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Software Startup Metrics

Are they used? Are they usefull?

Master's thesis in Computer Science
Supervisor: Pieter Jelle Toussaint

June 2021

Master's thesis

NTNU
Norwegian University of Science and Technology
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Kunnskap for en bedre verden

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1. Introduction

After the incredible success of Facebook, Twitter and Instagram software startups are more popular than ever and growing in numbers. [17] Unfortunately, sixty percent of startups do not survive in the first five years. [19] There are several reasons for startups failing. Lack of resources makes it so a failure of one project can mean the end of the company. Established companies can often survive failures of one or two big projects. Author and entrepreneur Eric Ries wrote that *"startups are human institutions that create innovative products or services and search for sustainable business models under extreme uncertainty."* [4] This uncertainty is a major obstacle for most startup companies and can be devastating. It can have its impact lessened by measuring the correct metrics. Fenton et al. (2014) explains that measurement is central to the scientific method. *"Stating a hypothesis, designing and running an experiment to test its validity, and analyzing the results. Underpinning the scientific process is measurement: measuring the variables to differentiate cases, measuring the changes in behavior, and measuring the causes and effects. Science and engineering can neither be effective nor practical without measurement."*

Giardino et al. (2014) found that one reason that many startups fail is neglecting to adhere to the validated learning method and pivoting (changing course, explained further in section 2.4) when needed. [14] Measuring the correct metrics is how a company knows if to continue with their path or pivot. Twitter and Instagram are great examples of companies that were saved by pivoting. Another example is when Circle of Friends remade their company to Circle of Moms when they discovered mothers where much more engaged than other users (of other circles less than 20% were active). Being able to take data driven decisions requires metrics to capture the data. This paper will gather metrics for companies from literature and survey which are used by actual software startup companies.

Research question: What metrics are used by software startup companies? Do metrics being measured by these companies change throughout different stages of the startup?

Chapter 2 is a literature review where I will explain what a software startup company is and how they differ from one another. It will also explain why metrics are useful and what a pivot is in a startup company. Chapter 3 is an explanation of how metrics were gathered, why and how a survey was conducted. In chapter 4 the results from the survey portrayed in chapter 3 are displayed. In chapter 5 I discuss the results displayed in chapter 4, and how they related to literature. Then finally in chapter 6 I conclude what was found, what limitations the method had and suggestions for future research.

2. Literature review

2.1 Software startup companies

There are several definitions of what a startup is. Serial-entrepreneur and academician Steve Blank defines a startup as *"an organization formed to search for a repeatable and scalable business model"* [9]. Blank has an outstanding history in Silicon Valley so one can presume that he had software companies in his mind when making that definition. Giardino et al. (2016) defines it as: *"Organizations focused on the creation of high-tech and innovative products, with little or no operating history, aiming to aggressively grow their business in highly scalable markets"* [10]. Author and entrepreneur Eric Ries wrote that *"startups are human institutions that create innovative products or services and search for sustainable business models under extreme uncertainty"* [4]. The most frequently reported characteristics of a software startup is general lack of resources, high reactiveness and flexibility, intense time-pressure, uncertain conditions and tackling fast growing markets [9].

The difference between a regular startup and software startup is that the latter build software-intensive products/services [15]. The consequence of project failure for a software startup can be more severe than that for an established software company. This is because a majority of software startups are focused on one single project at a time. One project failure could put a software startup out of business [10]. Steve Blank explains that *"the funding of a small established company is different than a startup. Both start with savings and initial investments, but when startups experience success they can get additional series of funding from angel investors, venture capitalist, and eventually, an initial public offering"* [9]. He further explains that *"while established companies execute a business model where customers, problems and necessary product features are known, startups operate in a search mode where they test and improve their initial hypotheses"* [9]. Eric Ries agrees with this inherent uncertainty for startups and wrote that *"the difference between an established company and a startup is that a startup does not know who their customer is or what the product should be"* [4].

Croll et al. (2013). suggests six business models for startup companies. They explain that *"a business model is a combination of things. It's what you sell, how you deliver it, how you acquire customers, and how you make money from them"* [5]. They further explain more detailed that a business model consists of 5 different aspects [5]:

1. The acquisition channel: how people find you.
2. The selling tactic: how you convince users to become visitors or visitors to become customers. This include asking for money or providing some sort of scarcity or exclusivity.
3. The revenue source: how you make money. This can come directly from customers or indirectly through advertising, referrals, analysis of their behavior, content creation, and so on.
4. The product type: what value your business offers in return for the revenue.
5. The delivery model: how to get your product to the customer.

This list of aspects is not exhaustive to every conceivable business model. The six business models presented by Croll et al. (2013) are a blend of these aspects [5]. Since the models have different aspects that drive the business model, they need different metrics to analyze the state of the company. Listed below are a description of the six business models [5], their revenue sources and some examples of companies that uses that model.

- E-commerce: This is a company that sells items or services online to their customers. They get their income from customers who purchases something from a web-based retailer. Examples are Amazon, Zappos, Bonobos.
- Software as a service (Saas): This is a company that offers software on an on-demand basis. This is usually delivered through a website it operates. They usually get their income from a monthly subscription or some upgradeable features. This include more storage, a premium edition, and so on. Examples are Skype, Dropbox, Slack.
- Mobile application: This is a company that offers a mobile application. Unlike web applications, where it's easy to do A/B testing and continuous deployment, mobile apps go through the app store gatekeeper—which limits the number of iterations a company can undergo, and hampers experimentation. The application can cost money, or more commonly the application can be free and be upgradable for a fee. Examples are MX player, Headspace: meditation, Camera+.
- Media site: This is a company that creates content online. It earns money through advertisement revenue or sales. Examples are CNN, VG, New York Times.
- User-generated content: This is a company that creates engaging communities that creates content. It gets its revenue from advertisement, but contrary to media sites it needs a thriving community to create content for them. Examples are Facebook, Twitter, Reddit.
- Two-sided marketplace: This is a company that offers a service to connect buyers and sellers. It usually gets its' income from charging a fee for the transaction. Examples are Ebay, Finn, Craigslist.

As you can imagine some businesses fall under several of the models presented, while some do not fall under any. It is simplified and generalized since reasoning about every single business model would take too much time.

Croll et al. (2013) explains *that "every startup goes through stages, beginning with problem discovery, then building something, then finding out if what was built is good enough, then spreading the word and collecting money"* [5]. The five stages a startup goes through identified by Croll et al. (2013) are listed below:

1. Empathy: This is the discovery stage. The company finds out who its customers are, what is important to them and empathies with their problems. It then validates the problem and find out if their proposed solution to that problem is likely to work. The discovery is completed through interviews, surveys, landing pages, and so on. Croll et al. (2013) suggests building a minimal viable product to test the hypothesis that the solution addresses the problem. A minimal viable product is the smallest thing you can build that will create the value you promised to your market. This stage is the least measurable by metrics.
2. Stickiness: The focus shifts to retention and engagement. The top priority is building a core set of features that get used regularly and successfully. Before moving on to the next stage one should know if the users are using the product or service as expected and that they value it enough to engage with it either through payment, ad clicks or by inviting other people. This proves that the problem has been solved.
3. Virality: This stage is simply put users sharing one's product or service with others. The focus is now on user acquisition and growth, while keeping an eye on one's stickiness. This is because virality and word of mouth can be at the expense of engagement. New users may have different expectations than earlier ones. If you're investing in adding users, but your churn (lost customers during a time period) is high, you may not be getting a good enough return on investment.

4. Revenue: The focus shifts from proving you have solved the problem to proving you can make money in a scalable, consistent, self-sustaining way. You're trying to figure out where to focus: more revenue per customer, more customers, more efficiencies, greater frequency, and so on. The core equation for the revenue stage is the money a customer brings minus the cost of acquiring that customer.
5. Scale: Once revenues and margins are within the targets you've set out in your business model, it's time to grow as an organization. You know your product and your market. Your metrics are now focused on the health of your ecosystem, and your ability to enter new markets. You'll look at compensation, API traffic, channel relationships, and competitors at this stage—whereas before, these were distractions.

