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MEASURING OF DIGITAL PRODUCTS – A GREY LITERATURE REVIEW

Master's Thesis (20 ECTS)

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Title: Measuring of Digital Products – A Grey Literature Review

Abstract: The number of digital products increased drastically and took an essential part in people daily lives. Digital products produce massive amounts of data that allow measuring product aspects. Digital product owners use metrics to measure products aspects. Based on the information provided by measurement, product owners make better product decisions, track product success, and build products that meet customer needs and bring value. However, the topic of digital products measurement is unrevealed by academic research.
Hence, this study reveals the topic of digital product metrics, aspects of digital products that they measure, factors that influence product aspects, information that product owners learn from metrics, tools for metrics measurement, and visualisation methods.
The chosen research method – a grey literature review – synthesises the data from unofficial publishing sources written by existing product professionals about their strategies of product measurement. The practical contribution of the paper is the digital product metrics framework that presents a guide for the measurement of different product aspects for product owners.

Keywords: product management, product owners, metric, measurement, product success

CERCS: P170 Computer science, numerical analysis, systems, control

Pealkiri eesti keeles: Digitaalsete Toodete Mõõtmine – Halli Kirjanduse Ülevaade

Lühikokkuvõte: Digitaalsete toodete arv kasvas drastiliselt ja võttis olulist osa inimeste igapäevases elus. Digitaalsed tooted toodavad massiivsed andmemahud mis lubavad mõõta toode aspekte. Digitaalsete toodete tooteomanikud kasutavad meetrikaid et mõõta toote aspekte. Kasutades mõõtmisest saadud informatsiooni, tooteomanikud teevad paremaid tooteotsuseid, jälgivad toote edukust ning ehitavad toodet mis vastab kliendi vajadustele ja lisab väärtust. Kuid digitaalsete toodete mõõtmine ei ole kajastatud akadeemilistes uuringutes. Seega, antud uuringus on kajastatud digitaalse toote meetrikate teema, nendega mõõdetavad digitaalse toodete aspektid, aspektidele mõjutavad faktorid, informatsioon mida tooteomanikud saavad nendest meetrikatest, tööriistad meetrikate mõõtmiseks ning visualiseerimismeetodid.
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Võtmesõnad: Tootehaldus, tooteomanikud, meetrikad, mõõtmine, tooteedukus

CERCS: P170 Arvutiteadus, arvutusmeetodid, süsteemid, juhtimine

Table of Contents

1. Introduction

Product owners play a critical role in any organisation building products and services. Everyday responsibilities of product owners differ widely from organisation to organisation. However, the core function is to connect and align internal stakeholders around the business's goals and ensure that those goals meet customers' needs [1]. Moreover, product owners are responsible for gathering, prioritisation and implementation of requirements as well as tracking product success [2].

The concept of product ownership was introduced by Procter & Gamble in 1931 [3] when the company ran into issues with one of the products and felt a lack of people to manage the product. The company's top management decided to hire a particular person responsible for managing the product development to solve the issue and avoid similar problems in the future. The success of assigning product owners to a product or product line led to the fact that other companies copied it outside Procter & Gamble [4].

While in 1931, product management was related to tangible attributes (physical goods), technological advances brought disruptive change into the market and products' nature. They introduced intangible qualities (software, services, or both) that refer to digital products [1]. Therefore, product management changed its nature and incorporated technical activities such as organising milestones and configuration management for delivering software products [3]. Moreover, learning, monitoring, and continuously optimising digital products and product lines became an essential part of digital product owners' routine. By applying diagnostic and quantitative skills, digital product owners examine how the product performs, the critical drivers of success, and how different changes affect the development [1]. They use metrics as a key that allows them to quantify, evaluate, diagnose, and explain findings to create plans and strategies for digital products. According to Investopedia, metrics are "measures of quantitative assessment commonly used for assessing, comparing, and tracking performance or production." Usually, they are combined into dashboards and regularly viewed by product professionals and analysts to maintain success measurement and performance assessments and business strategies [3].

Practitioners suggest using metrics leading to better product decisions and more seamless executive approval [4]. For instance, by tracking stickiness, product owners can investigate if product users are returning to the product and how relevant the product is. If the measurement shows low stickiness, the product owner can implement a new feature to increase users' interest and everyday engagement [5]. Therefore, product owners use metrics to evaluate the product success and spot the parts that need improvement. As a result, professionals use this knowledge to make better product decisions and lead products to success. However, it is not straightforward to know which metric to use, what information metrics provide, when to use it. Therefore, product owners face the challenges of deciding which product metrics to choose and how.

Current literature focuses on managing physical products or specific aspects of digital products. Researches on physical product metrics showed that metrics contribute to the decision making processes during the physical product manufacturing [6], identify the cost for the investments involved to develop the product [7], measure sustainability of physical effects [8]. In addition, available scientific literature on digital product metrics focuses on software development [9], software quality [10], object-oriented system metric [11]. To my knowledge, nowadays, a framework that aid product owners in navigating among existing digital product metrics does not exist. Thus, the field of metrics from a digital product management standpoint is unrevealed and needs exploration.

This thesis explores how product owners can use metrics to drive digital product success. More specifically, this thesis will answer the following research questions:

- RQ1: What aspects of digital products are measured?
- RQ2: What information do metrics provide to digital product owners?
- RQ3: What are the factors that impact the performance of digital products?
- RQ4: What are the tools used to measure metrics for digital products?
- RQ5: How are metrics for digital products visualised?

Digital products have different aspects that product owners monitor to identify product success. For example, some metrics reflect on the user experience[12], some metrics concern profitability and growth [13], some refer to product marketing success [14]. Thus, RQ1 will define existing product aspects and metrics measuring different digital product aspects. This research question specifies metrics definition, the formula of metrics calculation, data required for computation and frequency of data measurement. Besides, various metrics can bring additional information for product owners. For instance, conversion can point out low user engagement on the platform [15]; this information identifies the purpose of the metric and helps to take further actions to contribute to the product development mirrored in RQ2 is. In addition, external factors can affect the values of different metrics. For instance, an increase in the average number of users caused by an advertising campaign affects the conversion rate. Thus, we need to investigate what factors impact the performance of the digital product as measured by the metrics. If product owners know these factors, they know how to improve the metrics (RQ3). Different product owners work with large sets of data, and additional tools aid them, but not all of them are helpful for the measurement of all the metrics. That's why RQ4 investigated tools for measuring the metrics. In addition to that, there are different tools for measuring the metric, which RQ4 will cover. Moreover, product owners usually watch metrics on dashboards. To have metrics in the dashboard, professionals should visualise them. Thus, RQ5 investigates how to visualise the metric.

The study will be conducted as a systematic grey literature review. The Grey literature review is a systematic literature review that covers non-official published sources that are "grey" literature. In comparison, systematic literature review includes input only from formally published sources and does not necessarily include a "grey" literature source. This research method was chosen over a systematic literature review following the checklist of Garousi [16]. First of all, related work analysis presented a lack of academic research on the digital product metrics topic. It gave evidence only on the physical product metrics and measurement of particular parts of a digital product. Therefore, the grey literature review investigates how nowadays practitioners use metrics, analyses the data, and provides a comprehensive framework of digital product metrics for product owners. Secondly, the contextual information of the study (digital product ownership) is relevant to the subject of the study (digital products metrics). Moreover, the synthesis of insights about digital product metrics will be relevant to the practitioners who apply metrics to their day-to-day routine and use them for the product success measurement. The study will follow the guidelines of Garousi [16] based on Kitchenham's systematic literature review guidelines [17].

The thesis's contribution is a framework that will categorise digital product metrics and show how metrics can be chosen, used, visualised, measured, and calculated. Moreover, it will clearly distinguish between product aspects and factors affecting product metrics values. The framework aims to simplify and aid the everyday work of digital product owners by providing a systematic approach to digital product metrics choice.

The remainder of this paper is structured as follows. Chapter 2 represents background study and review of related work. The study's research method, which includes the presentation of

research questions and their motivation and grey literature review steps followed in the study, is described in Chapter 3. Chapter 4 is the part that elaborates on the study results, answering research questions one by one. Chapter 5 presents product owners' metrics framework based on research questions answers and describes how to use it. Discussion of the digital product metrics topic is described in Chapter 6, including the study limitations. Conclusions are drawn in Chapter 7. The digital metrics framework is presented in Appendix I. The study has two supplementary materials: "The grey literature review protocol" – the detailed guide on how the study was performed and the data extraction form that includes all studied papers and data extracted per each of the paper.

2. Background and Related Work

This chapter presents the background knowledge relevant to the study. Firstly, the history and types of digital products are covered. Secondly, the chapter presents digital product ownership's key points and specifics. Thirdly, it brings out digital products considering the definition of metrics, types of product metrics, and how product owners use them. The latest section of this chapter will present related to the study.

In this thesis, the term “digital product” refers to a software-enabled product or service that offers some form of utility to the people [18]. Moreover, the term “software product” denotes digital products. Therefore, software refers more to software development, which is not thesis scope. I will henceforth use the word “digital”.

2.1. Digital Products

The first one who presented the studies about digital product management was Kipli (1997), who considered digital product management as a “process consisting of version control, configuration management [18] ”. In the early stages, digital product MP3 players substituted vinyl discs, digital movies that covered reels of celluloid ones, and compact discs that replaced punch cards. Even though the first digital goods were similar to physical goods, digital products refer to knowledge rather than physical artefacts. These products are some of the most sophisticated products of human invention [19]. Moreover, a digital product is not always a stand-alone item but rather a part of product groups, a combination of product lines/solutions. Besides, products consist of modules, elements, modules or terms [20].

In [1], the product refers to anything that can be sold, empathizing with the role of product management. The core function of digital product owners is to develop and launch a successful digital product that produces a profit for the organization by strategizing, planning, managing, discovering, innovating.

However, various product types occupy the market and understanding their peculiarities is essential. To be more specific, there are generic and bespoke digital products. The first ones are created for a range or a group of people and serve them equally. For example, Gmail, Facebook messenger, Instagram are generic products. Bespoken digital products provide value for a single customer or group of customers who uses them. The hotel security system and job-seeking application represent a bespoken product [19].

Since digital products refer to software products, the types of digital products are also classified by the software type the product is built. For example, there are systems and applications. The system software is defined as a middle layer between the user and hardware. In other words, it is a software product that manages computer hardware behaviour to provide essential functionalities for a user. Operating systems (Android, iOS, Linux), Device Drivers (Printer drivers, Display drivers, ROM drivers), Firmware (BIOS, Embedded systems), antiviruses, utility software (WinRar, Windows File Explorer) are all examples of system software. Application software is an end-user program that helps the user accomplish a specific task, for example, PowerPoint, browser, fitness application, word processor, database software, multimedia software, education software, and applications on our mobile phones. Another type of digital product by software type is freeware available without cost (Skype, Yahoo messenger). At the same time, shareware provides the customer with a time-limited product trial. When customers want to use total product capacity, they should purchase it. Open-source products refer to the products available to the user with the source code modified and distributed. Users can add additional features to the software (Mozilla Firefox) [21], [22].

Besides, there are such product types as SaaP (Software as a Product), SaaS (Software as a Service), PaaS (Platform as a Service), IaaS (Infrastructure as a Service) that emerged to the market heavily. SaaP is a digital product where the user or organization has to pay a license once to use all the functionality without update fees or maintenance freely. While SaaS is software hosted on the web, primarily via cloud computing and charged for a time. As soon as users pay the subscription, they receive access to the application by the company that owns SaaS with the agreed availability and terms, security conditions, performance standards. SaaS provides users with functionality, who can always reach the service anytime from everywhere being connected to the Internet. The SaaS product that we use daily is Google Docs. PaaS (Platform as a Service) provides cloud components to specific software while being primarily used for the application. Great examples of PaaS are Windows Azure, Google App Engine. They deliver a framework for developers to build upon and use to create customized applications. IaaS refers to a cloud computing infrastructure and consists of servers, network, storage, operating systems supplied through API or dashboard. Users have complete control over the infrastructure and can access their outsourced servers through a "virtual data centre" in the cloud. IaaS Examples are Amazon Web Services, Google Cloud [23].

Notwithstanding, each product owner owns the specific product type and has to deal with its peculiarities and adoption lifecycle that constraint the strategy and approach of the management. Alternatively, products can be split into elements, modules, parts. They can be built on platforms or product architectures. However, there are some products where product management is not involved in their creation, such as system software, freeware, opensource, shareware, PaaS, IaaS or rarely involved. Hence, this paper will cover the scope of application software and SaaS products.

