Donnerstein, 1999). When parts of the findings mirrored the theoretical framework, it would reinforce the validity. In order to further increase validity and ensure reliability and reproducibility, the methodology was described in detail in chapter 2. Methodology and all codes from delayed projects and their subthemes are included in Appendix A.

Further validating the findings was the richness and extensiveness of the data. Most updates included very detailed and multimedia descriptions. The dynamics between the backers and the developers was also one of checks and balances as the backers were highly active in their evaluation

and examination of the updates. This likely limits potential reputation signalling, exaggerations, and deceit. When analyzing the findings, there was however a significant absence of high order and more abstract reflections on delays, which self-report data is ill-suited to capture. But the consequence is merely that the picture is not complete, not that the findings are inaccurate and therefore a valid limitation of an explorative study.

In order to increase the study's validity further, an interview study could have been used to triangulate the findings. If feasible, an interview study could have painted a more detailed picture of the context and the factors at play. The interviews could have served to strengthen or dispute the finding sourced from the platform. Furthermore, interviews could have been used to evaluate the effectiveness of actions taken to mitigate or eliminate delays. However, the context (delayed crowdfunding projects) made such a study very difficult to carry out. The present-day situation of the projects studied is one where developers are bombarded with communication from disappointed, angry and threatening backers. Developers consequently seize to monitor any publicly available communication channels and only communicate one-way and through non-public channels. Therefore, this approach was not possible within the study's time limitations.

6. Conclusions and Future Work

This chapter concludes the thesis by looking back; to highlight key takeaways and looking forward; to encourage future work.

6.1. Conclusions

New product development that obtains finances through crowdfunding is known to suffer delays. The primary purpose of this study was to investigate why. Through a qualitative content analysis actions and circumstances that caused, drove, mitigated, or eliminated delays where identified.

RQ 1: What can cause or drive delays in successfully crowdfunding hardware projects?

The findings related to what can cause or drive delays formed three themes; partnerships, knowledge, and uncertainty. Possible causes and drivers of delays related to partnerships were; poor collaboration with manufacturers, poor collaboration with suppliers, geographically distant from partners, and re-allocating resources to seize or ensure long term profitability at the expense of timeliness. Whereas the latter had relatively little representation in the analysed material the presence of the other three was strong. Problems with manufacturers and suppliers were explicit. Whereas geographical distance from partners driving and causing delays were indirectly expressed through actions taken to mitigate such effects.

The theme of knowledge presented the following causes and drivers; poor understanding of what resources and knowledge are required, poor understanding of the procurement process, insufficient technical proficiency, poor understanding of laws, rules and regulations, scope creep and underestimating the time involved before the transfer of funds is complete. Instances of delays cause and driven by poor understanding of the procurement process and insufficient technical proficiency were many. The amount related to scope creep or poor understanding of laws, rules, and regulations was less but still considerable. Only a few mentions of poor understanding of what resources and knowledge are required and underestimating the time involved before the transfer of funds is complete were included in the analysed material. The formers function as a potential cause or drive is however supported indirectly through mentions of the reverse situation mitigating delays, and through the theoretical framework. Underestimating the time involved before the transfer of funds is complete was undoubtedly a cause and driver in the few instances it was mentioned. However, the rarity of the mentions shows that this is not a frequent occurrence.

The following possible causes and drivers were related to uncertainty; technological immaturity, stakeholder delaying progress due to holidays, stakeholder delaying progress due to natural disasters, stakeholder delaying progress due to personal reasons, and a large number of backers and/or products ordered. Each which figure quite infrequently. But a large number of backers and/or products ordered and technological immaturity as causes and drivers is further supported

by the theoretical framework. And the instances of stakeholder delaying progress due to holidays, stakeholder delaying progress due to natural disasters, stakeholder delaying progress due to personal reasons provide are both explicit and clear in their role in causing or exacerbating delays.

RQ 2: What can mitigate or eliminate delays in successfully crowdfunded hardware projects?