2.2 Metrics

Fenton et al. (2014) defines measurement as *"the process by which numbers or symbols are assigned to attributes of entities in the real world in such a way so as to describe them according to clearly defined rules"*. [11] Thus, measurement captures information about attributes of entities. An entity is an object or an event in the real world. They further write that we want to describe entities by identifying characteristics that are important to distinguish one entity from another. [11] An attribute is a feature or property of an entity. [11] There are two kinds of quantification: measurement and calculation. Measurement is a direct quantification, while calculation is an indirect quantification that combines several measurements which combined gives a quantitative item. [11]

Why do we measure things? Fenton et al. (2014) explains that measurement is central to the scientific method. *"Stating a hypothesis, designing and running an experiment to test its validity, and analyzing the results. Underpinning the scientific process is measurement: measuring the variables to differentiate cases, measuring the changes in behavior, and measuring the causes and effects. Science and engineering can neither be effective nor practical without measurement"*. [11] They also warn that *"the accuracy of measurement depends on measuring instrument as well as the on the definition of the measurement"*. [11]

2.3 Survey

What is a survey? A survey is a system for collecting information. A questionnaire is one element of a process that begins with defining objectives and ends with data analysis and reporting result. [8] Below is the survey process described in Conducting online surveys [7]:
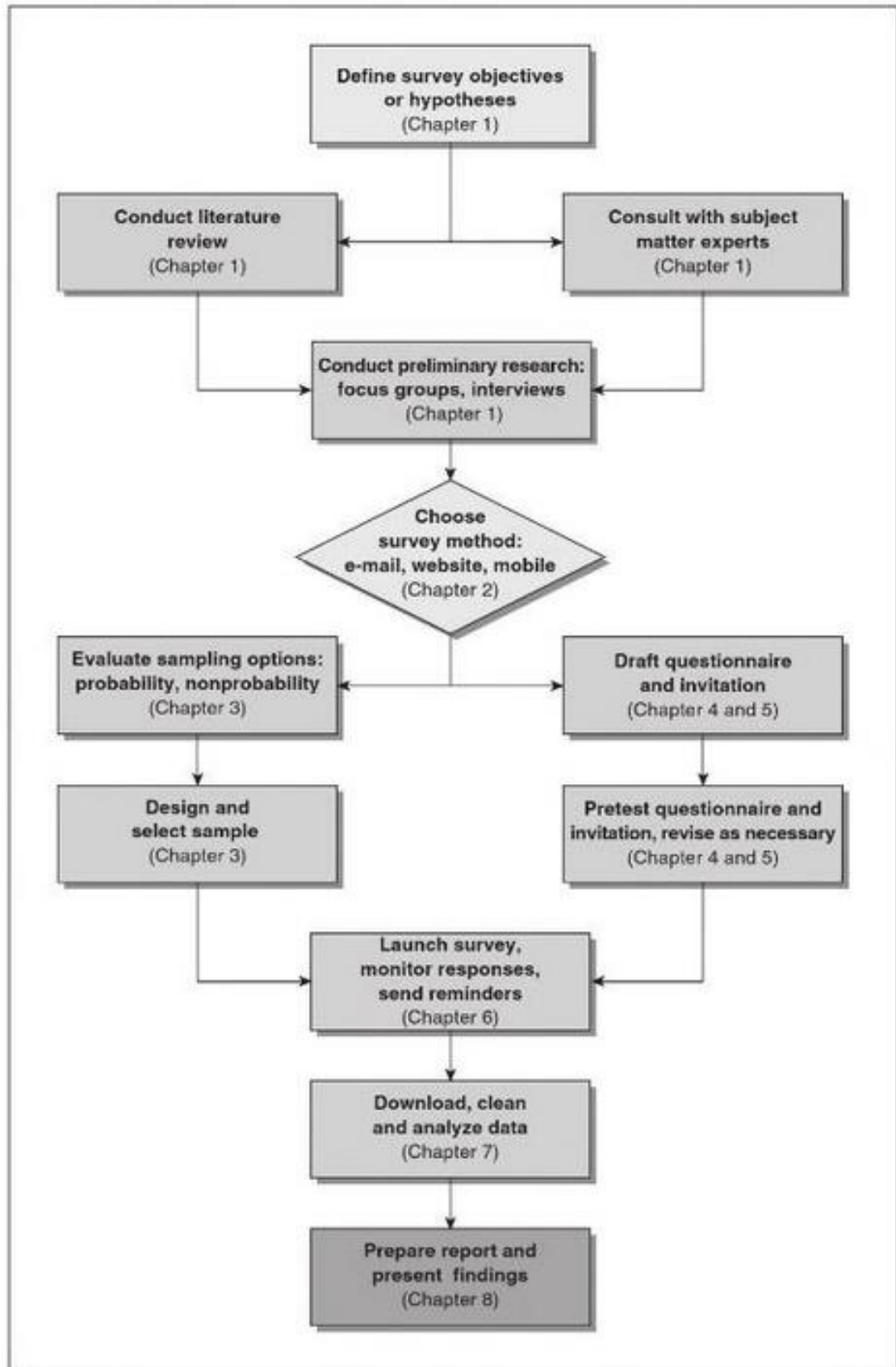
Figure 1: The survey process described in Conducting Online Surveys. [7]

The process begins with defining the study's goals and objectives and continues with a literature review and consultation with experts. Many researchers also choose to conduct preliminary research, such a focus group discussion or personal interviews with members of a target audience. Results of this type of investigation are used as a basis for deciding on the survey type to employ (or if a survey is even appropriate). [7]

Sampling refers to the process of selecting participants. This could introduce errors into the results. As sample size increases, margin of error decreases. [7] There are 2 different types of sampling:

- Probability sampling: those for which the probability of each participant's inclusion can be computed. These samples depend on random selection of participants from a defined sampling frame and afford the researcher the opportunity to reach conclusions about population characteristics based on sample statistics. [7] This is the best form of sampling as it statically more correct, but it requires more time and work.
- Non-probability sampling: do not employ random selection procedures and, thus, may or may not represent the population well. This is why most statistical texts advise against using nonprobability techniques or suggest they be reserved for exploratory research. [7]

Social research projects can be classified into three categories: exploratory, descriptive, and explanatory research. An individual study can have multiple purposes or may be part of a program of research that spans two or all three purposes. [7]

Exploratory research: The goal is to formulate problems, clarify concepts and form hypothesis. Exploration can begin with a literature search, a focus group discussion, or case studies. If a survey is conducted for exploratory purposes, no attempt is made to examine a random sample of a population, but rather individuals with knowledge of the topic are approached. Exploratory research typically seeks to create hypothesis rather than test them. Data from exploratory studies tends to be qualitative. Examples include brainstorming sessions, interviews with experts, and posting a short survey to a social networking website. [7]

Descriptive research: have more guidelines, but are not driven by structured research hypothesis. This type of research frequently aims to describe characteristics of populations based on data collected from samples, it often requires the use of a probability sampling technique, such as simple random sampling. Data may be qualitative or quantitative. Customer satisfaction surveys, presidential approval polls and class evaluation surveys are examples. [7]

Explanatory research: primary purpose is to explain why phenomena occur and to predict future occurrences. They are characterized by research hypotheses that specify the nature and direction of the relationships between or among variables being studied. Probability sampling is normally a requirement in explanatory research because the goal is often to generalize the results to the population from which the sample is selected. The data are quantitative and almost always require the use of a statistical test to establish the validity of the relationships. For example, explanatory survey research may investigate the factors that contribute to customer satisfaction and determine the relative weight of each factor, or seek to model the variables that lead to shopping cart abandonment. [7]