2.2. Digital Product Management

Product management is "the business management of products, product lines, or portfolios, holistically, for maximum value creation, across their life cycles [24]. It is a model for a business organization that includes discovering, innovating, strategizing, planning, developing, introducing, managing, and marketing products [20]". Product owners manage products, and their core responsibilities vary from company to company and are mirrored by the product and market specifics. For example, in a small start-up, product owners may deal with product mock-ups, conduct interviews, write strings of codes, test deliverables, plan a product roadmap, schedule review meetings with contract or freelance developers. As a medium-sized technology company, product owners facilitate and arrange meetings with a team of engineers, designers, and analysts; negotiate product strategy with top management of the company, talk and conduct interviews with customers to understand their needs better and deliver a value to them. Product professionals outline product requirements at large enterprises by creating user stories and analysing data to derive insights into customer engagement and behaviour [25]. Hence, product management contains dealing with ambiguity, having authority. There are some specific practices that product owners are incorporating in their day-to-day work to lead and manage products:

- *Solving problems and decision making*. Product owners strive to make better decisions in every step of the product life cycle.
- *Cross-functional teaming*. Product owners organize and lead cross-functional teams performing tasks to achieve product success. Moreover, they facilitate and lead discussions.
- *Leading and influencing*. Since product owners own the product vision, they have to use leadership skills to control other colleagues to believe in that vision.

- *Integrating and synchronizing*. To deliver results, product owners have to see the broader picture and to be able to "connect the dots" among all aspects of the product's business. They must align different functions to achieve a common goal.
- *Financial planning and analysis*. Professionals are responsible for product profitability and its assessment. They have to plan for profitability; hence, financial knowledge is crucial.
- *Assessing the industry and competition*. One of the core responsibilities of product owners is to analyse the market and industry, so that managed by them, people will strive and excel. Thus, product owners assimilate the data about the industry and competitors and design strategies for allocating investments across the product portfolio.
- *Segmenting markets, identifying target customers, researching customer needs.* Product owners are seekers of going beyond customers' expectations.
- *Leveraging the product management life cycle model*. Product owners should think through product strategy and integrate that strategy into the product development, release, launch, management [20]

Product owners not only bring new product in life but also manage the product lifecycle [2], [26] that consist of such main areas of work as Discovery and Innovation, New Product Planning, New Product introduction, Post-Launch Product management (figure 1).

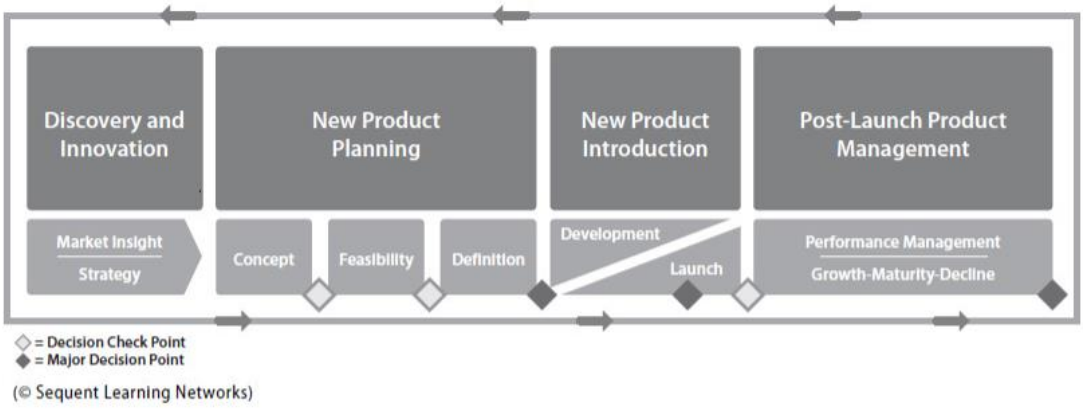

Figure 1. Product Management Life Cycle Model [20].

Discovery and *innovation* refer to data capturing, deriving insights, and formulating strategies. In comparison, the combined box of discovery and innovation refers to various events and actions. For instance, the insights are derived from multiple studies and observations. This step is essential for product owners to evaluate the challenges faced by customers, trends and tendencies on the market, actions and strategies of competitors. Thus, the primary outcome of the discovery and innovation area of work is product strategy formulation by setting a direction based on the product performance information with current market insights. At the same time, the *new product planning* area is a backdrop for guiding the decision making by ensuring the proper cross-functional work. There are three phases and decision gates within the new product planning area such as:

- *Concept phase* – generation, assessment and screening of new ideas
- *Feasibility phase*– assessment if ideas can be developed
- *Definition phase*– product design and specification mapping

The *new product introduction* area refers to the ideas execution and consists of mainly two blocks: development and launch. Development starts after the idea is funded or approved. The launch involves activities to bring products to the market. *Post-launch product management*

refers to the optimizing performance of the product within the context of the company's strategies. Post-launch activities combine product performance analysis and metric measurement to analyse the lunch's success and results [20].

Every digital product has its adoption lifecycle that represents users' behaviour related to its acceptance. Lifecycle classifies the market and its reaction to the digital product during its appearance on the market. It is presented in Figure 2 and includes such stages as introduction, growth, maturity and decline. Different personas in the product life cycle represent each step [27] .

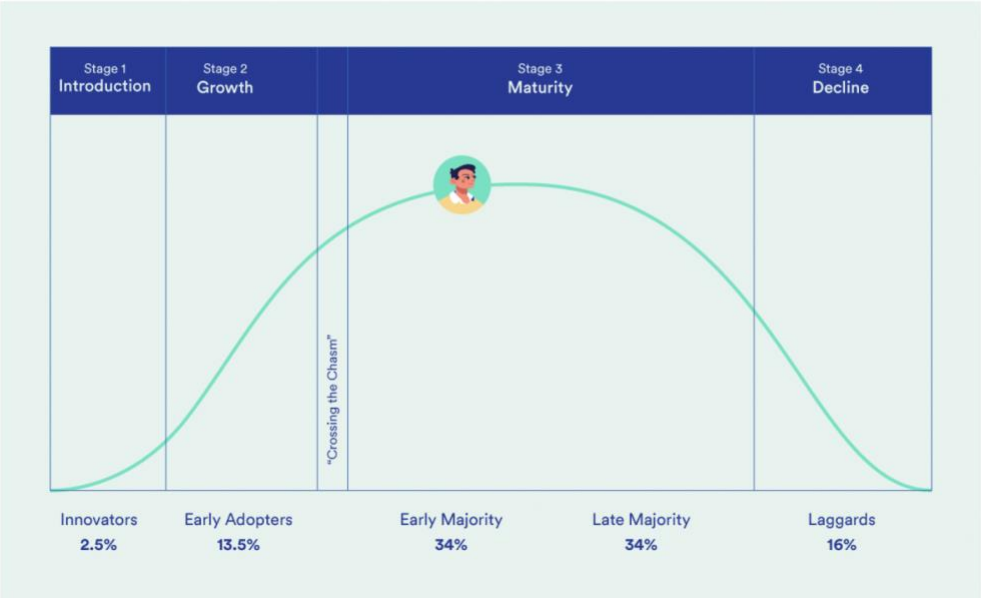

Figure 2. Product adoption lifecycle [27].

Thus, product introduction consists of the innovators and refers to the situation when the product is introduced, and demand is not specified. The growth stage is when the users (early adopters) promote the development and sales increase. Innovators and early adopters form 16% of the user's population and refer to the product's evangelists eager to try it, take a risk, pay for a new product, and provide feedback. "Chasm" in figure 1 refers to the gap between the product's early stages (introduction and growth) and maturity. This gap leads to declines in sales and is the reason for new products failures [28]. The peak of the product lifecycle is the maturity stage that includes the early majority (34%) and the late majority (34%). The early majority refer to the users' population and represents customers influenced by the early adopters who adopt the innovation.

In comparison, the late majority is ready to use a product after many others have tried it. The saturation phase of the product is called decline and represents laggards (16%) who are reverse to a change population of customers. Notably, each stage of the adoption lifecycle requires different product management strategies. Product owners keep in mind adoption lifecycle while managing the product. The success of these stages and metrics relevant to them will be considered in this paper [27].

2.3. Digital Product Metrics

Business requires product owners to track product performance as a product moves through the market. Post-launch management (management of the products already present in the market) demands thinking, planning and the ability to fix the problems. Moreover, product owners have to evaluate how a product performs by evaluating data and performance indicators that refer to

the product's KPIs (key performance indicators). When product owners can present relevant data to the organization's leadership, they earn more credibility and trust. Product metrics provide the keys to that. They quantify measure, identify, explain and find good reasons for the assumptions and findings. Metrics are based on the data. Thus, product owners have to learn, understand and interpret data. Data is a fuel that can be driven from various sources: observation of customers, documentation, analytical tools attached to the products, financial statements, competitors. Besides, data can be present in multiple databases and reports through different tools (i.e., Google Analytics, Kibana). These are major data categories:

- Market and usage data
- Financial data
- Sales, service, and operation data

The challenge appears when professionals choose correct data sources and investigate which data is needed to calculate the metric [1]. Product owners identify key metrics driven by data to evaluate their products. However, there is no "one magic metric" that every product owners needs [29]. Every product owner has to choose from various metrics that are the most suitable for their product type. Besides, metrics can be deceptive. For example, if the application product owner tracks the number of downloads of applications per month to understand how the product grows without considering how many active users are, then the number of downloads is misleading information that may not refer to the product growth at all. The author of [29] empathizes that product owners should categorize metrics. Otherwise, the insights-driven from the metrics can be biased and misunderstood. The primary metrics categories are financial, business, product, user metrics (see table 1). Financial and business metrics will be excluded from the study since they refer not to the product itself but the team KPI measurement and economic indicators.

Even though product owners work in a dynamic environment, they have to implement changes quickly and analyse if the change will positively affect product success. Thus, A/B testing and multivariate testing are used by product owners to validate their hypothesis and make a decision about the change, measuring the effectiveness of the result. A/B testing is a method to measure the performance of two product versions where one version is A, and another one is B. It assists in finding out which variations of the product resonate most with the end-user. Optimizely and Google Analytics are the standard tools used for A/B testing. The method proves or rejects the original hypothesis that usually assumes that the change will improve some metrics value. In contrast, multivariate testing tests the product's permutations and derives conclusions from the trial [30].

Table 1. Metrics types.

Type	Purpose	Example
Financial metrics	Provide an assessment of business performance by analysing fiscal health [31]	Net income, earnings per share, rates of returns, and insights about the company's operational insights [14]

Business	Assess the business process, including the key players such as employees, competitors, partners. In the case of product management, they are aligned with the performance measurement of the team that is working on product development [32]	Cost, return on investment
Product metrics	Quantifiable data points that represent the product's success and are aligned with the product strategy [4]	Churn rate, retention rate
User metrics	aim to understand user behaviour [9]	User satisfaction, engagement, user lifetime value

2.4. Related Work

In this section, I position my work against related work on digital product metrics. Related to my work are other reviews and studies on metrics for physical product management [6], metrics contribution into automation [33], object-oriented systems metrics [11], usage of metrics to measure quality and reliability [32].

Analysis of related work showed that the topic of physical products metrics is covered extensively by academia. For example, in [6], the authors review the academic literature on decision-making strategies in developing physical goods where metrics play a role in the decision-making process. Thus, technical performance metrics represent the product specifications, one of the essential product attributes and customer needs. In [34], authors conclude that metrics help clarify the link between company profit, research and development. After the research, they suggest using the metric as a parameter that will tie the study and development of the process to the number in the manufacturing demand [7].

Moreover, the measure of investments in tools, infrastructure takes into consideration during the physical product development [35]. Furthermore, some metrics establish a product sustainability index for physical good and their manufacturing. Authors in [8] present a methodology to quantify product sustainability metrics. Compared to the listed studies, this thesis will cover the topic of digital product metrics that digital product owners measure.

Review studies have been conducted on the usage of metrics to analyse the variability. For instance, in [36], the authors review metrics for analysing variability for software product lines. Product lines are “groups of related products all marketed under one brand. Software product lines minimise costs and efforts by maximising the quality of a family of software products [37]”. The paper covers variability model metrics, code metrics considering variation. It provides and clarifies a framework for identifying existing metrics and assessing their

variability to serve as a basis for making a qualitative conclusion. The study [11] focuses on the survey of existing metrics proposed for object-oriented systems concentrate on the product metrics, specifical coverage of entities, attributes, and development stages (indicated as states). These reviews track metrics associated with the development process for physical products. The contribution of this thesis, on the other hand, focuses on metrics measuring the performance of digital products.