All explicit mentions of mitigating or eliminating delays fit into either a theme of partnerships or of knowledge. The former constituted of findings showing that good relationships with manufacturers, good relationships with suppliers, and partners within close geographical proximity has the potential to mitigate or eliminate delays. The latter was strongly supported by many explicit mentions the others were primarily supported through descriptions of delays caused and exacerbated in the same subtheme.

The discoveries related to knowledge were that good technical proficiency, a good understanding of what resources are required, a good understanding of laws, rules and regulations and scope reduction have the potential to mitigate or eliminate delays. There were several instances of actions taken to mitigate or eliminate delays that highlighted the importance of a good understanding of what resources are required. There were lesser explicit mentions of good technical proficiency, a good understanding of laws, rules and regulations and scope reduction but all were supported by descriptions of delays caused and exacerbated in the same subtheme as well as the theoretical framework.

Finally, a good understanding of the procurement process and a small number of backers and/or products ordered can also mitigate or eliminate delays. Although there were no explicit mentions of these factors, the former was indirectly mentioned in descriptions of delays caused and exacerbated in the same subtheme and the latter equally strongly supported by the theoretical framework.

6.2. Future Work

This thesis explores delays in successfully crowdfunded hardware projects. A natural next step would be to explore the same issue but with a different set of delimitations. Instead of studying projects from Kickstarter, data could be collected from another crowdfunding platform. A geographical perspective would also be interesting. Both Kickstarter and Indiegogo categorize projects by the developer's country of origin. These two approaches could also be combined by choosing a crowdfunding platform for developers from a specific country.

Instead of changing the delimitations, an alternative method to approach the research questions would be to carry out an interview study. In this case, contact with the successfully funded hardware project would be established immediately after a funding goal is reached. The developers would at that point be asked to participate, with anonymity, in a research study. This approach would also allow another interesting topic of study - wheater the procurement process is especially difficult for developers who have crowdfunded their products. An exploration of the extent to which the negotiation lopsided by the transparency of crowdfunding endeavours.

While reading and analysing the interaction between the developers and the backers – it is apparent that crowdfunding democratizes the product development process. This would be another interesting area for further research.

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Appendix

A. Codes and subthemes for the delayed projects studied

With the aim of transparency, all codes and their subthemes are presented below. The codes are preceded by a key that explains how to read the material. The codes are presented project by project (in the order that they were analyzed) and include actions that caused, drove, mitigated, or eliminated delays.

Table 7: Key explaining the information from the projects included in the consent analysis.

n	**Name of the Crowdfunding Campaign**		
	Meaning unit 1	CD=Causing/Driving	SUBTHEME
	Meaning unit 2	ME=Mitigating/Eliminating	SUBTHEME
	A purple line indicating that an attempt to look for patterns and saturation was made		

1	**Smart & Secure Fast-Charge USB Cable and Adapter**		
	Apple's rejects initial MFi application	CD	LAWS & RULES AND REGULATIONS
	National Day Holiday Week in China	CD	HOLIDAYS

2	**Cmoar Virtual Reality Headset with integrated electronics**		
	Not expecting campaign money transferred in installments	CD	KICKSTARTER MONEY TRANSFER
	Manufactures requiring additional time due to product complexity	CD	MANUFACTURING
	Design requires a very large amount of injection molds	CD	MANUFACTURING
	European supplier is chosen because of proximity	ME	GEOGRAPHICAL PROXIMITY TO PARTNERS
	Tooling company negotiations took very long	CD	PROCUREMENT
	Tooling company violated agreement	CD	MANUFACTURING
	Compromising modular design vision	CD	SCOPE
	Android updates causes extensive application rework delaying approval process	CD	TECHNOLOGICAL UNCERTAINTY
	Manufacturer revised their initial timeline	CD	MANUFACTURING
	New product added	CD	SCOPE
	Severely underestimated final manufacturing costs	CD	TECHNICAL PROFICIENCY