2.4 Pivoting

Eric Ries explains that *"it does not matter if you build something on time and budget if nobody wants it. The key challenge for startups is finding out what potential customers wants. If you detect that the customer base is not satisfied with your product you need to change direction".* [4] Changing course is referred to as pivoting in the Lean Startup approach. [4] More precisely it is *"a strategic change, designed to test a fundamental hypothesis about a product, business model or engine of growth".* [4]
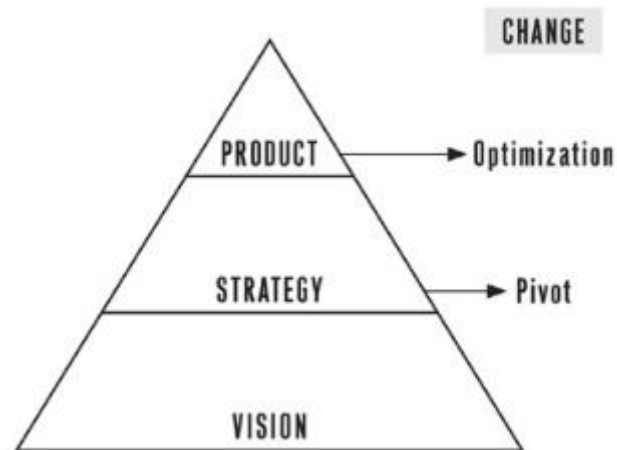
Figure 2: Pivot is affecting the strategy. Figure from The Lean Startup.[4]

Pivoting is often considered an outcome of validated learning, another concept of the Lean Startup, which tests a business hypothesis and measures the response. [4] Giardino et al. (2014) found that one reason that many startups fail is neglecting to adhere to the validated learning method and pivoting when needed. [14] Measuring the correct metrics is how a company knows if to continue with their path or pivot. Twitter and Instagram are great examples of companies that were saved by pivoting. Twitter is known as the most famous microblogging platform but was originally a podcast service provider back in its startup phase in 2005. [13] Instagram is now a famous picture sharing service, but was originally a social check-in application called Burbn, which combined features of a game (Mafiawars) and a photo share app (Foursquare). [12]

3. Method

The study was designed to be exploratory due to the lack of centralized information on metrics for software startups. Since there is limited scientific articles regarding software startup metrics additional sources were considered viable. This includes newspapers, magazines, blogs, forums, Wikipedia and company websites.

3.1 Gathering 100 metrics

The resulting list consisted of 100 metrics. [1] The metrics are not exclusive for startups and must be evaluated if they are correct to use at any time for a company. The categories business type and startup stage are my recommendations for when they are best applicable, but this is subjective and not validated by hard data. The pros and cons columns are collected from the sources. It is possible there are pros and cons of the metrics that are not mentioned. The data collection process was completed using two different methods illustrated in the figure below.
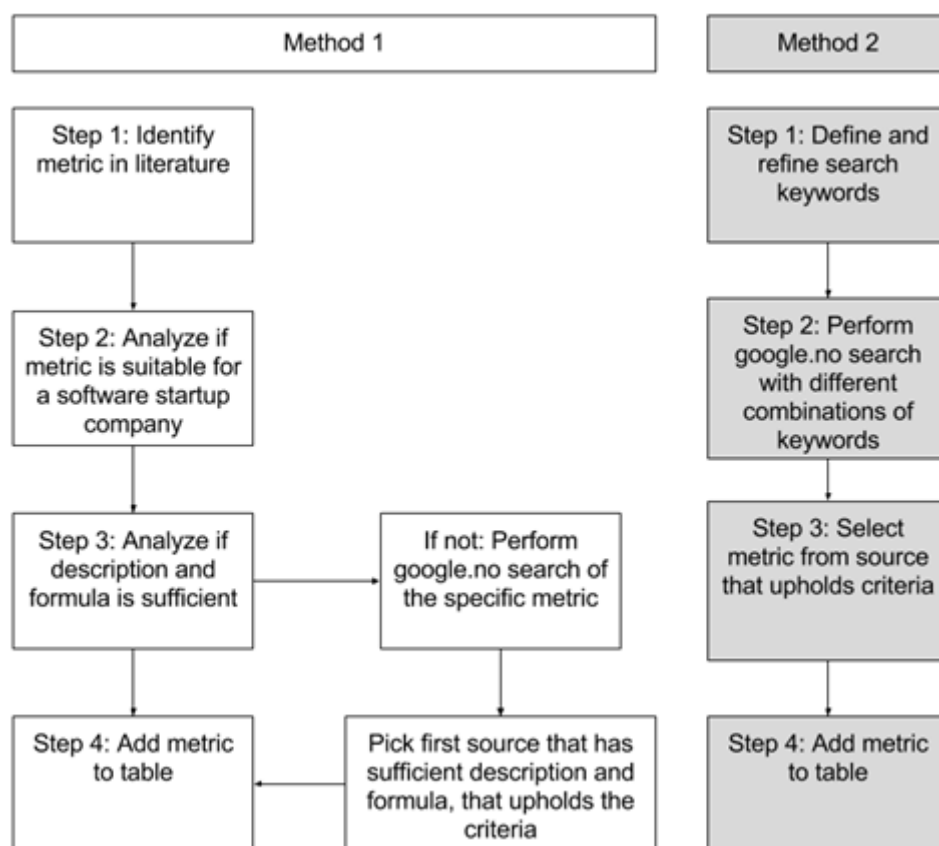
Figure 3: The data collection method i created.

The first method consisted of reading multiple literature books [5] [4] [20] identified through consultation with an experienced advisor. These books contain several startup metrics intended for software companies and some that are not eligible for software companies. Identified metrics were analyzed regarding their suitability for a software company. If I found them suitable and the description of the metric and its' formula were sufficient, I would include it to the table. If the description was too vague or simply mentioned in passing, I would initiate a search in the Google search engine for the specific metric. I would choose the first source that had a sufficient description and included a formula describing specifically how the metric was calculated. The source also needed to uphold the following criteria:

- The URL is working and accessible.
- The webpage is in English.
- The webpage is in text format.

The second method consisted of performing a search in the Google search engine using several identified keywords seen below.

"software" AND/OR ("startup" OR "startups" OR "start-up" OR "start-ups") AND "metric" OR "metrics"

Notice that "software" is optional as it can be referred to as "technological", "IT" or other terms. The search results were analyzed and then included if the following criteria was upheld:

- The metric mentioned is applicable to a software startup.
- The URL is working and accessible.
- The webpage is in English.
- The webpage is in text format.

The viewpoints used in the final table [1] are:

- Name of the metric.
- Description of the metric.
- Unit of the metric accompanied with a mathematical formula that describes how to calculate the metric.
- Business model where the metric is applicable.
- Startup stage where the metric is applicable.
- Evidence of use of the metric.
- Source from where the metric was gathered.
- Pros of the metric. Intended or known benefits of the metric use, or motivation for its use.
- Cons of the metric. Non-intended or known disadvantages from the use of the metric, or risks involved.

3.2 Selecting metrics for survey

Metrics collected ranged from specialized for software startup, to generalized metrics that are used in all companies. I decided to focus on eight of them and gain information on how they are used in the real world, while also keeping the survey short. Below are the eight metrics, their description, their mathematical formula, what are known about them from literature, and why I chose to focus on them.

3.2.1 Gross Churn Rate

Description: Percentage of customers lost during a given time period.

Mathematical formula: (Customers churned at the end of the period / Total customers at the start of the period)*100

Suggested startup business model: E-commerce, SaaS, Mobile application, Media site, Two-sided marketplace.