The quality and reliability of digital products are essential for product owners. If the product has a lot of bugs and errors, it is hard to use by customers. Therefore, measurement and ensuring of reliability and quality of the product is essential for the product owner to understand how good the product is to be used by its customers. Several studies shed light on the quality metrics. For example, in [9], authors discover the topic of software metrics and bring clarity on their usage in the industry. In the study conclusion, the authors state that software complexity metrics help assess the software development process and improve the quality of the software. In [10], authors conduct an empirical study on the metrics in software testing and compare different metrics such as quality code, test coverage, software maturity, software reliability. The paper describes and summarizes existing product metrics in testing. In addition, it concludes that metrics should be chosen carefully and benefit measurement by providing helpful information for decision-makers [10]. Besides, metrics usage in an engineering design project is described in [38]. The study concludes that such metrics as duration and effort are underestimated and describe the quality of the product, test coverage, software maturity, software reliability.

All in all, these studies reveal the software development and quality assurance metrics that are important for product owners. However, these metrics are predominantly the responsibility of the development teams. At the same time, product owners focus on the digital product metrics that define the product's performance and success; that's why this thesis focuses on metrics that provide insights to product owners about the digital product success from the perspective of growth user experience, marketing.

Related work analysis showed that present studies focus more on the physical product metrics, sustainability of physical products, metrics of the product development process, quality and reliability of digital products. However, this study will focus on the digital product aspects that product owners measure to validate product success without considering the development and quality assurance process of product development.

3. Research Method

This study explores how product owners can use metrics to drive digital product success. The study's main contribution is a digital product metrics framework for product owners that will help them find the best metrics for their product measurement request and describe how to use the metric. To achieve the thesis goal, I conduct a grey literature review. The attached to those thesis file "The Grey Literature Review Protocol" presents a detailed description of the steps taken to conduct the study, while this chapter will summarise it.

The review is conducted in a systematic and repeatable manner following the guidelines of Garousi [16] based on Kitchenham's [39] systematic literature review guidelines. It consists of three main phases: 1) planning the review, 2) conducting the review, and 3) reporting the review.

As a part of the planning, the review phase assessed the need for the grey literature review. The grey literature review (GLR) is a systematic literature review that includes only grey literature sources [16]. Based on the "Luxemburg definition", grey literature refers to source "produced on all levels of government, academics, business and industry in print and electronic formats, but which is not controlled by commercial publishers, i.e., where publishing is not the primary activity of the processing body" [40], [41]. Grey literature differs from the systematic literature review. The primary shortage of systematic literature review is that it includes only formally published sources, excluding the "grey" literature sources that the practitioners constantly produce. Grey literature review is preferred when the subject of the study is not solvable by considering only formal literature. A large volume of practitioner sources shows a high interest in the topic. To assess the suitability of the grey literature for this study, the Garousi checklist [16] was applied (table 2). Garousi suggests that if two or more questions are answered positively, a grey literature review has to be conducted [16].

Table 2. Garousi checklist to decide is grey literature review should be performed [16].

ID	Question	Answer
1	Is the subject "complex" and not solvable by considering only formal literature?	Yes
2	Is there a lack of volume or quality of evidence, or a lack of consensus of outcome measurement in the formal literature?	No
3	Is the contextual information relevant to the subject under study?	Yes
4	Is it the goal to validate or corroborate scientific outcomes with practical experiences?	No
5	Is it the goal to challenge assumptions or falsify results from practice using academic research or vice versa?	No
6	Would a synthesis of insights and evidence from the industrial and academic community be useful to one or even both communities?	Yes
7	Is there a large volume of practitioner sources indicating high practitioner interest in a topic?	Yes

As a result of the assessment, the grey literature review is suitable for the study. First of all, the subject of digital product metrics in the domain of digital product management is "complex"

enough since the industry of digital products is very dynamic and technological advances may lead to disruptive and ongoing changes. To succeed and survive, digital companies must adapt their business models and strategies and the opportunities made possible by technology [42]. As related work of the study showed, the topic is not solvable only using formal literature, and there is a shortage of academic research on the matter. Secondly, contextual information (digital product management) is relevant to the subject of the study (digital product metrics). Thirdly, the synthesis of insights about digital product management will be relevant to the practitioners who apply metrics to their day-to-day routine and use them for the success measurement of the products. In addition, for most Product Owners, their personal KPIs are defined as product KPIs and are measured employing metrics [42].

Moreover, Google gives 346,000,000 outputs when searching for the "Digital Product metrics". Thus, many practitioners' sources indicate high interest in a topic. Consequently, by positively answering the four questions from table 2, we are sure that the grey literature review is suitable for the current study.

According to [43], [44], grey literature can be categorised according to its credibility. Sources associated with low credibility such as blogs, emails and tweets are classified as "Grey 1st tier". While moderate credibility sources as reports, news articles, presentations, presentations Q/A articles from sources such as Product Talk, Stack Overflow form "Grey 2nd tier". High credibility sources as books, magazines, LinkedIn articles [45] ,[16] present "Grey 3d tier". In this review, sources from all three tiers will be included apart from the tweets and emails which can't be found in Google Search and accessed by the reviewer.

The next step of planning the review is to formulate research questions [39]. The research questions were formed based on the aim of the study, which is to extract data about digital product metrics usage in digital product management to accumulate the best practices and insights not readily available for the general public. The research questions and their motivation are as follows:

- *RQ1: What aspects of digital products are measured?*

Digital products have various aspects that product owners need to track. Therefore, RQ1 identifies aspects of digital products that different product metrics measure and define those metrics. For example, some metrics reflect on the user experience[12], some metrics concern profitability and growth [13], some refer to product marketing success [14].

- *RQ2: What information do metrics provide to digital product owners?*

Various metrics can bring additional information for product owners. For instance, conversion can point out low user engagement on the platform [15]; this information identifies the purpose of the metric and helps to take further actions to contribute to the product development. RQ2 reveals what information metrics provide to product owners.

- *RQ3: What are the factors that impact the performance of digital products?*

Different factors impact the performance of the digital product as measured by the metrics. If product owners know these factors, they know what to do to improve the metrics. Hence RQ3 shed light on the factors impacting the performance of digital products.

- *RQ4: What are the tools used to measure metrics for digital products?*

Different product owners work with large sets of data, and various tools aid them, but not all of them are helpful for the measurement of all the metrics. Therefore, RQ4 investigates measuring tools to simplify the product owner routine.

- *RQ5: How are metrics for digital products visualised?*

Product owners collect and track metrics in dashboards. To depict metrics in the dashboard, the product owner has to visualise them. Thus, RQ5 described visualisation practises of product metrics.

3.1. Search Strategy

Another step of the "planning the review" phase of the literature review is "Search strategy: Definition and refinement of the search string". It aims to define an unbiased approach for finding relevant grey literature sources on digital product metrics that will help answer the research questions [46].

I followed Kitchenham's guidelines to identify search strings for the study that will get the grey literature sources answering the research questions [39]. First of all, I developed a search string by deriving a critical term from the research questions and aim of the study, such as "digital product metrics", "product management". Then I tested different search strings with combinations of keywords in Google Advanced search and looked at the first outputs. As a result, it became clear that the term "development" should be excluded from the investigation because the work should not include studies about the development process. In addition, it was decided to eliminate "team", "process", and "quality" terms to avoid software development metrics. Thirdly, it was identified that the search on "digital product metrics" does not provide an overview of SaaS products; hence it was decided to include SaaS products in the investigation. As a result, such search strings were identified in the advanced google research:

- Search string 1: "digital product "metrics" -development"
- Search string 2: "product metric software, OR product, OR success -team, -process, -quality."
- Search string 3: "SaaS product "metric""

Google advanced search was chosen as a search source since after checking other search engines such as Bing, it was noticed that it gives the same output as Google Advanced Search, and there is no need to screen duplicate information.

3.2. Search Criteria

Applying the search that is described above will return 36,900 results which are not manageable. In the form of inclusion and exclusion criteria, search criteria were introduced to narrow the scope of found articles to relevant ones (table 3). Since the study area is digital product management, the articles regarding metrics should be in the domain of digital product management. Hence, IC1 validates that point by asking, "Is the study within the domain of digital product management?". Moreover, articles must contain enough information about the product metrics because only some valuable data can be extracted from the source. Thus, IC2 asks if the report contains sufficient information about measuring digital products, i.e., explain and discuss at least one metric. Exclusion criteria are dedicated to examining whether the text's information is understandable, accessible, complete, sophisticated, and sufficient. Thus, sources that are not in English are out of scope because they could not be understood, which leads to the EC1 that asks if the source is not in English.

Moreover, grey literature sources may not be complete, or to access them, the researcher should purchase the content. That's why EC2 asks, "Is the full version of the page accessible?". If the source contains duplicate content, it should not be included in the grey literature review. EC3 covers this criterion. Last but not least, articles should have a sufficient amount of information. Hence, the EC3 ("Is the page less than 500 words?") is applied. To check how many characters the page has, I will use the "Word Counter Plus" plugin.

Table 3. Inclusion and exclusion criteria of the study.

Criteria Identifier	Criteria	Criteria reasoning
IC 1	Is the article within the domain of digital product management?	The article must address the usage of metrics within the context of managing a digital product.
IC 2	Does the article contain sufficient information about measuring digital products, i.e., explain and discuss at least one metric?	The article must include enough content for answering the research questions.
EC 1	Is the article not English source?	The source should be understandable.
EC 2	Is the full version of the article not accessible?	Sometimes there are sources that can be accessed by paying, login, or any other condition. if this is the case then the page can't be fully understood.
EC 3	Is the article a duplicate?	There is no need to analyse the two same studies.
EC 4	Is the article a grey literature source?	If the article is created by official publishers, it is out of the scope of the current research.
EC 5	Is the article too short (less than 500 words)?	The usual single page contains 500 words. If the literature resource has fewer words, then it is not sophisticated enough for the analysis. Online Google Plugin "Word Counter Plus" will be used for measuring the number of words

The researcher uses the following approach to screen articles. First of all, the header (title) of the page is checked for the right domain for the study - digital product management (IC1). Suppose the header suits the inclusion criteria (IC1). In that case, exclusion criteria can be applied to the full text of the articles (EC1, EC2, EC3, EC4) that eliminate sources that are not in English (EC1), are not complete (EC2), duplicates (EC3), are not grey literature sources (EC4), are too short (EC5). After the exclusion criteria were applied, left articles were checked on having sufficient information about measuring digital products, i.e., explaining and discussing at least one metric (IC2). As a result of the screening, 302 articles were defined as ones to be analysed, PDF of the articles were saved for the next step of the research - data extraction.

3.3. Data Extraction

Relevant data were extracted from the final list of sources. Data extraction form was designed to ensure an unbiased and sophisticated extraction strategy [46], [47], [48]. The form includes two parts: data about the source (metadata) and data supporting the research questions. The first part provides information about the web-based source as the identifier, title of the article, authors, link when the page was accessed. The second part consists of the fields that will help to gather information for the research questions of the study (Table 4).

To answer RQ1, I will gather metric name and definition, data required, frequency of data, formula as well as I will get information on the aspect of digital metrics to measure. By getting the data about the metric's information, I will approach answering RQ2. Data about factors that influence the performance of the subject measured by the metric will help me to answer RQ3. "Tools for the measurement" field will gather input for RQ4, while "How to visualise" will gather input for RQ5.

Table 4. Data Extraction form.

Data about the source (metadata)	
Data about the page	**Description**
Identifier	Unique id from the table (should be the same as during the process of criteria validation)
Title	Title of the page (header)
Authors	Who wrote an article
Link	Link to the page so that it is possible to find it later
Date accessed	When the researcher accessed an article
Data supporting research questions	
Metric name and definition	Definition of the metric to support the answer to the RQ1 and provide more context and knowledge about the metric
Data required	Data required for the metric calculation. Information is needed to support RQ1 and provide more knowledge about the metric data measurement.
Frequency of data	How often the metric should be applied. Information is required to provide more knowledge of RQ1 and how to use the metric and measure needed data.