3	**Realiser A16: real 3D audio headphone processor**		
	Manufacturing hold-ups	CD	MANUFACTURING
	Production samples required design changes	CD	MANUFACTURING

	Chinese New Year	CD	HOLIDAYS
	Prototype revealed problem needing redesign	ME	TECHNICAL PROFICIENCY
	Verified ability to pass certification tests	ME	LAWS & RULES AND REGULATIONS
	Self- certification revealed problems which had to be addressed	ME	TECHNICAL PROFICIENCY
	Waiting on certification test slot	CD	LAWS & RULES AND REGULATIONS
	Usability issues requiring action discovered	CD	TECHNICAL PROFICIENCY
	Key components discontinued, requiring new configuration	CD	PROCUREMENT
	Covid-19 disruption	CD	NATURAL DISASTERS
4	**HELLO The Most Advanced Video Communication Device**		
	Team on site in china	ME	GEOGRAPHICAL PROXIMITY TO PARTNERS
	Natural disaster affecting manufacturers production capacity and delivery timeline.	CD	NATURAL DISASTERS
	Chinese New Year	CD	HOLIDAYS
	Supplier delayed delivery	CD	SUPPLIERS
5	**PowerMAG**		
	Manufactured parts fail QC	CD	MANUFACTURING
	Chinese new year	CD	HOLIDAYS
6	**Nuki: The smart lock for Europe**		
	Design fault discovered	CD	TECHNICAL PROFICIENCY
	Supply bottleneck	CD	SUPPLIERS
	Engaged backers as beta testers	ME	KNOWING YOUR NEEDS
	Availability issue with a purchased part	CD	PROCUREMENT
	Throughput on manufacturing site not at anticipated rate	CD	MANUFACTURING
	Quality issues with purchased part	CD	SUPPLIERS
7	**Ultra Slim Laptop with Android 5.1 running Remix OS 2.0**		
	Shortage of key components	CD	PROCUREMENT
	Material cost increases as a consequence of delays	CD	PROCUREMENT
	Underestimated logistics and shipping process	CD	KNOWING YOUR NEEDS
	Lack of experience in managing a Kickstarter program.	CD	KNOWING YOUR NEEDS
8	**abode - The Future of Home Security.**		
	Product appears subpar	CD	TECHNICAL PROFICIENCY
	Problems with software functionality	CD	TECHNICAL PROFICIENCY
	Issued beta products to gather information	ME	KNOWING YOUR NEEDS

	Quality issues	CD	MANUFACTURING
	Slow app-approval due to recent re-architecture of iOS 9.	CD	LAWS & RULES AND REGULATIONS
9	**Side Window Wiper**		
	Chines New Year	CD	HOLIDAYS
	Quality issues	CD	MANUFACTURING
	New manufacturer needed	CD	PROCUREMENT
10	**Build Upons: World's Tiniest Light Up Bricks**		
	Manufacturer prioritizing other production runs	CD	PROCUREMENT
	Plastic sourced earlier was revealed to be contaminated as production started	CD	SUPPLIERS
	Tooling was cut incorrectly	CD	MANUFACTURING
	Products held in customs on route from manufacturer	CD	LAWS & RULES AND REGULATIONS
11	**SWIMNERD PACE CLOCKS**		
	Site of production close to developers (USA)	ME	GEOGRAPHICAL PROXIMITY TO PARTNERS
	Late decision to change the country of production to a cheaper manufacturer (clock specialist in china)	CD	PROCUREMENT
	Challenging software issues	CD	TECHNOLOGICAL UNCERTAINTY
12	**TarDisk 256GB | MacBook Storage Expansion**		
	Site of production close to developers (USA)	ME	GEOGRAPHICAL PROXIMITY TO PARTNERS
	Not expecting campaign money transferred in instalments	CD	KICKSTARTER MONEY TRANSFER
	DFM together with manufacturer	ME	MANUFACTURING
13	**indieGO! All-in-One Retro Game Console**		
	Supplier failed to deliver parts	CD	SUPPLIERS
	WEEE- number hold up	CD	LAWS & RULES AND REGULATIONS
14	**Krimston TWO - Dual SIM case for iPhone**		
	DFM carried out	ME	MANUFACTURING
	Testing and redesign iteration taking more time than planed	CD	TECHNICAL PROFICIENCY
	First experience with this type of advanced hardware manufacturing	CD	TECHNICAL PROFICIENCY
	Suppliers undelivered on their commitments	CD	SUPPLIERS