Evidence from sources: Eric Ries [4] writes that customer churn helps you see trends in product satisfaction (or dissatisfaction). It gives a realistic picture of revenue churn. While customer churn is a helpful metric for detecting a "leaky bucket"' it varies from revenue and doesn't indicate which customers you're losing (i.e. high-value customers, low-value customers, or perhaps customers who would be better served with another product) [4]. Croll et al. (2013) further explains that there are major complications with using churn over a month, since startups' churn can vary too much from start of the month to end of the month and gives a false impression. [5]

Reason for inclusion in the survey: A major inspiration for the "100 metrics for software startups companies" list [1] was Eric Ries' book "The learn startup" [4]. In this book he praises this metric. I wanted to see if it was used in real life, as a way to somewhat validate the rest of his theories.

3.2.2 Lead time
Description: The total time it takes for work to move through the value stream, from the moment the work is requested to the time it's delivered. This includes process time, as well as time that work spends sitting in queues, or wait states.

Mathematical formula: Time unit.

Suggested startup business model: All startups.

Evidence from sources:

Reason for inclusion in the survey: A measure of how prevalent Kanban-esque systems are.

3.2.3 Enrollment rate
Description: Percentage of visits that result in a new user.

Mathematical formula: (New users added for the period / Total number of visits) *100

Suggested startup business model: SaaS, Mobile application, User-generated content, Media site.

Evidence from sources: Croll et al. (2013) suggests that enrollment rate is key in early stages of a startup. "Your 'one metric that matters' at this point is enrollments, social reach, and other indicators that you'll be able to drive actual users to your MVP so you can learn and iterate quickly." [5]

Reason for inclusion in the survey: Croll et al. (2013) says enrollment rate is a must to measure early on for startups, so how many startups do measure it?

3.2.4 User engagement rate
Description: Percentage of users performing actions that constitute engagement on a site over a given time period.

Mathematical formula: (Users performing certain tasks in a given period / total users) * 100

Suggested startup business model: User-generated content, Media site

Evidence from sources: Circle of Friends remade their company to Circle of Moms when they discovered mothers where much more engaged than other users (of other circles less than 20% were active). This had a drastic positive impact on user engagement. [5]

Reason for inclusion in the survey: User-generated content and media sites depend on users using their sites for content and ad revenue. User engagement seems like a key metric to monitor for these businesses. Do they monitor this in real life?

3.2.5 Repurchase rate

Description: Percentage of customers who bought something last period buys something this period.

Mathematical formula: (Same customers buying this period / Buying customers last period) * 100

Suggested startup business model: E-commerce, Mobile application, Two-sided marketplace

Evidence from sources: It's essential for online retailers to know what kind of relationship they have with their buyers, because this drives everything from marketing strategy to shopping cart size.[5]

Reason for inclusion in the survey: I wanted a metric that was often used in e-commerce and two-sided marketplaces.

3.2.6 Time to customer breakeven

Description: How many days it takes for the cost of acquiring a customer is recouped.

Mathematical formula: Cost of customer acquisition - (Avarage daily customer value *X) = 0

Suggested startup business model: E-commerce, SaaS, Mobile application, Media site, Two-sided marketplace

Evidence from sources: Revenue helps growth only when you funnel some of the money generated from revenue back into acquisition. Then you have a machine that you can tune to grow the business over time. The two knobs on this machine are customer lifetime value and customer acquisition cost. Making more money from customers than you spend acquiring them is good, but the equation for success isn't that simple. You still need to worry about cash flow and growth rate, which are driven by how long it takes a customer to pay off. One way to measure this is time to customer breakeven—that is, how much time it will take to recoup the acquisition cost of a customer. [5]

Reason for inclusion in the survey: This metric is important to be able to plan for the future as it says something about how much time is needed before you make revenue. It is also a metric that is calculated using two other metrics, cost of customer acquisition and customer value. If companies use this metric, it follows that they also use the other two metrics.

3.2.7 Viral Coefficient

Description: The number of new customers that each existing customer is able to successfully convert.

Mathematical formula: Invitation Rate * Acceptance Rate

Suggested startup business model: All startups

Evidence from sources: It's unlikely that users will continue to invite their friends as time goes by. Instead, they'll invite those friends who they think are relevant and then stop inviting, and many of those they invite will have the same groups of friends. [5]

Reason for inclusion in the survey: Do startups encourage their users to invite other people? And do they track the success rate? I wanted a metric that says something about how companies spread the word of their product.

3.2.8 Return on investment

Description: A performance measure used to evaluate the efficiency of an investment or to compare the efficiency of a number of different investments. It measures the amount of return on an investment relative to the investment's cost.

Mathematical formula: (Gain on investment - Cost on investment) / Cost of investment

Suggested startup business model: E-commerce, SaaS, Mobile application, User-generated content, Two-sided marketplace

Evidence from sources: Return on Investment is a popular profitability metric used to evaluate how well an investment has performed. [6]

Reason for inclusion in the survey: This is the first metric most people learn in an economics class. Is it used in real life?

3.3 Survey process

To gather data from companies I had to choose how to extract data from them. Face-to-face interactions were disregarded because of covid-19 and time constraints. In consultation with my advisor, I decided to create a survey to reach as many companies as possible and get a larger sample size.

I deviated from the process displayed figure 1 in the following manner. I did consult with an expert, Pieter Jelle Toussaint, and conducted a literature review by gathering 100 metrics, before I defined the objectives of the survey. I did not conduct preliminary research in the form of interviews or focus groups. Below is my process, using the same figure as presented in figure 1, but with some modifications:
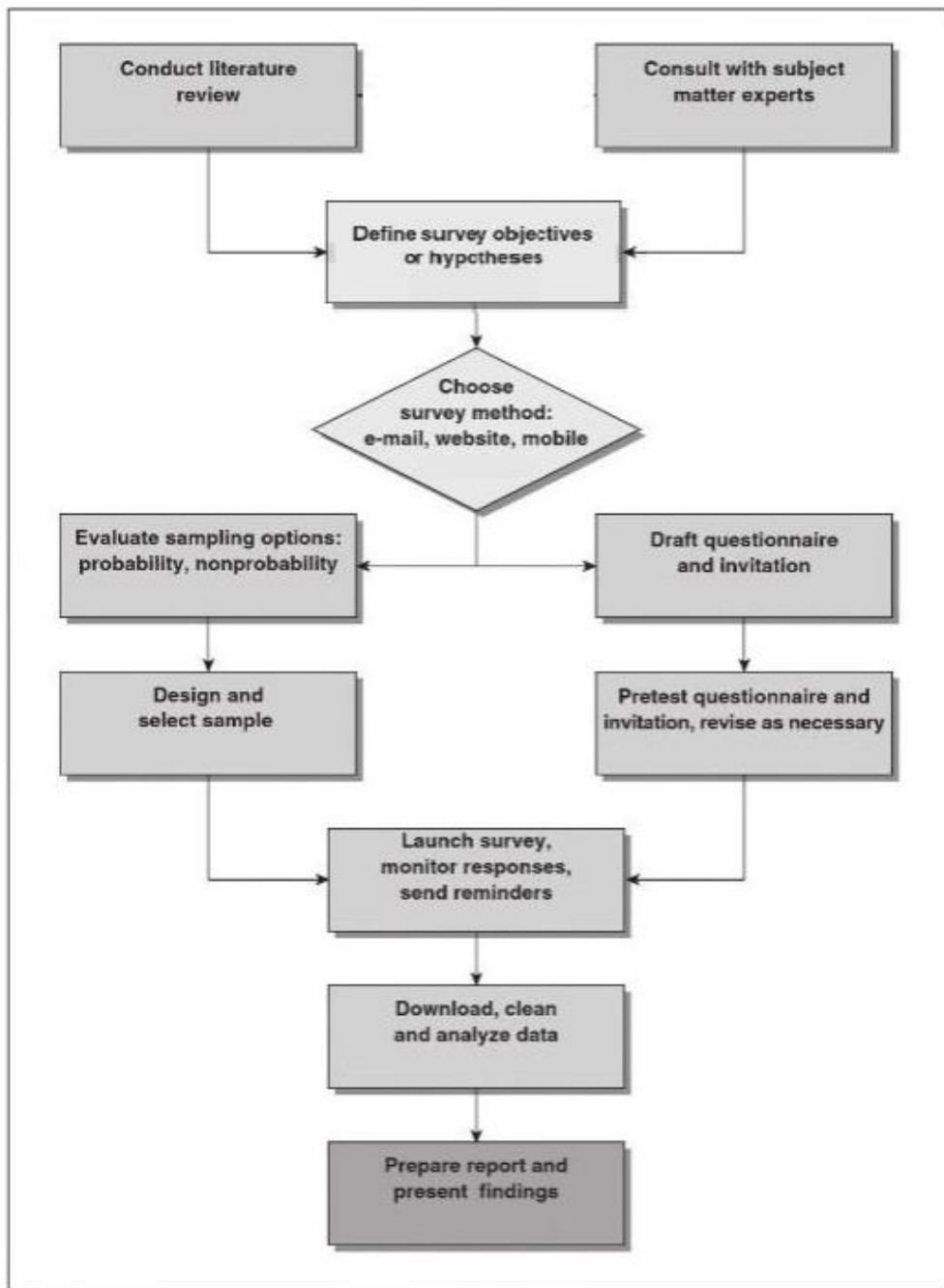
Figure 4: The survey process from Conducting Online Surveys [7], but with some alterations.