Formula	Formula of metric calculation. Information is required to provide more knowledge on the RQ1.
Aspect of digital project to measure	Aspects of the digital product that the metric measures. Information Is required to provide answers on RQ1 and help to group metrics by the aspects they measure.
Information that the metric provides	What information metric can provide to the product owner. Data provides knowledge on the RQ2.
Factors that influence the performance of the subject measured by the metric	Describe factors that influence the performance of digital products measured by metrics and reflect on RQ3.
Tools for measurement	Tools that are used for the metrics measurement. Information to support RQ4.
How to visualize	Techniques of metrics visualisations. Information to support RQ5.

Attached to this thesis file "Data extraction form" presents the list of papers and data extracted from each of them. During the literature review phase, a search strategy was applied to identify relevant grey literature sources. The total number of screened articles is 787. The article screening process resulted in 302 articles picked up for the study after applying all the inclusion and exclusion criteria to every study. Then data was extracted into the data extraction form. 28 articles were eliminated during the data extraction because they did not pass through the selection criteria after a more detailed look during the data extraction, and 10 articles were added as backward links that gave the selection criteria of the paper listed in 3.2. As a result, data from 281 articles were extracted and analysed during the studies. Figure 3 shows all the steps taken to receive the final number of pieces.

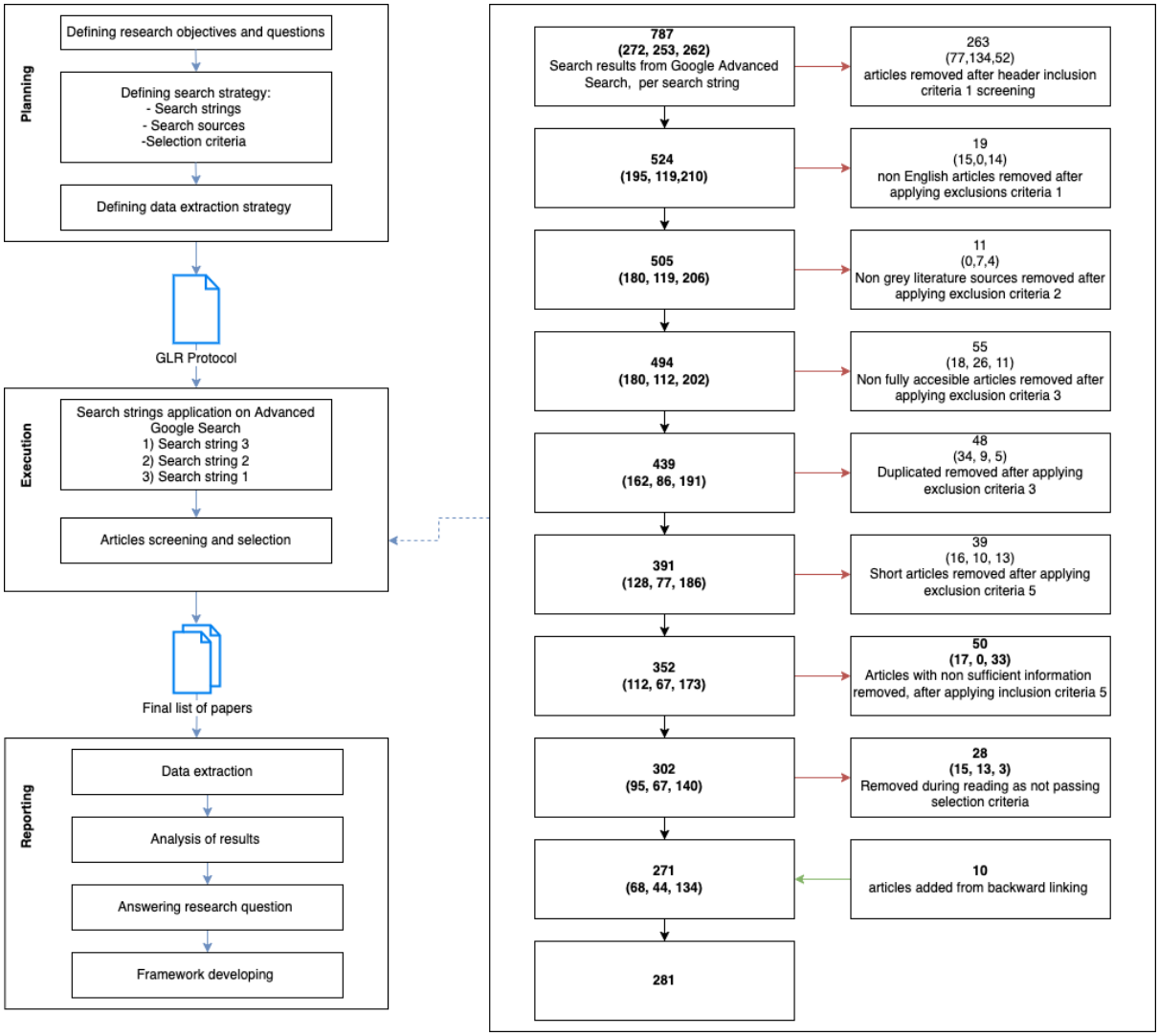

Figure 3. Study selection process visualisation.

Data about 688 metrics were extracted into the data extraction form during the data extraction. Some metrics were mentioned in different articles more often than others (see Figure 4). After the data about all 281 articles were input into the form, it was thoroughly analysed and cleaned, and typos were deleted, fields with metrics that mean the same but were named differently in the original sources were fixed to be consistent. Then the data on metrics were analysed, and as a result, the core set of the most popular metrics was formed, and these findings and analysis will be presented in the next chapter of the thesis.

4. Results - Digital Product Metrics

This chapter answers in details research questions, namely what aspects of digital product different product metrics measure (RQ1), present information that metrics can provide about digital products (RQ2). Then it points out factors that influence product aspects that metrics measure (RQ3) and defines tools that professionals use to measure metrics (RQ4). In the end, it describes how to visualize metrics findings (RQ5).

4.1. Aspects of Digital Products that Different Metrics Measure

The first research question presents the digital product aspects measured by different product metrics. It aims to identify the product aspects and the metrics that measure those dimensions. The research question is defined as follows: *RQ1*: *What aspects of digital products are measured?* The review showed that specific metrics were frequently discussed as compared to others. The most frequent metrics were:

- Recurring revenue (112 articles)
- Customer lifetime value (103 articles)
- Customer acquisition cost (98 articles)
- Churn rate (91 articles)
- Net promoter score (68 articles)

The answers to the research questions will focus on the most popular metrics presented in Figure 4. Figure 4 shows the frequency of metrics discussed. This figure includes only metrics mentioned seven times in all articles list. The more times metric is mentioned in the grey literature articles, the more popular it is in the field; hence it is proven to be used by other companies and is relevant to other professionals. However, some metrics are not mentioned seven times but are still relevant to the study. For example, site speed, load time, customer maintenance cost, product downtime, and server health are mentioned in the articles 1-2 times. Still, they are relevant to the product stability aspect and need to be covered as a part of the answer to RQ1. More details of this aspect and why it is not mentioned often in the study will be described in section 4.1.4.

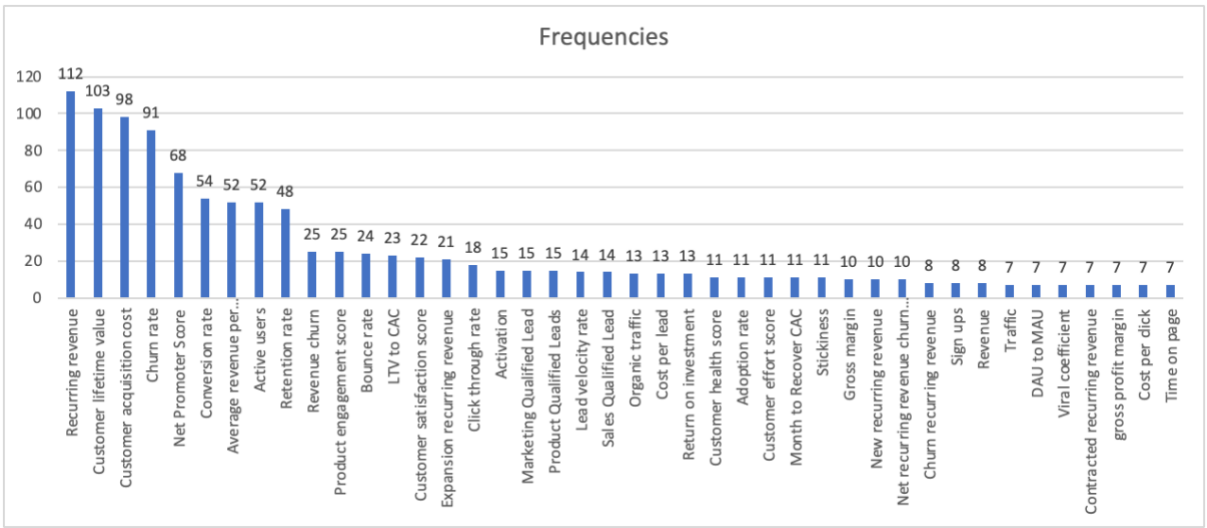

Figure 4. The number of metrics across the articles.

The metrics identified measure different product aspects and can be classified based on their focus on output. I mean the product aspect that the product owner wants to analyse by output.

Thus, the metrics can be classified by growth, marketing, customer success, and product stability. Each aspect has categories that will be described and presented further (Table 5).

Therefore, growth metrics refer to the customer growth and revenue growth metrics and represent metrics dedicated to tracking customer growth of the product and revenue growth, respectively. Product marketing metrics include acquisition metrics and traffic metrics. Acquisition metrics refer to the metrics that provide an overview of the customer acquisition strategy success. In contrast, traffic metrics reflect on the product traffic and give knowledge on the customer segment. Customer success metrics consist of engagement metrics and satisfaction metrics. Engagement metrics refer to customer engagement success, whereas satisfaction metrics tell how customers are satisfied with the product. The product stability aspect means product reliability for customers usage, how a product performs and is available for its users.

Table 5. Aspects of digital products metrics.

Metric category	Subcategory	Description
Product growth	Customer growth	Present metrics that track user growth of the product
	Revenue growth	Present metrics that rack monetary growth of the product
Product marketing	Acquisition	Present metrics that give overview of the customer acquisition strategy success
	Traffic	Present metrics that reflect on the product traffic and provide knowledge about the customer segment
Customer success	Engagement	Present metrics that show user engagement and interaction with the product and reflects on its success
	Satisfaction	Reflect on how users are satisfied with the product
Product stability	Stability	Describe how the product is reliable to be used by customers.

Each of the described products' aspects is measured by different metrics that are going to be described below by aspect and its category.

4.1.1. Product growth metrics

Some metrics identify product growth from the revenue perspective and the customer perspective. *Revenue growth metrics* present metrics that indicate the monetary growth of the product and how the product is profitable. *Customer growth metrics* refer to the metrics that elaborate on the product's customer base and evolution. They include customer churn rate, customer retention rate, viral coefficient. The following sections shed light on these two categories in more detail.

Revenue Growth Metrics

Revenue growth metrics are customer lifetime value [49], recurring revenue [49], revenue churn [50], average revenue per account/user [51], return on investment [52], gross margin [53], revenue [54], churn, expansion and contracted recurring revenue as well as net recurring revenue churn rate [55].