15	**XSHIFTER: World's First Affordable Wireless Shifting System**		
	Components are on backorder and project is delayed	CD	PROCUREMENT
	Software developer taking longer than anticipated	CD	TECHNICAL PROFICIENCY
	Technology is very recent and cutting edge	CD	TECHNOLOGICAL UNCERTAINTY
	To realize the technology required several design iteration	CD	TECHNOLOGICAL UNCERTAINTY
	To realize the technology required working with several engineers	CD	PROCUREMENT
	Dealing with copycats	CD	LAWS & RULES AND REGULATIONS
	Components shipped to the wrong country	CD	SUPPLIERS
	Scope reduction	ME	SCOPE
	Component quality lacking- tooling modification required	CD	MANUFACTURING
	Part to the PCB on back order	CD	PROCUREMENT
	part improperly manufactured	CD	MANUFACTURING
	Struggling to deal with the realization of the true scale of the project	CD	SIZE
	A 3rd change of software team	CD	PROCUREMENT
	Apple app approval taking time	CD	LAWS & RULES AND REGULATIONS
	Chinese new year	CD	HOLIDAYS
	Present on site of manufacturing in china	CD	GEOGRAPHICAL PROXIMITY TO PARTNERS
	Shipping laws changed (shipping of lithium ion batteries)	CD	LAWS & RULES AND REGULATIONS
	Reducing scope further (only android app, no dual shift etc.)	ME	SCOPE
	Requite bicycle marketing professional	ME	KNOWING YOUR NEEDS
	Utilize backer for app development	ME	KNOWING YOUR NEEDS
	Corona virus	CD	NATURAL DISASTERS
16	**Torch. A simple router for digital parenting.**		
	Closed Alpha testing locally	ME	KNOWING YOUR NEEDS
	Underestimated time needed for software development	CD	TECHNICAL PROFICIENCY
	Got side-tracked with nonessentials features	CD	SCOPE
	Underestimated time needed for firmware development	CD	TECHNICAL PROFICIENCY
	Typhoon Megi	CD	NATURAL DISASTERS
17	**Whoa Board: Dream With Touch Sensing EL Wire, Panels, Paint**		
	Parts from suppliers are late	CD	SUPPLIERS
	Faulty components from factory - needed rework	CD	MANUFACTURING