In the following sections I will detail the process used to conduct the survey.

3.3.1 Defining survey objectives

I decided to create an exploratory research survey, were I mostly wanted to create hypotheses, not test them. I wanted to explore what metrics were used in real life by startup software companies, and enquire what metrics were used by what kind of startup business models. I wanted to test the hypotheses that metrics being measured change over time. I also wanted to create hypotheses about what metrics, if any, are used to pivot the direction of a company.

3.3.2 Choosing survey method

I decided to create an online questionnaire for multiple reasons. Websites gives a better sense of anonymity than emails. Some companies think their use of metrics are important to keep secret from their competition, and I received many answers that they could not disclose any information because of this. By making it anonymous people would not be that intimidated to disclose information. I initially required participants to include their email in the reply, but after sending out over 40 emails without any response I removed that requirement. Another reason not to use emails was that I wanted the survey to be interactive to keep it as short as possible. That is if for example participants said they used only one of the eight metrics, any follow up question would only concern that one metric.

3.3.3 Sampling

I wanted to contact specific individuals for the sample. Specifically, employees of software startup companies. This is known as domain experts. [7] The reason for this is that it is a specialized subject that the general public does not have any experience with, and there were not enough software startup companies that I could create a pool of companies to randomly select from. A convenience sample was deemed sufficient. This reinforced the choice of creating an exploratory research survey.

Participants from suitable companies were first identified using my advisor, Pieter Jelle Toussaint. This were Norwegian software startup companies with ties to NTNU. After that an extensive google search was conducted. The google search terms used were (on www.google.no):

"norway" AND/OR "software" AND ("startup" OR "startups" OR "start-up" OR "start-ups")

As you can see from the formula, I had to cut out "norway" after some time as it did not yield a large enough sample. That said, almost all of the responses are from Norway, but I cannot guarantee that they are all from Norway. A total of 187 companies were contacted.

3.3.4 Questionnaire

My focus from the start was to keep the survey short, so I could advertise that the survey would take about 5 minutes. This was because I was counting on strangers spending their time on my survey without any reward. I initiated the questionnaire with a question about what services their company offered. This was so I could categorize the participants regarding what business model their startup used:

Welcome. There will be 3 parts to this survey and it is estimated to take about 5 minutes.

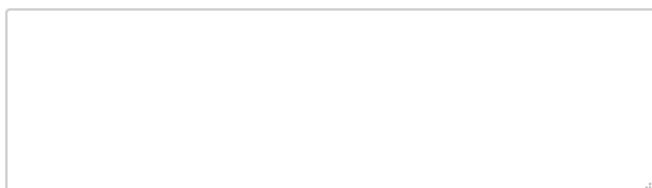Short summary of your company *
What services does your company offer?

Figure 5: Screenshot of the first question of the questionnaire.

I was initially going to ask specific questions regarding each of the purposed metrics. The initial questions were:

- "Have 'Gross churn rate' (Percentage of customers lost during a given time period) made you revert previous changes?
- Have 'User engagement rate' (Percentage of users performing actions that constitute engagement on a site over a given time period) made you remove/add features?
- Have the 'Click-through rate' (The number of people who clicked on a specific link at the website) made you implement those links differently?
- Have the 'Cost of customer acquisition' (The average cost of getting a new customer) made you try a different marketing approach?
- Was 'Time to customer breakeven' (How many days it takes for the cost of acquiring a customer is recouped) used when creating budgets and did it change the approach?
- Have the 'Conversion rate' (Percentage of visits that result in a sale / paying customer) made you change something?
- Have the 'Uptime' (Percentage the website/client is available and operational) made you change the implementation?
- Have 'Return on investment' (Measures the amount of return on an investment relative to the investment's cost) made you scrap a planned investment?"

I ended up removing them as they were too random. They would not contribute towards any measurable research question. I therefor simply asked if they used the metrics. I included a short description of the metrics, since some metrics may use different names. I included a "None of the above" option to make sure the participants read all the alternatives:

Part 1: What metrics are considered

What metrics (current or previous) does your startup measure? *

You will be asked to input more metrics in part 3

☐ Gross Churn Rate (Percentage of customers lost during a given time period)

☐ Lead time (The total time it takes for work to move through the value stream, from the moment the work is requested to the time it's delivered. This includes process time, as well as time that work spends sitting in queues, or wait states)

☐ Enrollment Rate (Percentage of visits that result in a new user)

☐ User engagement rate (Percentage of users performing actions that constitute engagement on a site over a given time period)

☐ Repurchase Rate (Percentage of customers who bought something last period buys something this period)

☐ Time to customer breakeven (How many days it takes for the cost of acquiring a customer is recouped)

☐ Viral Coefficient (The number of new customers that each existing customer is able to successfully convert)

☐ Return on investment (measures the amount of return on an investment relative to the investment's cost)

☐ None of the above

Figure 6: Screenshot of the second question of the questionnaire.

To conclude part 1 of the questionnaire the participants were asked if any of the metrics were involved in making the company pivot their business strategy. The description of a pivot was taken from a blog. This description was deemed adequate of what Ries' described in his book [4], but more precise in fewer words: "A *startup pivot occurs when a company shifts its business strategy to accommodate changes in its industry, customer preferences, or any other factor that impacts its bottom line."* [16] The description was supported with additional clarification that "A pivot of the business strategy can be changes to technology, platform, channel, target customer or business architecture*."* The options for each metric were "contributed" to pivoting, or "decisive" for pivoting. The reason for these grading options was to identify metrics that truly made the company pivot, not simply the ones being measured at the time of a pivot:

Did any of the metrics make you pivot?

A startup pivot occurs when a company shifts its business strategy to accommodate changes in its industry, customer preferences, or any other factor that impacts its bottom line.

A pivot of the business strategy can be changes to technology, platform channel, target customer or business architecture.

If you do not measure the metric, or it did not contribute to a change in business strategy, simply skip it.

	Contributed	Decisive
Gross Churn Rate	○	○
Lead time	○	○
Enrollment Rate	○	○
User Engagement Rate	○	○
Repurchase Rate	○	○
Time to Customer Breakeven	○	○
Viral Coefficient	○	○
Return on Investment	○	○

Figure 7: Screenshot of the third question of the questionnaire.

In the second part I wanted to research if metrics being analyzed changed over the course of the company's life span. Croll et al. (2013) believes that a company should measure different metrics at different times. I feared that explaining the different stages and getting meaningful data would require too much time, and I would be losing too many participants during the explanation. Therefor the different startup stages presented in 2.1 were not introduced in the survey. The question asked if the metrics being analyzed changed at during different stages of the startup. If the participants answered yes, they would be asked more specifically what metrics they stopped measuring and what metrics they started measuring. The reason for the follow-up question being hidden was to make the questionnaire seem smaller than what it was at first glance. Below is the fourth question of the questionnaire displayed:

Part 2: How metrics change over different startup stages

Did the metrics being analyzed change during different stages of the startup? *

○ Yes

○ No

What metrics did you stop measuring in a later stage of the startup and why?