Since this product category talks about revenue, the revenue metric is one from the metrics. It refers to the total income generated on the product over a defined period. Product professionals can measure it per month and year [54]. As an opposite of revenue, the churn revenue metric shows the revenue lost during the period revenue by the product. Churn refers to the loss in revenue and customers. Revenue loss happens due to customer churn. Revenue churn is calculated as a division of revenue loss in a certain period and the total revenue at the start of the period [56], [49] (1).

$$Revenue\ churn = \frac{total\ revenue\ lost\ during\ the\ period}{revenue\ at\ the\ start\ of\ period} * 100 \quad (1)$$

Recurring revenue refers to the amount of generated revenue used in subscription-based products such as SaaS. It can be annual or monthly, referring to annually and monthly generated revenue [57]. Another name of the annual recurring revenue is annualised run [58]. In the case of SaaS products for those with yearly billing, the annual recurring revenue will be more suitable, while for the products with monthly billing, the monthly recurring revenue is the choice [49]. Recurring revenue is calculated as the number of customers multiplied by the average billed amount, excluding the one-time fees [59] or as a multiplication of average revenue per account on the total amount of accounts [49] (2).

$$Recurring\ revenue = Average\ revenue\ per\ account * total\ amount\ of\ accounts \quad (2)$$

Some companies in the industry measure lost recurring revenue, and recurring expansion revenue contracted recurring revenue, new recurring revenue, contracted recurring revenue and net recurring revenue churn. Lost or churn recurring revenue [58] refers to the revenue lost because of cancellations, stopping using the product and downgrades [60]. Expansion recurring revenue is the revenue that is made through upgrades and upsells from existing customers [60]. The other name of the metric is added recurring revenue [61] (3).

$$Expansion\ recuring\ revenue = \frac{Total\ expansion\ revenue\ at\ end\ of\ period - Total\ expansion\ revenue\ at\ start\ of\ period}{Total\ expansion\ recurring\ revenue\ at\ start\ of\ period} * 100 \quad (3)$$

Contracted (committed) recurring revenue shows the predictable recurring revenue of SaaS products. The main difference between contracted recurring revenue and recurring revenue is that it shows the contracted revenue indefinitely [62]. New recurring revenue refers to the revenue brought by acquiring new customers [63]. Some companies track reactivated recurring revenue since there are also customers who churned but reactivated their accounts [58]. The revenue churn rate measures the revenue lost because of cancellations, stopping using the

product, and downgrades [60]. Net recurring revenue churn rate estimates the revenue loss based on the product downgrades, subscription cancellation, a user leaving that includes the revenue generated from the expansion and upgrades [64]. To calculate this metric, the product owner needs to know the churn recurring revenue at the end of the period and subtract it from recurring revenue added in the period, dividing it by the total recurring revenue at the beginning of the period [65] (4).

$$Net\ monthly\ recurring\ revenue\ churn = \frac{Churn\ recurring\ revenue - added\ recurring\ revenue}{Total\ recurring\ revenue\ at\ the\ beginning\ of\ the\ period} \quad (4)$$

Customer lifetime value (LTV) is the "amount of money customers pay during their engagement with the product" [66]. The more extended customers use the product, the higher life is [67]. In SaaS products, LTV customers' engagement with the product is defined by the customers' subscription to the outcome [66]. The LTV calculation formula is divided to churn rate [68] (5).

$$LTV = \frac{1}{Churn\ rate} \quad (5)$$

The average revenue per account/user (ARPA) is another revenue growth metric that refers to the average revenue that [64] every user brings per period. Accounts refer to the customers that pay for the product or subscribe to it [50]. To calculate it, recurring revenue should be known and the total number of accounts/users [68] (6).

$$ARPA = \frac{Recurring\ revenue}{Total\ number\ of\ customers} \quad (6)$$

Gross profit margin also indicates the growth of the product and is a measurement of money left after-sales activities deducting the cost of goods sold (COGS) [69]. It is calculated as the difference between recurring revenue and COGS of the measured period [70]. The cost of goods sold is defined as "all of the expenditure associated with serving customers and delivering your solution" [58]. Another key revenue growth indicator is the return on investment (ROI), which measures how well the product's assets are performed and whether the product is profitable. Marketing efforts and other costs associated with keeping a product operational are typically included in investments [71]. The lifetime value divided by the client acquisition cost is one of the ROI formulas [55] (7).

$$ROI = \frac{LTV}{CAC} \quad (7)$$

However, usually, it is calculated as a difference of the total revenue and total cost (investment) involved in the product divided by the total investment [52] (8).

$$ROI = \frac{Total\ revenue - Total\ investments}{Total\ investments} \quad (8)$$

Companies that exclusively make marketing investments analyse ROI by dividing the difference between total revenue attributed to the digital product and the total cost of digital marketing by digital marketing [52].

Customer Growth Metrics

Customer growth metrics include customer churn rate [72], customer retention rate[59] and viral coefficient [73]. Customer churn rate measures the number of customers or accounts leaving the product over a defined period, defined as the percentage of the overall customer count [67]. To calculate the metric, one must know the number of customers who stopped using the product during the period (churned customers), the count of the overall customer base, and define the period during which the churn rate needs to be counted. Customer churn rate is

calculated as the number of churned customers divided by the total number of customers [74] (9).

$$Customer\ churn = \frac{Number\ of\ churned\ customers}{Total\ number\ of\ customers} \quad (9)$$

Churned customers might refer to various factors of stopping using the product. For example, in the article about SaaS metrics [75], churned customers are defined as customers that are not only unsubscribed from the subscription or cancelled but did not renew the subscription. SaaS names the churn rate as a "subscriber churn rate"[76]. In [77], churned customers refer to lost customers. At the same time, it is essential to specify what is meant by the number of customers. Some articles determine that the active base of the users is those that pay for the product. The author of [72] empathises that subscribers are customers in the case of subscription products.

The opposite term of churn rate is retention rate which specifies the percentage of customers that retained over the defined period and continued to use the service. Customer retention rate is calculated as the number of customers at the end of the period minus the new customers acquired during the period, divided by the number of customers at the start of the period and multiplied by 100 [59] (10).

$$Customer\ retention = \frac{Customers\ at\ the\ begining\ of\ period - Customer\ acquired\ during\ the\ period}{Customers\ at\ the\ start\ of\ the\ period} * 100 \quad (10)$$

The other way to calculate retention rate is to subtract the total number of customers during the period from the number of customers churned [51], [78]. Since the retention rate is the opposite metric from the churn rate, the other way to calculate is to subtract from 100% the churn [59] (11).

$$Customer\ retention = 100\% - churn\ rate \quad (11)$$

Viral coefficient measures how existing customers of the product acquired new customers, in simple words, the percentage of the customers who joined the product through referral [73] and became active users. This metric highlights the customer growth throughout the referral.

This section of Chapter 4 presented the detailed overview of the digital product growth metrics with the definition and guidelines of metrics calculation. Table 6 summarises the past information and presents the data that product owners must know about product growth metrics as definition and how to measure metrics.

Table 6. Definition of product growth metrics

Category	Metric name	Definition	How to measure the metric
Revenue	Recurring revenue	Amount of generated revenue and is used in subscription-based products such as SaaS [57].	$Recurring\ revenue = Average\ revenue\ per\ account * total\ amount\ of\ accounts$ [49] [49]
	Net recurring revenue churn	Estimation of the revenue loss based on the product downgrades, subscription cancellation, a user leaving that includes the revenue generated from the expansion and upgrades [64].	$\frac{Churn\ recurring\ revenue - added\ recurring\ revenue}{Total\ recurring\ revenue\ at\ the\ beginning\ of\ the\ period}$ [65]

	Expansion recurring revenue	Revenue that is made through upgrades and upsells from existing customers [60].	$\frac{Total\ expansion\ revenue\ at\ end\ of\ period - Total\ expansion\ revenue\ at\ start\ of\ period}{Total\ expansion\ recurring\ revenue\ at\ start\ of\ period} * 100$ [61]
	Contracted recurring revenue	Committed recurring revenue of SaaS products [62].	*Amount of revenue that is planned each period from the signed contracted or requested product service* [62]
	New recurring revenue	The revenue which is brought by acquiring new customers [63].	*Sum the amount of the revenue that came from the new users during the period* [63]
	Churn recurring revenue	The revenue lost because of cancellations, stopping using the product and downgrades [60].	*Sum of the revenue that is lost during periods because of cancellations, stopping using the product and downgrades* [60]
	Customer lifetime value	"Amount of money customers pay during their engagement with the product" [66].	$\frac{1}{Churn\ rate}$ [68]
	Revenue churn	The revenue that was lost because of cancellations, stopping using the product and downgrades [60].	$\frac{total\ revenue\ lost\ during\ the\ period}{revenue\ at\ the\ start\ of\ period} * 100$ [49]
	Average revenue per account	The average revenue that every user brings per period [64].	$\frac{Recurring\ revenue}{Total\ number\ of\ customers}$ [51]
	Revenue	Total income generated on the product over a defined period [54].	*Sum of the revenue generated during the period* [54]
	Gross margin	Measurement of money that is left after sales activities deducting the cost of goods sold [69].	$\frac{Total\ revenue - development\ cost}{Total\ revenue} * 100$ [79]
	Return on investment	Measuring of how long it takes to return back investments that was spent for the product [71].	$\frac{Total\ revenue - Total\ investments}{Total\ investments}$ $\frac{LTV}{CAC}$ [55]
Customer	Churn rate	The number of customers or accounts leaving the product over a defined period and is defined as from the percentage of the overall customer count [67].	$\frac{Number\ of\ churned\ customers}{Total\ number\ of\ customers}$ [74]
	Retention rate	The percentage of customers that retained over the defined period and continued to use the service [67].	$100\% - churn\ rate$ [59]
	Viral coefficient	The percentage of the customers who joined the product through referral and became active users [73].	*Investigate the percentage of customers who joined through referral* [73]

4.1.2. Marketing Metrics

From the name stands that marketing metrics are metrics that reflect on the product marketing activities. Hence, they are dedicated to helping practitioners make better decisions regarding

the marketing strategy. The marketing aspect of the product consists of such categories as acquisition, traffic and adoption. Acquisition metrics describe how the customer acquisition strategy performs. Traffic metrics give an overview of the product traffic, source, origin, device. These categories will be described more in-depth and then summarized in the section below.

Acquisition Metrics

Acquisition metrics are essential to track to reflect on the success of the customer acquisition process. This section is dedicated to describing acquisition metrics as customer acquisition cost [59], month to recover CAC [80], LTV to CAC [81], marketing, product, sales qualified lead [75], lead velocity rate [51], cost per lead, click-through rate [82].

Ninety-eight articles mentioned customer acquisition cost (CAC), an acquisition metric that calculates how much money the company is spending on acquiring new customers. In [58], CAC is defined as "the total cost of sales and marketing efforts that are needed to acquire a customer." It can be measured annually or monthly [67]. CAC is calculated as sales and marketing costs divided by the new customers [83].

$$CAC = \frac{Sales\ and\ marketing\ costs}{Amount\ of\ new\ customers} \tag{12}$$

Professionals track months to recover CAC - a metric that refers to how long it takes to recover the costs spent to acquire the customer [80]. To calculate the month to recover CAC, one needs to divide CAC on recurring revenue and gross margin over the required period [84]. Another metric that refers to how efficient the customer acquisition strategy is LTV to CAC. LTV to CAC is a measurement of the ratio of LTV and CAC that also refer to how the recovering of CAC is performing [81].

$$Month\ to\ recover\ CAC = \frac{CAC}{Recurring\ revenue * Gross\ margin} \tag{13}$$

Acquisition of customers aims to get more users into your product. During this phase, professionals are also tracking other metrics that help to optimise acquisition strategy. Thus, companies follow lead generation. All the potential customers are product leads. Three marketing metrics analyse leads of the product:

- *Marketing qualified leads (MQL)* refer to the users that visit a product and, through their behaviour, show interest in using it or purchasing it. The signal may vary depending on your service. For example, those that start to fill in the registration form or read through everything about the product [75]
- *Sales qualified leads (SQL)* - users who already use the product but have not purchased it yet or have a free version of it are potential customers to whom the product can be upscaled. [75]
- *Product qualified leads* (PQL) refer to users whose behaviour shows that they are ready to purchase the product [75]

If SQL is transformed to sales, the marketing campaign and followed up sales activity is considered successful. Conversion rate is the number of leads who became customers. Conversion rate is calculated as the number of product qualified leads divided by the total number of customers in the period [68]. While adoption rate refers to the percentage of product key features a user has used in a given timeframe [85]. It is usually calculated per month as the division of feature monthly active users to monthly logins multiplied by 100 [68]. While computing the feature adoption, it is crucial to consider adoption depth, adoption time, and

duration [73]. Moreover, it is essential to specify those key features that need to be measured by adoption.

Another metric that reflects on product leads is lead velocity rate - leads growth per period. It is calculated as the difference between the qualified leads amount current period and the qualified lead amount this period divided by the qualified leads last period multiplied by 100 [51] (14). Therefore, to calculate this metric, one needs to have a number of leads at the beginning of the period and the end of the period [63].

$$Lead\ velocity\ rate = \frac{Qualified\ leads\ this\ period - Qualified\ leads\ last\ period}{Qualified\ leads\ last\ period * 100} \quad (14)$$

Such metrics as click-through rate cost per lead help to understand the effectiveness of the acquisition strategy. Click-through rate is a ratio of the users who view the acquisition campaigns such as email links, social media posts, call-to-action statements. Cost per lead is the metric that measures how cost-effective marketing acquisition campaigns are [82].