	Using lead-free solder, slowing down the process but ethical choice	CD	TECHNICAL PROFICIENCY
18	**PaPiRus - the ePaper Screen HAT for your Raspberry Pi**		
	Original design was not technically viable	CD	TECHNICAL PROFICIENCY
	New part sourced to address design issue	CD	PROCUREMENT
	Ordered long-lead-time parts as soon as campaign was funded	CD	PROCUREMENT
	Small sample run -when demoed problems where discovered	ME	MANUFACTURING
	Reach out to backers for experience of spring loaded pogo pins and where to source them	ME	KNOWING YOUR NEEDS
19	**Fishbit: Your Aquarium Made Simple**		
	Hired a product safety certification and reliability firm	ME	KNOWING YOUR NEEDS
	Strength of material of the first sample was not sufficient	CD	TECHNICAL PROFICIENCY
	Saw necessary mechanical changes and the resulting delays as an opportunity for additional changes	CD	SCOPE
	Test runs before running the full production line	ME	MANUFACTURING
	Problems with sample quality	CD	MANUFACTURING
	Scaling up, from a smaller to a larger supplier - the new parts caused a bug	CD	MANUFACTURING
	Certification took much longer than anticipated	CD	LAWS & RULES AND REGULATIONS
	Supplier took the money and severed contact	CD	SUPPLIERS
	Staff-member shared language with manufacturer (Mandarin)	ME	MANUFACTURING
	Staff to oversee manufacturing	ME	GEOGRAPHICAL PROXIMITY TO PARTNERS
	Underestimating the difficulty of melting and hardening	CD	TECHNICAL PROFICIENCY
	Large amount of suppliers causing waterfall delays	CD	SUPPLIERS
20	**RaceCapture and Podium: Race it. Share it. Prove it.**		
	Open development process	ME	KNOWING YOUR NEEDS
	Underestimated apple app store approval process	CD	LAWS & RULES AND REGULATIONS
	Two family members passing away	CD	PERSONAL
	Late stage testing revealed severe firmware and bootloader issues	CD	TECHNICAL PROFICIENCY
	Bad soldering causing quality issues	CD	MANUFACTURING
21	**Voltus - Mobile power + expansion for your MacBook**		

	High part complexity are delaying suppliers	CD	TECHNOLOGICAL UNCERTAINTY
	Thermal problems discovered	CD	TECHNICAL PROFICIENCY
	Used several suppliers to minimize impact of delays	ME	SUPPLIERS
	All suppliers delayed	CD	SUPPLIERS
22	**Halo Back: World's First Smart Screen Protector**		
	Manufacturer never achieved promised functionality	CD	MANUFACTURING
23	**PiJuice - A Portable Project Platform For Every Raspberry Pi**		
	Massively exceeded goal	CD	SIZE
	After project suffers delay, a component becomes end of the line	CD	PROCUREMENT
	Discovered a new design opportunity - fewer components, using a (fairly new) IC	CD	SCOPE
	Parts from supplier failed testing (second time around)	CD	MANUFACTURING
	Waiting on quotes for the production	CD	PROCUREMENT
	Original partnership fell apart	CD	PERSONAL
	Recruiting a project manager	ME	KNOWING YOUR NEEDS
	Scope creep, new function integrated	CD	SCOPE
	Scope creep; new manufacturing method	CD	SCOPE
	Have to fight trademark issues	CD	LAWS & RULES AND REGULATIONS
	Unsuccessful sourcing	CD	PROCUREMENT
	Two parts in their tolerancing extremes - not mating	CD	TECHNICAL PROFICIENCY
24	**PiSoC: Learn to Create**		
	Local manufacturing allows oversight and a customized testing process	ME	GEOGRAPHICAL PROXIMITY TO PARTNERS
	Financial and communication problems with manufacturer	CD	MANUFACTURING
	Change of manufacturer	CD	MANUFACTURING
	Several through-hole parts which the developers didn't know were very expensive to manufacture	CD	MANUFACTURING
	Can't address DFM problems since have already developed add on based on original design	CD	MANUFACTURING
25	**microSSD - add up to 384GB extra storage to your Macbook**		
	Anodizing treatment took longer than expected	CD	TECHNICAL PROFICIENCY
	Processing Kickstarter address data to suit shipping carrier	CD	KNOWING YOUR NEEDS
26	**Manga Screen – Multi Touch 4.3" LCD**		