ⓘ This element is only shown when the option "Yes" is selected in the question "Did the metrics being analyzed change during different stages of the startup?"

What metrics did you start measuring in a later stage of the startup and why?

ⓘ This element is only shown when the option "Yes" is selected in the question "Did the metrics being analyzed change during different stages of the startup?"

Figure 8: Screenshot of the fourth question of the questionnaire.

For part 3 I was interested in learning what metrics the participants found important to measure. During my literature review I found that many of the metrics I researched had little evidence from real use cases, I therefor also asked how they used the metrics and if any of them were used to make a pivot. Finally, I include a question of how many metrics they measured total:

Part 3: More metrics to consider

Are there any metrics not mentioned that you use?

How do you use your three most important metrics? Did any metrics make you pivot?

How many metrics does your company measure? *

Figure 9: Screenshot of the fifth question of the questionnaire.

3.3.5 Launching survey

The survey was launched using Nettskjema.no from the University of Oslo. I initially was recommended "questback" by my advisor, but after some research I found out it cost money. After some quick searches on google.no I came upon nettskjema.no and found that it had all the features I wanted:

- Useable in web browser without any additional software requirements. To make it easy to use and get more participants.
- Answers exportable to excel. This was important to be able to sort easily through the answers.
- Customizable schema setup. I wanted some questions to be dependable on earlier answers. I also wanted different layouts (text answers, checkboxes, matrixes, radio buttons) for different questions. Nettskjema gave me many options as seen in the screenshot below:

Figure 10: Screenshot of Nettskjema's user interface.

3.3.6 Cleaning and analyzing data

I removed two answers where the participants did not provide any information.

4. Results

4.1 Non textual answers

The participants' company business model was identified through the initial question regarding what service their company offered. Below you can see the prevalent business models. It was an even split in the middle with nine companies identified as using an e-commerce model, and nine companies identified as using a software as a service model.
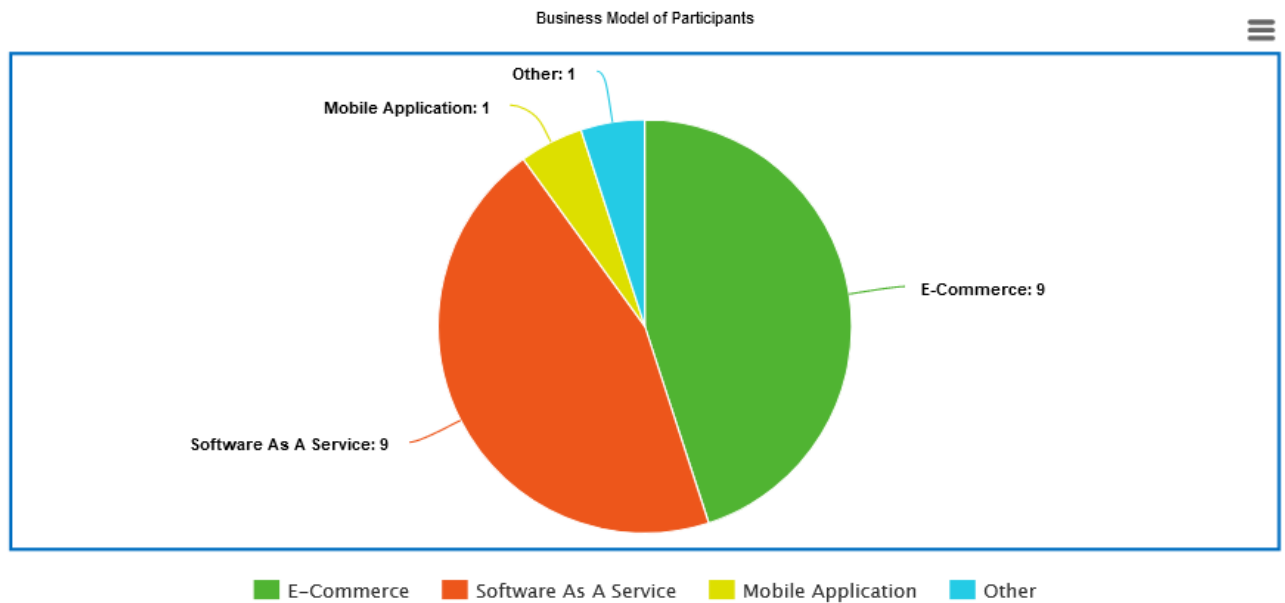

Figure 11: Business model of the participants' companies.

The first question of the questionnaire was a check off list of what metrics they used of the eight that was suggested. Below are the responses:

Part 1: What metrics are considered
What metrics (current or previous) does your startup measure? *

You will be asked to input more metrics in part 3

Answer	Number of	Percentage
Gross Churn Rate (Percentage of customers lost during a given time period)	9	**45%**
Lead time (The total time it takes for work to move through the value stream, from the moment the work is requested to the time it's delivered. This includes process time, as well as time that work spends sitting in queues, or wait states)	9	**45%**
Enrollment Rate (Percentage of visits that result in a new user)	4	**20%**
User engagement rate (Percentage of users performing actions that constitute engagement on a site over a given time period)	9	**45%**
Repurchase Rate (Percentage of customers who bought something last period buys something this period)	7	**35%**
Time to customer breakeven (How many days it takes for the cost of acquiring a customer is recouped)	4	**20%**
Viral Coefficient (The number of new customers that each existing customer is able to successfully convert)	0	**0%**
Return on investment (measures the amount of return on an investment relative to the investment's cost)	9	**45%**
None of the above	4	**20%**

Figure 12: Answers to the second quesiton of the questionnaire.

The companies using an e-commerce business model answered as follows:
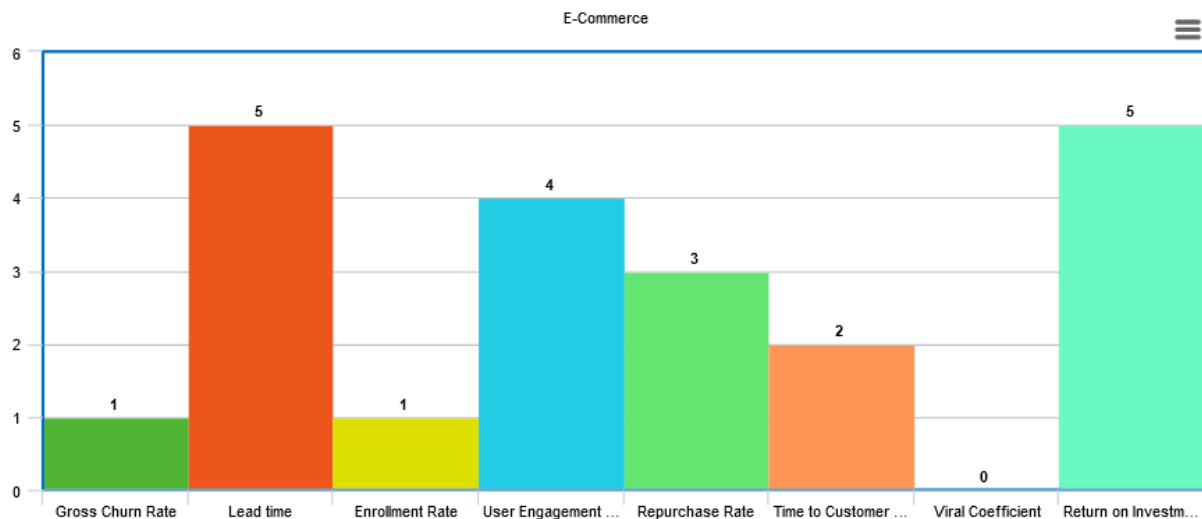

Figure 13: Answers to the second quesiton of the questionnaire, from participants of companies using the e-commerce business model.