Traffic Metrics

Traffic metrics are metrics that signal the various factors of the product traffic. It helps to specify market segments that the product should target. Among traffic metrics are social traffic [86], mobile/desktop traffic [86], unique vs repeat traffic[86].

Different metrics measure traffic types. The traffic metric itself refers to the volume or type of traffic changes to the product [87]. Social traffic refers to the total amount of web traffic (amount of users) found about the product through social media channels [86]. Organic traffic refers to the number of customers that reached the product, not from the different campaigns. It is usually compared with the paid traffic when the users are coming from the paid campaigns [88]. Unique traffic vs returning traffic counts the ratio between new users of the product and repeating users of the product [86].

Mobile traffic refers to the percentage of traffic that is on mobile devices. Desktop traffic relates to the users of the product on the desktop. Moreover, it is possible to analyse the web traffic by location, which refers to the country's web traffic. Some online tools such as Google Analytics provide an opportunity to do that in one click [86]. RQ4 will explain more on the topic.

This section of Chapter 4 presented marketing metrics that measure the acquisition and traffic aspects of the product. Table 7 shows the summary of the section by defining metrics and describing how to calculate the measured value.

Table 7. Metrics that measure marketing aspect of digital product

Category	Metric name	Definition	How to measure the metric
Acquisition	Customer acquisition cost	"The total cost of sales and marketing efforts that are needed to acquire a customer" [59].	$\frac{Sales\ and\ marketing\ costs}{Amount\ of\ new\ customers}$
	Month to recover CAC	How long it takes to recover the costs spent to acquire the customer [80].	$\frac{CAC}{Recurring\ revenue * Gross\ margin}$

	LTV to CAC	Ratio of the customer lifetime value and customer acquisition cost [81].	$\frac{LTV}{CAC}$
	Marketing qualified lead	The number of the users that visit a product and, through their behaviour, show interest in using it or purchasing it [75].	*Amount of leads that are qualified for marketing activities* [75]
	Product qualified lead	The number of users whose behaviour shows that they are ready to purchase the product [75].	*Amount of leads that passed sales activities and are prospective product users* [75]
	Sales qualified lead	The number of users who are already using the product but have not purchased it yet or have a free version of it and are potential customers to whom the product can be upscaled [75].	*Amount of leads that passed marketing campaign and are prospective sale leads* [75]
	Lead velocity rate	Growth of leads per period [51].	$\frac{Qualified\ leads\ this\ period\ -\ Qualified\ leads\ last\ period}{Qualified\ leads\ last\ period\ *100}$ [63]
	Cost per lead	Measurement of how cost effective marketing acquisition campaigns [82].	$\frac{Cost\ needed\ for\ lead\ generation}{Amount\ of\ leads}$ [82]
	Click through rate	The ratio of the users who view the acquisition campaigns such as email links, social media posts, call-to-action statements [82].	*Percentage of users who viewed acquisition campaign and landed on the product* [82]
	Adoption rate	The percentage of product key features a user has used in a given timeframe [85].	*The percentage of product key features a user has used in a given timeframe* [85]
	Conversion rate	The number of leads who became customers [68].	*Ratio of amount of customer that were leads* [68]

Traffic	Social traffic	The total amount of web traffic (amount of users) that is found about the product through social media channels [86].	*The percentage of users that came to the product through social media campaign*
	Mobile/desktop traffic	The amount of traffic from on the mobile/desktop devices [88].	*Percentage of users that are using product on mobile/desktop device*
	Organic traffic	The amount of customers that reached the product not from the different campaigns but organically [88].	*Number of users that came to the product without any campaign*
	Unique/returning traffic	The ratio between new users of the product and repeating users of the product [86].	$\frac{Amount\ of\ unique\ users}{amount\ of\ returning\ users}$

4.1.3. Customer Success Metrics

Many articles mentioned satisfaction, engagement, usage as a product aspect measured by metrics. These categories refer to the customer experience of the product usage and its success. Customer success metrics refer to the product's user experience and its success and satisfaction. Below, there will be described metrics that belong to engagement and satisfaction.

Engagement Metrics

Engagement metrics tend to describe how users are engaging with the product, so they are taking some actions and using functionalities of the product. Among the engagement metrics are product usage [49], time on page [86], sign-ups [89], active users [85], stickiness [90], product engagement score [85], conversion [91] and bounce rates [92].

Firstly, consider metrics that refer to the engagement from the user perspective. Product usage is a metric representing the number of engagement customers use the product. These engagements include the number of logins, sign-ups, amount of time spent using the app, amount of features or add-ons they use, amount of active users [49]. Product usage is segmented by components, users, accounts, time, and product latency. Product usage by features refers to the users' favourite and most minor favourite features. Product usage by users guides the usage patterns by user roles. Product usage by accounts provides an insight on the demographic of product accounts while by time referred to the favourite time of product usage. Product usage by latency is the loading time of the product [93]. Time on page is another engagement metric that measures how much time the user spent on the particular page of the product before navigating away [86]. Some professionals specify that it is essential to measure the user sign-ups and compare them with the number of unique visitors. Sign-ups refer to the

number of people signing up for a service compared to a prior period, while sign-ins are the number of people signing-in to the product or service compared to a previous period [89].

Active users refer to the count of users who used a product within a given timeframe [85]. In the products that have an account, it is essential to measure the account penetration metric, which refers to the number of active users at a single charge or the percentage of active users [94]. It is a signal of how effectively the product keeps customers coming back. Measurement of the active users can be daily and refer to the daily active users count or monthly and refer to the monthly active users rely on. In [84], the authors suggest measuring the metric weekly when the product is a SAAS business app with weekly patterns to watch. However, active users are not the same as an activation rate. Activation rate is the number of users taking specific action to derive value from the product. Users face the moment of activation when they first realize the product value themselves. Before identifying this metric, it is essential to locate one active action that refers to the product's key value [95]. The ratio of daily active users and monthly active users form the product stickiness ratio [90]. Stickiness indicates the level of engagement with the product and is calculated as a division of DAU to MAU.

The metric that combines adoption rate (defined in the section about marketing acquisition metrics), stickiness and growth is product engagement. Product engagement score refers to a measure of how engaged your users or accounts are in a given time frame. It's a model that scores each of your users based on (a) the number of times they do certain things in your product; and (b) the importance of those activities [85]. Product engagement score can be measured as an average between adoption, stickiness and growth [96].

To measure engagement, some companies measure the product breadth that refers to how many users the product has, and more importantly, how many users the product has per account [97]. Product depth measures how much of the product users use [97]. This metric is usually calculated daily. In the context of engagement, the conversion rate can measure the percentage of visitors who are "converted" and make an engagement [91], however, this metric is used in the marketing aspect of the product as well. Conversion in case of engagement can signal engagement with a particular feature or product functionality. The opposite of conversion is a bounce rate indicating the rate of users who visited the product and left immediately; in other words, they are users who saw only one section of the product [92].

Satisfaction Metrics

The satisfaction aspect of the product is a subcategory of the user experience aspect of the product, and it refers to the extension of how users are happy with using a product. This subcategory consists of such metrics as net promoter score (NPS) [98], customer satisfaction score [58], customer effort score [99], customer health score [73].

Net promoter score is one of the most commonly used satisfaction metrics used in the industry (mentioned 68 times). NPS provides a measurement of customer satisfaction and loyalty by asking the users, "How likely are you to recommend [product] to a friend or colleague?". Users are requested to provide ratings from 0 to 10, where ten means that they are likely to recommend the product and 0 means that they are least likely to recommend it [99]. Those customers that tend to recommend the product are called promoters, and those that don't are detractors. NPS is calculated as subtracting promoters percentage from detractors percentage [100].

Another satisfaction metric where the customer is asked to rate something is the customer satisfaction score (CSAT). CSAT is an individual satisfaction measure of the user interaction with a product. The customer is asked the question: "How would you rate your overall satisfaction with the service you received" [58]. Measurement of CSAT is based on a 5-point

scale from 1 equal to very unsatisfied to 5 referring to very satisfied. To calculate, a CSAT professional needs to divide the total number of customers who selected 5(are very satisfied) or 4 (are satisfied (4) by the total number of responses and then multiply that by 100 [101].

Customer effort score (CES) is a touchpoint metric that measures usability by checking how easy it was for the user to accomplish their goal [101], for example, a request fulfilled, a product purchased/returned, or a question answered [102]. The author of [103] provides such an example of metric measurement "To determine CES, you'll ask your customers, "On a scale from "Very Easy" to "Very Difficult", how was your experience? If you find that you have a low CES score, identify how to remove obstacles and friction".

The customer health score is a score value to how often a customer uses a software product and how much they rely upon it. It is one of the customer feedback tools [94]. Another definition of the customer health score is a value that signals the long-term chances to stop their subscription with a product or become a high-value customer [49]. The customer health score is another engagement metric that monitors how the customer engages with the product, the average login time, and other usage statistics such as too many or no support conversations, survey scores, and critical features [48]. During this metric calculation, it is essential to consider the background of the company and market specifics and calculate it per month.

This section presented customer success metrics that measure user engagement and satisfaction with the product. Table 8 summarises the provided information by definition of metric and describes how to calculate the metric value.

Table 8. Customer success metrics.

Category	Metric name	Definition	How to measure the metric
Engagement	Time on page	How much time the user spent on the particular page of the product before navigating away [86]	*Amount of the time in minutes/seconds user spend on different pages of the product*
	Sign ups, sign ins	The number of people signing-up for a service compared to a prior time period while sign -ins is the number of people signing-in to the product or service compared to a prior time period [89]	*The number of users sign ups, sign ins per defined period.*
	Product usage	Amount of engagement customers are using the product. These engagements include number of logins, sign ups, amount of time spent using the app, amount of features or add-ons they use, amount of active users [49].	*Number of engagement customers are using the product. Engagement activities should be defined.*

	Active users	The count of users who used a product within a given timeframe [85]	*Sum of users who used a product within a given timeframe*
	Activation	A number of users taking a specific action to derive value from the product. Users face the moment of activation when they first realize the product value of themselves [95]	*Number of steps user takes to perform value action. Value action should be defined.*
	Stickiness	The ratio of daily active users and monthly active users forms product stickiness ratio [90].	$\frac{Daily\ active\ users}{Monthly\ active\ users}$
	Product engagement score	Combines adoption rate, stickiness and growth is product engagement and refers to a measure of how engaged your users or accounts are in a given time frame. It's a model that scores each of your users based on (a) the number of times they do certain things in your product; and (b) the importance of those activities [85].	*Average between adoption, stickiness and growth* [96]
	Conversion rate	Measurement of user engagement with a particular feature or functionality [92].	*Ration of users who completed to use the feature to those who started to use it.*
	Bounce rate	The percentage of users who visited only one page of the product and left it [92].	*Ration of users that opened only one page of the product and dropped.*
Satisfaction	Net Promoter score	Measurement on customer satisfaction loyalty [58].	*Users need to provide a rating from 0 till 10 while answering the question "How likely are you to recommend [product] to a friend or colleague?"*
	Customer satisfaction score	An individual satisfaction measure of the user interaction with a product. The customer is asked the question: "How would you rate your overall satisfaction with the service you received" [58].	*Ask user to rate your product on 5-point scale by answering "How would you rate your overall satisfaction with the service you received"*

	Customer health score	Score value to how often a customer uses a software product and how much they rely upon it [94]	*Define the scores for each of the user actions and sum them per user.*
	Customer effort score	Touchpoint metric that measures usability by checking how easy it was for the user to accomplish their goal [101], for example, a request fulfilled, a product purchased/returned, or a question answered [102]	*Ask users "On a scale from "Very Easy" to "Very Difficult", how was your experience?*

4.1.4. Product Stability Metrics

Stability metrics indicate the stability of the product in the sense of how it is stable for customer usage. This aspect is essential for the product owners because it influences its success and monitors relevant elements that may affect it. This aspect of the product was not mentioned often (only five times) in the articles included in this study because it relates to the software. This grey literature review minimises the outcome of the software product by search criteria specification. However, this is a critical product aspect for product owners since it helps understand and determine the problems that affect product usage from the software perspective. Such metrics belong to the stability metrics like site speed, load time, customer maintenance cost, product downtime, server health.

First of all, stability metrics signal the product functionality and performance. Site speed that tracks how fast the product downloads [104]. While load time refers to how quickly the site is loading when visitors request to see it [105]. Digital products consist of many microservices, databases and have a complicated architecture design. There is a cost of maintaining this complex for every customer. The metric that reflects on the cost of customer maintenance includes the cost of all the engineering, support, account management and customer service, and billing activities and physical infrastructure [62].