	Manufacturer of key component has pushed forward delivery	CD	MANUFACTURING
	Distributor can't deliver amount agreed	CD	SUPPLIERS
	Sourcing and approving new part supplier	CD	PROCUREMENT
	Testing jig damaged in transport	CD	GEOGRAPHICAL PROXIMITY TO PARTNERS
	Insufficient screen yield	CD	MANUFACTURING
	Returned defective parts failed to clear customs (insufficient documentation)	CD	LAWS & RULES AND REGULATIONS
	Changed manufacturer due to quality issues	CD	MANUFACTURING
27	**Wired In - Wireless Productivity Sign With Arduino & HomeKit**		
	Backers asking for additional feature (RGB)	CD	SCOPE
	Technical solution turns out to not deliver enough signal	CD	TECHNICAL PROFICIENCY
	Lacked insight into what the process required	CD	KNOWING YOUR NEEDS
	Personal situation has changed	CD	PERSONAL
	New solution also causing diffuser problems	CD	TECHNICAL PROFICIENCY
	Received a quota higher than expected	CD	PROCUREMENT
	Parts from supplier fail QC	CD	SUPPLIERS
	Piece of developers manufacturing equipment broken	CD	MANUFACTURING
	Manufacturer used wrong screw size and wrong threading	CD	MANUFACTURING
	Supplier stored parts in a way that damaged them	CD	SUPPLIERS
28	**The Smartest Music Reactive LED Controller - ViVi**		
	The contractor developing software delivered late	CD	PROCUREMENT
	All components held in customs (4 months)	CD	LAWS & RULES AND REGULATIONS
	Hiring a customs broker	ME	KNOWING YOUR NEEDS
	Chinese new year	CD	HOLIDAYS
	Tax deadlines requiring administrative work	CD	PERSONAL
	Sourcing and hiring new software development company	CD	PROCUREMENT
	Change to US manufacturing	ME	GEOGRAPHICAL PROXIMITY TO PARTNERS
	A lot more paperwork involved in FCC/CE testing than we expected.	CD	LAWS & RULES AND REGULATIONS
	Personal changes, newborn baby	CD	PERSONAL
	PCB design contractor late from previous project	CD	MANUFACTURING
	Severely underestimated staffing needs, project is still understaffed	CD	KNOWING YOUR NEEDS
	Failed fcc/ce testing and needs re-design	CD	LAWS & RULES AND REGULATIONS
	Natural disaster (snow storm)	CD	NATURAL DISASTERS

29	**Solu - A new breed of computing**		
	Discovered that chosen tech had a too great immaturity	CD	TECHNOLOGICAL UNCERTAINTY
	Component delivery delay	CD	SUPPLIERS
30	**MakerBloks - Kids electronics powered by imagination.**		
	Key components on backorder	CD	PROCUREMENT
	Joins retail accelerator; Target + Techstars	CD	SCOPE
	Focus on CES	CD	LONG TERM PRIORATES
	Found and integrated a new feature	CD	SCOPE
	Retail accelerator program results in a transformation into a software company with a hardware component	CD	SCOPE
31	**ZKOO - The Worlds€™s Most Advanced Gesture Tracking Camera**		
	Limited availability of key components	CD	PROCUREMENT
	FCC testing approval hold-up	CD	LAWS & RULES AND REGULATIONS
32	**Scriba - the stylus reinvented**		
	Late redesign to further optimize	CD	TECHNICAL PROFICIENCY
33	**Auroma: Never Make Bad Coffee Again**		
	Pre-emptively developed “soft tools”	ME	TECHNICAL PROFICIENCY
	Miscommunication with factory - resulted in a wrong tolerance	CD	MANUFACTURING
	Hired someone with manufacturing experience	ME	KNOWING YOUR NEEDS
	Quality observed at factory does not match quality of parts delivered	CD	MANUFACTURING
	Hired supplier manager	ME	KNOWING YOUR NEEDS
	Lack of DFA cause a part to break upon (quicker and less careful)assembly	CD	MANUFACTURING
	Temporarily relocated to live on the site of manufacturing (accountability and addressing problems)	ME	GEOGRAPHICAL PROXIMITY TO PARTNERS
	Supplier changed the internal build without consent	CD	SUPPLIERS
34	**Spreedbox : The most private video chat and file exchange**		
	Quality of technical drawings from design partner insufficient	CD	PROCUREMENT
	Key component availability issues	CD	PROCUREMENT