The companies using an software as a service business model answered as follows:
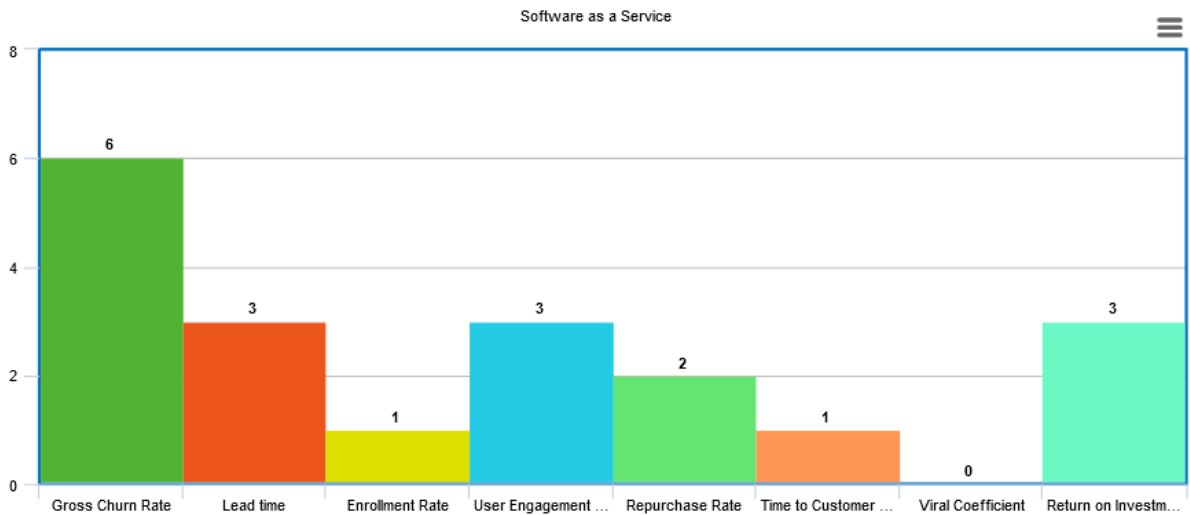
Figure 14: Answers to the second quesiton of the questionnaire, from participants of companies using the software as a service business model.

Included in the first part of the questionnaire was the questions regarding pivoting. The participants answered as follows:

Did any of the metrics make you pivot?

A startup pivot occurs when a company shifts its business strategy to accommodate changes in its industry, customer preferences, or any other factor that impacts its bottom line.

Changes to the following are regarded as pivots: technology, platform, channel, target customer, business architecture.

If you do not measure the metric, simply skip it.

Response distribution (raw data)

	Contributed	Decisive
Gross Churn Rate	1	2
Lead time	6	1
Enrollment Rate	5	1
User Engagement Rate	3	4
Repurchase Rate	5	1
Time to Customer Breakeven	3	0
Viral Coefficient	1	0
Return on Investment	6	0

Figure 15: All Answers to the second quesiton of the questionnaire

In part 2 the participants were asked how metrics being measured changed over time. The answers were as follows:

Did the metrics being analyzed change during different stages of the startup? *

Answer	Number of	Percentage	
Yes	11	**55%**	▬
No	9	**45%**	▬

Figure 16: All answers to the third question of the questionnaire.

In part 3 the participants were asked how many metrics they tracked in total. Six participants did not report an exact number of metrics measured. The answers were as follows:
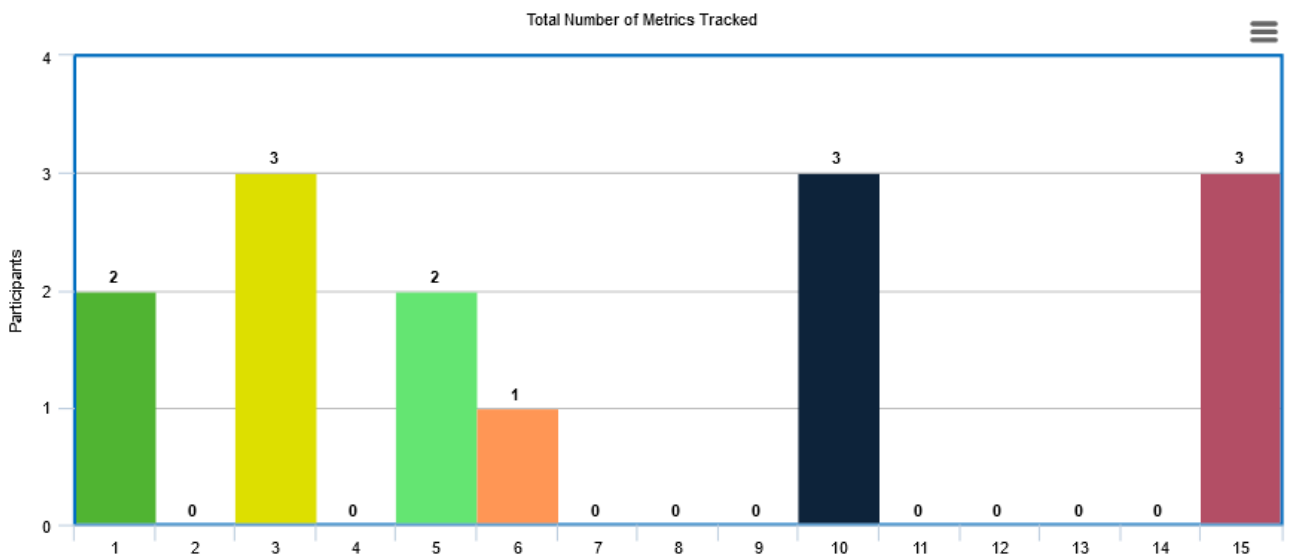

Figure 17: Total metrics tracked by companies of the participants.

4.2 Textual answers

In the questions from part 2 of the questionnaire regarding changes to what metrics were measured, only six participants answered both questions. One participant only answered what metrics the company started to measure in a later stage of the startup. This was a low answer rate considering eleven participants reported changes in metrics being measured during different startup stages. The answers were as follows:

What metrics did you stop measuring in a later stage of the startup and why?

1. I can't speak the specifics over the 3 year life of the company, but one example is: - moved away from % of total revenue from repeat customers
2. Less focus on social media metrics as we shifted from B2C to B2B customers.
3. Not so much stopped, but less focus on number on customers and ARR. Then in later stages started with user engagement and conversion funnel
4. Started with a super wide set of metrics inspired by this article: https://a16z.com/2015/08/21/16-metrics/ It was hard to measure in our business and wasn't actionable enough. We, therefore, narrowed it down.
5. Not stop/start, but rather different weight over time
6. We stopped emphesising top of funnel growth (new visitors/users) to focus on user engagement.

1. Too many metrics to count that we have incrementally added on, but for the example above, we pivoted away from % of total revenue that came from repeat customers and shifted focus to Repeat Purchase Rates, Repeat Revenue, and Lifetime Revenue as the priority. As an example.
2. More traditional sales process focused metrics, such as lead creation, opportunities, etc.
3. User engagement with stickiness and retention. Also sales and marketing conversion funnel. Be able to identify bottlenecks of where we can improve.
4. NPS, to scale the collection of feedback from clients
5. Churn, started after input from one of the new members of the steereing group
6. Revenue per pageview (per country) to enable us to optimize prices for different regions / countries.
7. Onboarding rate and SKU count because the faster we can onboard people the most vendors we will have the bigger selection we will have for our customers.

The last question of the questionnaire was an open question where participants could include metrics that they found important, how they used them, and clarify if any of them made them pivot. The question was answered by 16 of the 20 participants. The answers were as follows:

Are there any metrics not mentioned that you use? How do you use your three most important metrics? Did any metrics make you pivot?