Secondly, the metrics show the product's availability - how often users can use it. Hence, downtime measures how often a product has an outage and is not reachable [105]. Another critical measure is server health which refers to how many requests the product can handle, how quickly it responds and if it returns any service errors [105].

This section presented product stability metrics such as site speed, lead time, customer maintenance cost, and downtime. Table 9 shows each metric definition and instructions on measuring the metric.

Table 9. Product stability metrics

Category	Metric name	Definition	How to measure the metric
Product stability	Site speed	How fast the product downloads [104]	*The velocity of the product loading*
	Load time	Measure of how quickly the site is loading when a visitor requests to see it [105]	*The time it takes to load particular parts of the product*
	Cost of customer maintenance	The cost of all the engineering, support, account management and customer service as well as billing activities and physical infrastructure [62].	*Sum of the all the costs involved into the maintenance of the product*
	Product downtime	How often the product face outages [105].	*Percentage of time when the product was down*

4.2. Information that Metrics Provide for Digital Product Owners

The second research question is *"What information do metrics provide to digital product owners?"*. RQ2 provides the information that professionals can gather when tracking the metric. Product owners can then take this information, make product decisions, and pick insight. In this section, I will follow the four aspects of digital products and describe the information that metrics provide in each element: growth, marketing, user experience, performance.

4.2.1. Information That Metrics Provide About Growth

Digital product metrics provide information about customer and revenue growth. This section will focus on the retention and churn metrics in common for the two categories and then follow up on customer and revenue growth metrics, respectively.

The retention rate measured in money represents the revenue growth and, if measured in customers, represents customer growth. It provides information about how the product is attractive for the customers and keeping customers using it. A high retention rate means that the professionals do not have to spend a lot to attract customers. Hence, professionals can focus on the existing customer base [68]. Users who are not returning to the product can be targeted with additional messaging or education materials to make them recurring and grow customer retention [106]. In [106], it is pointed out that a strong retention rate may make it easier to get new customers. For example, if customers like your product that will likely upgrade their accounts to more expensive ones and then the product will grow monetary wise.

Moreover, users whose high retention will recommend the product to others and attract more referral customers [108], impacting the viral coefficient. All in all, this metric indicates how the customer base is loyal towards the digital product, and the result of this metric is impactful from the revenue and customer growth perspectives. If the retention rate is high, then the company's revenue is growing. At the same time, when the retention is low, then it means that the company needs to think of new sources of income and improvement of customer acquisition

strategy. However, retention can reflect the wrong side of product growth. If the company stops acquiring new users, retention can be high; however, user growth declines. Thus, retention should be considered together with the customer growth metric [109].

Meanwhile, churn refers to the lost customers and no longer using the product, which means that the company is losing revenue. Hence, if the churn rate is high, that will signal that the product is in trouble and will motivate product owners to dig deeper and investigate the root cause [49]. Increased customer churn rate means that the production company will need to invest more into customer acquisition and maintain monthly and yearly recurring revenue [68]. Besides that, churn rate proof is there is a product-market fit of your product, and low churn reflects the successful customer onboarding and support performance [110].

Virial coefficients provide information on how your user base grows using the referral. If the metric equals zero, none of the product customers brought a new customer to the product. Hence, the product's referral system can be considered an opportunity for the product owners to improve customer growth in general. If the viral coefficient is more than one, each existing customer brings at least one new customer to use the product [73].

From the name of the category "revenue growth", metrics that belong to this category should provide information about the product's profit. Thus, revenue is the metric that provides clear information on how the product is profitable and how much money the company generates from it [54]. Analysing this metric can help to foster and adapt sales strategies [111]. In comparison to the revenue growth metrics, gross profit margin metrics helps to quantify how much money the company keeps versus how much money is spent on the operational activities of the product [112].

Customer lifetime value helps to assess the financial value of the customers and predict how the company will be profitable over time [53]. In [82], the author empathises that the CLV can tell professionals which segment of customer they should focus on based on the analysis of which customer segment has the highest lifetime value of the product. Moreover, CLV indicates how much each customer contributes to the product’s revenue. Each product company should strive to increase the customer lifetime value and decrease customer acquisition cost [66]. Customer lifetime value helps companies validate how their strategies were efficient and allows them to predict how loyal and valuable customers will use the product over time. This information then can be used to build product strategies [113].

Recurring revenue provides the product companies with the reliable benchmark metric to set growth goals [49]. It tells that the product has a market fit and can become profitable or vice versa. It is not growing as intended and needs adjustments to appeal to the customer’s needs [53]. When the recurring revenue churn rate is higher than the new recurring rate, the company is losing customers faster than acquiring them [68]. Comparison of present period recurring revenue with the previous ones might lead to the analysis of the fluctuation, identification of the problem and, as a result, optimising the strategy to grow the product. In addition, recurring expansion revenue points out the possibility of the company delivering more value to the customers and monetising it [64], which is a sign for the product owners that customers are willing to expand their packages. Net recurring revenue and net churn recurring revenue helps to understand the recurring revenue from the new customer and churned customers without the other costs involved, only purely that revenue that product leaves to themselves [65].

Many articles raise the point to measure average revenue per account separately for new customers. However, it is the same metric and depends on the product functionality and use case. [50], [114]. The average revenue per account/user can provide a lot of information about the product’s professionals. First of all, these metrics help to forecast and optimise revenue.

Secondly, they provide evidence of a good balance of subscriptions tires in the accounts. For example, if the metric goes down, there are too many free accounts or too many customers on the lowest subscription level. While if the metric is growing, it might mean that the customers are moving to the hire subscription plans [115]. Moreover, this metric is used by stock analysts to compare subscription companies growth on the market [116].

Return on investment is a metric that provides information on how the product managed to make a profit after all the costs involved in the development to be built. In simple words, "it means to quantify how much you earned for every dollar you spent" [117], [52] and provides information to the product owners how the strategy of the product development is reasonable and profitable and if there is something needed to change.

All in all, this section described what information growth product metrics provide to the product owners to make better product decisions. In general, the growth metrics signal the product's profitability and validate if the customer base is growing and retains the existing customer base. Table 10 summarises this section by providing information on what happens if the specific metric value is low or high. For example, a product owner can look at the table and see that if the return on investment metric is low, then the product is not interesting for investors, and it is not great to invest in it. While if the metric is high, then it means that the product is profitable and can be in great interest for investors [117].

Table 10. Information that growth metrics provide.

Category	Metric name	When value is low	When value is high
Revenue growth	Recurring revenue	Product is growing [53] Product is not profitable [53]	*Product is profitable* *Product has market fit*
	Net recurring revenue churn	No or less threat to profitability of the product [68]	*The threat to the profitability of the product* [68]
	Expansion recurring revenue	Product is less profitable [65]	*Possibility to deliver more value to the customers* *Product is profitable* [65]
	Contracted recurring revenue	Low expected growth from the potential customers [68]	*High product growth expected*[68]
	New recurring revenue	Low growth from the new customers [68]	*Strong growth from the new customers* [68]
	Churn recurring revenue	No monetary losses from the customers [68]	*Company loosed customers faster than acquires them (higher then new recurring rate)* [68]
	Customer lifetime value	The product will not be profitable over time [83]	*The product will be profitable over time* [83] *Define the customer segment that the product owners must focus* [83]
	Revenue churn	There is a product market fit Successful user experience and customer onboarding [73]	*Loss in the revenue* *Urgency to improve customer acquisition and retention strategies* [73]

	Average revenue per account	Too many free trial accounts/user [115]	*Customers move to the higher billing plans.* *Good balance between free subscription and paid accounts* [106]
	Revenue	Product is not profitable [54]	*Product is profitable* [54]
	Gross margin	Too much money is spent on the operational activities [112]	*Normal amount of money is spent on operational activities* [112]
	Return on investment	Product is less interesting for investors It is not profitable to invest in the product. It will take a long time to make a product profitable [117]	*Product is in the interest for the investors* *Product is profitable* .[117]
Customer growth	Churn rate	Product loses money by users stop using There is a product market fit Successful user experience and customer onboarding. [73]	*Product loses money by users stop using it.* *Urgency to improve customer acquisition and retention strategies.* [73]
	Retention rate	Customers stop using the product and therefore improvements on retention strategy are needed [68] Low customer loyalty [109]	*Product owners can focus on the current customer base and invest into the customer retention programs but not acquisition* [68] *High chances that current users recommend the product to prospective users* [108] *High customer loyalty* [109]
	Viral coefficient	Existent customers do not bring new ones (value less than 1) [73].	*Each of the customer bring at least one new customer (Value more than 1)* [73].

4.2.2. Information that metrics provide about marketing

This section will highlight which information marketing metrics provide to professionals. The role of acquisition metrics is to point out how well the acquisition strategy is set up and performing. For example, the customer acquisition cost is targeted to understand if the product is profitable and if the money spent on the customer acquisition is worth it. The metric can help understand the efficiency of the sales and marketing campaigns [83]. Customer acquisition cost is related to the customer lifetime value because it is a goal to make more profit from the customers than it costs. The best rule is to have a lifetime value three times bigger than the customer acquisition cost; then, it will mean that all the efforts spent on the customer acquisition are paying off [113]. Thus, the lower the CAC, the more profit the product earns. This information is a key to scaling product business [118]. Months to recover CAC helps understand how quickly customers begin to generate revenue for the company [84]. The higher the value, the more time it takes for the customers to become profitable. Conversion rates, in general, show how successful all the acquisition and lead generation activities are and how the leads are high-quality [119]. If the conversion is high, it means that many customers converted after the campaign [88]. Whereas adoption rate helps understand “what percentage of your key

features" your customers are using. Low adoption rates refer to users' use of the product in a very concentrated way, while the high adoption rate means that the product is used more broadly [85].

Moreover, the adoption rate helps to understand how often and frequently users use the product, and it helps to identify critical features and functionalities of the product [14]. In addition, an important metric to validate marketing activities is click-through rate. It is dedicated to telling if the users are engaged enough with the content. The better the click-through rate, the higher the quality of the lead sources is [120]. The cost per lead metric measures the cost-effectiveness of the advertisement campaign. It demonstrates the price per lead getting to the product. The higher the price, the more expensive it is to get the information [120].

MQLs, SQLs and PQLs reflect the lead generating strategies of the product. Leads drive sales and hence result in product growth and expansion. Marketing qualified leads refer to the users that used the product and, through the behaviour, suggest that they can be the right customers of it. Hence, tracking this metric can help investigate the right customers of the product [121]. While SQLs show if the lead will be a good fit to become a customer. Also, SQLs is the metric for the product sales team, while MQLs is for the product marketing team [122]. Tracking PQLs can help to understand the potential customers of the product, help to target and upgrade marketing campaigns towards the right personas. Hence drops or spikes in PQLs can signal the failures or successes in different marketing activities. It also ensured that the right leads were passed to sales at the right time [86], [81]. Lead velocity rate shows the future of the growth and revenue possibilities of the product. The metric helps professionals forecast how much lead you need every month to achieve product goals [51].

Traffic metrics reflect the origin and quality of the traffic that visits the product if the ratio of organic traffic is more significant than paid traffic, reflecting that more people know about the product and are interested in it [63]. While traffic source metrics will show where the users are coming from and help identify the customer segment and optimize the customer acquisition strategy [119]. Thus, if the social traffic metric is high, then it means that most of the users are coming from the social media product campaigns. Other traffic metrics, such as mobile/desktop traffic, will help you identify which devices the customers are using the most and focus on the user experience and product quality on those devices. The unique/returning traffic metric presents the ratio between returning and individual product users. If the number of returning visitors is higher than unique ones, then it means that existent customers form most of the customer base.

This section presented what information product owners learn from the marketing metrics that generally provide information about the success of customer acquisition campaigns and how it impacts growth. Moreover, traffic metrics shows where the majority of traffic comes. The summary of this section is presented in table 11, which summarises what product owners learn when the value of each marketing metrics goes up or down. Thus, for instance, product owners might know that if the month to recover CAC is low, the product customer becomes profitable fast, while when it is low, it takes a long time until the product customer brings profit.