	Quality of another set of technical drawings from design partner insufficient	CD	PROCUREMENT
	Underestimated time needed for procurement and contracting	CD	PROCUREMENT
35	**Lightpack 2 - Ultimate Light Orchestra For Your Living Room**		
	Underestimated time needed to understand hardware capabilities	CD	TECHNICAL PROFICIENCY
	Supplier did not deliver order	CD	SUPPLIERS
	Change the functionality of mounting thrice (single use, some reuse, more reuse)	CD	SCOPE
36	**Superbook - Transform Your Smartphone Into A Laptop**		
	Errors are costly (time, money) due to the projects large size	CD	SIZE
	DFM carried out after campaign and revealed changes necessary	ME	MANUFACTURING
	Late decision to change design to improve functionality	CD	TECHNICAL PROFICIENCY
	Component quotes increased significantly.	CD	SUPPLIERS
	Discovered that in order to pay customs and VAT expenses in full - ocean freight (slower) was necessary	CD	KNOWING YOUR NEEDS
	Produced a first small batch followed by users test	ME	KNOWING YOUR NEEDS
	Shipping to 160 countries with difference tax rules	CD	SIZE
	Different region have different requirements of regulated components (e.g. Lithium-ion batteries)	CD	LAWS & RULES AND REGULATIONS
	Typhon	CD	NATURAL DISASTERS
	Software fix requires component on backorder	CD	PROCUREMENT
	Supplier imprisoned, no access to critical component	CD	SUPPLIERS
	Suppliers shipped the wrong part variant	CD	SUPPLIERS
	Early design decisions requires several fixes and workarounds that slowed mass production	CD	MANUFACTURING
	Difficult negotiation position since crowdfunding updates are easily accessible to the other part	CD	PROCUREMENT
37	**Gloveone: Feel Virtual Reality**		
	Assumed mass-production would be no more difficult than prototyping	CD	TECHNICAL PROFICIENCY
	Delays and difficulties forced them to settle for an inferior product	ME	SCOPE
	Suppliers ran out of stock	CD	SUPPLIERS
	Key component that suddenly was discontinued	CD	PROCUREMENT
	Costs were heavily underestimated	CD	TECHNICAL PROFICIENCY

	Depreciated the products position in the business model in order to make money from non-cf products	CD	LONG TERM PRIORATES
38	**SENIC - music controller device**		
	Site of production close to developers (GER)	ME	GEOGRAPHICAL PROXIMITY TO PARTNERS
	O-series lacking in DFA considerations -> parts where combined	ME	MANUFACTURING
	Sent staff to the manufacturing facility to oversee completion	ME	GEOGRAPHICAL PROXIMITY TO PARTNERS
	Integration in IoT products is proving a greater challenge than expected	CD	TECHNOLOGICAL UNCERTAINTY
39	**Hub+ for USB-C: Get your MacBook ports back.**		
	Failed to achieve theoretical result in practice	CD	TECHNOLOGICAL UNCERTAINTY
40	**PiTouch: 10" Touchscreen Monitor for Raspberry Pi / Mac / PC**		
	Functional issues discovered when testing early samples	ME	TECHNICAL PROFICIENCY
	Poorly design testing procedure concealed issue	CD	TECHNICAL PROFICIENCY
	Used backers for early tests	ME	KNOWING YOUR NEEDS

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I KEEP six honest serving-men
(They taught me all I knew);
Their names are What and Why and When
And How and Where and Who.
I send them over land and sea,
I send them east and west;
But after they have worked for me,
I give them all a rest.

I let them rest from nine till five,
For I am busy then,
As well as breakfast, lunch, and tea,
For they are hungry men.
But different folk have different views;
I know a person small—
She keeps ten million serving-men,
Who get no rest at all!

She sends'em abroad on her own affairs,
From the second she opens her eyes—
One million Hows, two million Wheres,
And seven million Whys!

The Elephant's Child

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