- CAC - Cost to Acquire a New User LTR/LTV - Lifetime Revenue (Gross)/Lifetime Value (Net)
- - Number of units sold per month - Gross margin of product - Inbound and outbound leads created
- In an early startup we use adoption rate, and stated interest from customers. Note that we are mostly selling to a market that is not transition based since the market has to be rebuild or educated. Our market is also business to business.
- NET Growth rate Average contract value CAC (cost of aquired customer) LTV (lifetime value)
- Support conversation ratings and response time is high on the list. We use the metrics in day to day work by having them back up decisions. The most important metrics are also highlighted in the company and team KPI and OKRs.
- As we are in B2B Enterprise Sales with complex sales cycles and complex purchasing organizations: 1. sales cycle (between 12-24 months) 2. deal size (average deal size, typically about 250K to 2 Million euro) 3. deal contract period (typically minimum 3 years) 4. number of deals through channel partners 5. weighted pipeline 6. Cross margin
- All metrics relate to market. We are not in the market yet, as most startups are. We measure burn rate, organizational growth, market / customer interest, etc.
- - GMV: Gross merchandise volume. Or how much business are we contracting each month - AOV: Average order value per transaction - Take rate: what is our realized take rate - Oppportunity to close: what is the % of opportunities that becomes a customer
- As a startup, it is more relevant to measure growth in terms of personell and customers. As a B2B platform, our customers customers are defined as consumers and not customers. The previous "customer" metrics were more considering a B2C customer relationship
- Decisions made by users of the software

- Very many business specific metrics
- We deliver a small number of highly specialized projects (3-5 per year), commonly used general metrics are not very useful to us.
- Churn, User Engagement, and Leads are the ones we are analyzing each month. The user engagement and the amount of leads/demos made us pivot.
- conversion rate (lead -> contract) marketing / positioning / inbound lead / demand generation the first made us pivot
- Annual Recurring Revenue
- Topline growth / revenue to make sure we are growing. User engagement (subjective + some metrics) - used to evaluate our community efforts. Revenue per pageview per country is as mentioned used to optimize local prices.

5. Discussion

This paper set out with two research questions. In this chapter I will use theory from chapter 2 and results from chapter 4 to try answers these questions. Below are the subsections of both questions and their answers.

What metrics are used by software startup companies?

4 of the 8 metrics suggested in the start of the survey were used by 45% of the participants. This was striking that so many of my suggested metrics were used in real life. In my list of 100 metrics [1] I recommended what metrics should be used by what startup business models. The business type recommendation is for where they are best applicable, but this is subjective and not validated by hard data. Most companies used metrics that I found useful for their business model, but there were some exceptions. User engagement rate was not suggested for companies using the e-commerce business model in my 100 metrics list [1], still 4 out of 9 companies used it. User engagement rate was not suggested for companies using the software as a service business model in my 100 metrics list [1], still 3 out of 9 companies used it. When I researched the user engagement rate, I thought it was important for sites that rely on ad-revenue or user-generated content. The survey results show that this metric has a much wider use, and more business types are interested in how visitors use their site. Repurchase rate was not suggested for the software as a service model in my 100 metrics list [1], still 2 out of 9 companies used it. This makes sense in hindsight. Most companies using the software as a service model are reliant on customers returning for their services, and it makes sense to monitor repurchase rate. Since I only got 1 result from a company using the mobile application model, it is meaningless to analyze anything regarding that business model.

Lead time and return on investment were the two most popular metrics for companies using the e-commerce business model. Return on investment is a staple metric that most familiar with metrics have heard of, and this is reflected in the answers. Lead time being so prevalent is interesting as it shows that most of the companies using the e-commerce model seems to be using a kanban-esque system. Gross churn rate was the most popular metric used by 6 out of 9 companies using the software as a service model. As explained in 3.2.1, while customer churn is a helpful metric for detecting a "leaky bucket"' it varies from revenue and doesn't indicate which customers you're losing (i.e. high-value customers, low-value customers, or perhaps customers who would be better served with another product) [4]. Croll et al. (2013) further explains that there are major complications with using churn over a month, since startups' churn can vary too much from start of the month to end of the month and gives a false impression. It would be interesting for future research to see if companies combine gross churn rate with other metrics to make up for its shortcomings.

User engagement rate was the most impactful metric regarding pivoting business strategy. It was decisive for 4 out of 20 companies. This was consistent with my research as it was one of the few metrics I was able to find examples from real-life as being decisive to a pivot. *"Circle of Friends remade their company to Circle of Moms when they discovered mothers where much more engaged than other users (of other circles less than 20% were active)."* [5] Gross churn rate was the second most impactful metric with 2 out of 20 companies claiming it being decisive for a pivot. This metric also had evidence from real-life as explained by Ries (2011) *"PointCast was struggling to grow, it was incredibly successful in new customer acquisition, but this growth was offset by an equivalent amount of churn."* [4] The fact that the two most decisive metrics for pivoting had evidence of other companies using them to pivot before this survey was interesting and validates these metrics.

Croll et al. (2013) suggests that you should focus on "one metric that matters". This is supposed to be especially important early on in the startup. This is to not be distracted by too many metrics, to have clear goals and defined success. [5] Kakati (2003) on the other hand suggests that *"it is advisable to use multiple performance criteria to measure the startup success, instead of one single measurement (such as ROI or churn)".* [21] Only 2 of the 16 companies that answered the question regarding total metrics tracked said they only tracked one metric. This could be because some of the participants' companies are in later stages of the startup, but it is clear that most companies do not subscribe to "one metric that matters".

Do metrics being measured by these companies change throughout different stages of the startup?

Only 11 of 20 companies changed what metrics they measured over time. In other words, 9 of 20 companies did not agree with Croll et al. (2013) assessment that it is important to change what metrics are being measured over time. Of the seven companies that reported what metrics they started measuring, user engagement was the only metric reported twice as being started measured in a later stage. It makes sense to monitor this in a later stage when the site actually has some traffic. None of the companies reported stopping measuring the same metric. Several of the companies did report to not stopping measuring metrics, but rather giving metrics different weights throughout the startup's lifetime.

6. Conclusion

To conclude it is clear that a wide range of metrics are being measured by software startup companies. 21 new metrics were identified from participants textual responses, none who were in the 100 metrics for software startup companies list. [1] User-engagement rate was the clear winner of the survey being most popular and deemed the most decisive for a strategy pivot.

6.1 Limitations

There were a few things I would have done differently had I the chance. I would have asked if the company "changed metrics measured over time", rather than "different stages of the startup" as stages are vague. I would present the 6 business types suggested in 2.1 instead of letting the participants describe their company. That way I would have known that they agreed on my characterization of their business types. It is difficult to assess if all of the participants are still in the "startup" phase as I do not have insight into their company's history, beyond a google search. I would have researched more how other known studies define startup companies, and strived for a "line in the sand" to cut of possible participants.

I would have replaced the questions regarding pivot as this was vaguely defined, and leaves a lot up to interpretation from the participants. This could have been replaced with expanding the last question *"Are there any metrics not mentioned that you use? How do you use your three most important metrics? Did any metrics make you pivot?"* into three separate question prompting more clear responses. This could backfire though, as the survey relace on being short to not deterrent people from answering. The survey is limited since it is dependent on strangers using their free time to answers question that might aid the competition with their company secrets. This is reflected in only 20 out of the 187 companies contacted actually responding. This is of course a small sample that makes the survey unreliable.

6.2 Suggestions for future research

As displayed in the results there was almost an even split dividing the companies that changed what metrics it monitored and those who did not. It would be interesting to gauge how companies that do and do not change metrics over time fare compared to each other. As mentioned in the conclusion, it would be interesting for future research to see if companies combine gross churn rate with other metrics to make up for its shortcomings. There should be more research on how multiple metrics are used together.

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