Table 11. Summary of the information that metrics provide about marketing

Category	Metric name	When value is low	When value is high
Acquisition	Customer acquisition cost	The product is profitable Money investment spent on the customer acquisition is low [83] If the lifetime value three times bigger then customer acquisition cost then the product is profitable [113]	*Money spent on the customer acquisition cost is high* *There is a risk pf product profitability* [83] *If more than customer lifetime value then the product is not profitable* [113]
	Month to recover CAC	Customers become profitable fast [84]	*It takes long time until customers are profitable* [84]
	LTV to CAC	Customer acquisition strategy needs revision It take more money to acquire customers than they bring profit [113]	*Customer brings more money that were spent to acquire them* [113]
	Marketing qualified lead	Show the failure in the marketing campaign [86], [81]	*Define the customer segment for the product* *Show the success of marketing campaign* [86], [81]
	Product qualified lead	Failure in acquisition campaign [86], [81]	*Shows who are the potential customers of the product, help to target and upgrade marketing campaigns towards the right personas* *Success of marketing acquisition campaign* [86], [81]
	Sales qualified lead	Show the failure in the sales acquisition campaign [122]	*Show the success of the marketing acquisition campaign* [122]
	Lead velocity rate	Forecast that product owners need low amount of leads every period to achieve product goals [51]	*Forecast that product owners need high amount of leads every period to achieve product goals*[51]
	Cost per lead	It is cheap to get a product lead [120]	*It is expensive to get a product lead* [120]
	Click through rate	Users are not engaged or have low engagement with the product [120]	*Users are engaged with the content* *Hight lead quality* [120]
	Adoption rate	Users use the product in a very concentrated way	*Broad product usage*[85]

	Conversion rate	Failure of advertisement campaign [88] The acquisition campaigns should be revised	*Success of advertisement campaign* *Increase in the prospective customers and product leads* [88]
Traffic	Social traffic	Shows that customers are not coming from the social media campaigns.	*Shows that customers are coming from social media campaigns*
	Mobile/desktop traffic	Shows that majority of users are on desktop devices	*Shows that majority of users are on mobile devices*
	Organic traffic	If it is lower than paid traffic, then it shows that majority of users learn about the product through paid campaigns [63]	*If it is higher than paid traffic then it means that less money can be invested into the advertisement campaigns and the product grows naturally* [63]
	Unique/returning traffic	Shows that most of the product customers are already existent users [123]	*Shows that a lot of the product customers are unique and new users* [123]

4.2.3. Information That Metrics Provide about Customer Success

This section will provide how useful marketing metrics are for product owners. Therefore, time on the page helps professionals estimate how engaging and interesting the content on the particular page was. The higher the number, the more time user interacts with the product [124]. At the same time, sing ins metrics monitor user engagement trends. The higher the metrics, the more often users sign in or sign up for the product [89].

Engagement metrics show professionals how the product is easy and enjoyable for the users to engage with. Thus, the product usage metric indicates how many customers are interested in the product now and can become potential customers. Low product usage can provide information about the problems with customer satisfaction that can lead to higher churn [125]. Moreover, if the product usage is declining to 50%, it can mean that it is too late to take action. Hence, this metric should be monitored very thoroughly [49]. Whereas the active users metric is the more specific metric that helps indicate the user type is the most profitable for the product, users are more likely to stick around. It shows how healthy the customer base is and how the customers who signed up for the product are using it [83]. However, an active user is a standalone metric that cannot be compared with anything. Hence product stickiness should be involved and looked over. It speaks about product success precisely and explains user engagement success. The bigger the number, the more engaged users are. For example, if the stickiness is 50%, the average user uses the product 15 out of 30 days per month [126]. Whereas activation rate points out how long it takes for users to receive a value from the product, and if the metric is high, the user experience should be improved [127].

Product engagement score tells what percentage of the customer is engaged with the product. The high number indicates an excellent active customer relationship, while the low number is a sign to take action and improve the engagement strategy of the development [128]. Bounce rate helps to investigate how to improve the product, reduce this metric number, and increase user attention. A high bounce rate informs professionals that the user experience was unpleasant or irrelevant; hence some optimisation has to be done [129]. Whereas a high

conversion rate shows how the feature or page user experience is apparent to the user, the low conversion rate can indicate the user experience optimisation and improvement [130].

Customer satisfaction metrics show professionals that users are satisfied and enjoy using the product. For example, a net promoter score that indicates customer health and points out which users are not satisfied with the product, as a result, triggers an action to find out why [128]. Moreover, the metric helps to assess the loyal customers of the product. NPS tells you how likely the customer is to recommend the product to a friend or a colleague. Hence the metric is an indicator and pushes on when the marketing retention strategy improves [75]. Same as NPS, the customer satisfaction score measures customer loyalty and health. The low number can be an indicator that some actions are needed. The metric can explain user needs, expectations, pain points and demand [128]. At the same time, customer effort scores pinpoint "if the product is delivering a superior customer experience or the customer is experiencing several frustration points that could eventually cause them to leave" [65]. The idea is that the more accessible a customer can use the product, the longer the user will be engaged with it [131]. The customer health score is dedicated to helping investigate customer engagement, happiness, likeness to churn [49] and spot out the problematic areas of the product.

Therefore, this section presented that customer success metrics can provide information for the product owners on how pleasant the product user experience is and how the customers are satisfied to use the product. Table 12 presents a summary of the section and gives an overview of each metric's information when its value increases or decreases.

Table 12. The information that metrics provide about customer success

Category	Metric name	When value is low	When value is high
Engagement	Time on page	Users do not spend much time on the product [124]	*The content of the product is engaging* [124]
	Sign ups, sign ins	Users sign in or sign up to the product not often [89].	*Users sign in or sign up to the product often* [89].
	Product usage	Indicates the problems with the customer satisfaction Threat of the churn [125]. If the product usage is declining to 50% it can mean that it is too late to take action [49]	*Users are happy to use the product* [125] *High engagement*
	Active users	The product engagement is low [83]	*The product health* *Indicates the segment of the most active users* [83]
	Activation	It takes less time for the user to receive product value [127]	*It takes more time for the user to receive value from the product* [127]
	Stickiness	Users are less engaged with the product [126]	*Users are more engaged with the product* [126]
	Product engagement score	There is a poor active customer relationship and	*There is a good active customer relationship* [128]

		customer engagement improvements are needed [128]	
	Conversion rate	Feature experience needs user experience optimization [130]	*Feature experience is clear to the user* [130].
	Bounce rate	Pleasant and relevant first user experience [129]	*Unpleasant or irrelevant user experience* [129]
Satisfaction	Net Promoter score	Customers are not likely to recommend the product 66]	*Customers are likely to recommend the product* [75]
	Customer satisfaction score	Low customers loyalty and the need to take actions to improve it [128]	*High customer loyalty* [128]
	Customer health score	Customers experience frustrations during the product experience 57]	*Customer thinks that the product deliver a superior customer experience or the customer* [65]
	Customer effort score	Low customer loyalty and engagement, likeness to churn [49]	*High customer loyalty and engagement* [49]

4.2.4. Information That Metrics Provide about Product Stability

Compared to user experience metrics, product performance metrics provide information on how the product is stable and enjoyable to use from the software performance perspective. For example, if the product cannot load the profile picture of the user and it requires 15 minutes, that is most likely, the user will not enjoy such a user experience. Hence, it is essential how many requests the product can handle, how often it is available to the users (downtime), and whether it is available.

Measuring downtimes allows understanding and ensuring customers with the reliability of the product. This metric can be used in marketing campaigns to promote and advertise it. Moreover, speed and load time can ensure the more excellent user experience of the product users and hence provide information to product owners what the areas of the product performance are lagging and think of how this can be boosted [62]. The cost of customer maintenance provides an understanding of how efficient the product development strategy is. If the customer maintenance cost is higher than the profit from a customer, it refers to a bad sign, and management must reconsider the product development strategy.

Table 13 summarises this section by presenting what information product owners have if the stability metric increases or decreases.

Table 13. Information that product stability metrics provide to the product owner

Category	Metric name	When value is low	When value is high
Stability	Site speed	The product loads fast and user enjoys the experience [62]	*The product loads too slow and there is a threat that the user will churn* [62]
	Load time	Product content is available for the users seamlessly [62]	*Users cannot see the product content because it is not loading* [62]
	Cost of customer maintenance	The product development strategy is efficient [62]	*The product development strategy is not efficient* [62]
	Product downtime	Users can use the product in most of the times	*Users can't use the product often* [62]

4.3. Factors That Impact Digital Products Aspects as Measured by Metrics

Metrics provide insights on different product aspects such as growth, marketing, customer success and performance. All these aspects can be influenced by various factors that will be described in this section. This section is dedicated to answering *RQ3: What factors impact the performance of digital products?* It will provide the answer per each product aspect as growth, marketing, customer success and stability. In the end, there will be a summary of the factors that influence each of these categories.

The growth aspect is impacted by many different factors such as acquisition strategy, billing strategy, customer loyalty, the product's user experience, and others. All these factors are going to be described in the section below.

First, the growth metrics holistically are not helpful if not chosen correctly by the specific product. Adopters, for example, a recurring revenue metric is used for contract-based products such as SaaS [132]. While churn and retention rates are informative on the early adopter's phase of the product life cycle, more or less stable users are using the product [77].

Product growth is dependent on customers and their acquisition strategy success. If there are no new product customers, there is no growth. In general, sales and marketing activities involved in customer acquisition are excellent product growth influencers. Thus, recurring revenue is not informative and does not provide a broad picture of the success of product growth. It incorporates the new customer, product upgrades and downgrades, churns, the metric accumulates lost and acquired revenue. Hence, it is more efficient to track expansions recurring revenue, contracted recurring revenue, churn recurring revenue [133]. The shift in revenue churn may occur because of the new customer acquisition, downgrades, and product updates. Hence, it is essential to consider the new customers churn, not only customer churn in general [74]. Seasonality impacts the growth metrics primarily. For example, there are fewer subscribers during the summer holidays that's why growth declines. That's why professionals should learn seasonal trends and consider them.

Different customers can have separate accounts, affecting the average revenue per account metric because the number of accounts would be more significant. Professionals have to be sure how many customers and account the product has [51]. Acquisition of new customers also impacts the average revenue because if the period had more new customers, that would more likely increase the metric. That's why the average income per new accounts has to be tracked

separately [50]. Changing the pricing of the product impacts the average revenue of the report. If the average revenue per account is growing and the pricing model has not changed, customers naturally move to the more expensive products plans [113]. Upselling the product to the customers also impacts the average revenue per account, making the users choose more expensive product tiers and increasing the metric [134]. Moreover, the sudden market changes as a new competitor that entered the market with better customer conditions might influence the product growth [135]. The average revenue per account connected to the customer lifetime value is better when the average revenue per account is higher as the lifetime value grows and the low churn rate, which refers to the fact that customers are not dropping to use the product [50].

Apart from being acquired, customers must be onboarded to use the product, followed by the valuable, enjoyable, and equivalent user experience. Having great onboarding and user experience results in product growth and customer retention metrics. When the user immediately knows and is aware of the quick wins of the product, it motivates them to be back to the development [136]. If a user has a pleasant experience with a product, that results in loyalty which makes the user spread the word about the product and improve product retention. Besides, user experience creates a habit of product usage and makes users use a product regularly and be back to it. That results in the retention increase [135].

To sum the factors that influence the product growth up, one should remember that customer acquisition influences growth together with a great user experience that usually fosters the growth. Besides, external factors influence the growth aspects, such as seasonality and competition.

4.3.2. Factors That Influence Marketing Aspect of the Product

Product marketing aspects consist of such categories as acquisition and traffic. Product marketing aspects can be influenced by many internal and external factors that will be described in this section.

The customer acquisition cost metric is tightly dependent on the acquisition activities and the required cost for the acquisition. It also depends on the budget dedicated to acquisition strategy. If the budget is low, there is not much to do for acquisition. The cost is not only the salaries of the employees but also publishing costs, lead generation campaigns costs, and tools used for the acquisitions [49]. That’s why the more optimal and accurate acquisition is the higher the metric value. Besides, each product has its pricing model. Some of the products offer free trials. Hence, it can take up to 60 days when the customer starts to use the product and profit the company [53].

Customer acquisition cost is related to the customer lifetime value. These two metrics on their own are not informative. Companies aim to have customer lifetime value three times bigger than customer acquisition cost. Comparing customer acquisition cost with the customer lifetime value helps understand if the effort spent on the customer acquisition is worth its fees [113]. Suppose the product has an inbound acquisition (customers came to the product on their own without campaigns). In that case, it is essential to measure their customer acquisition separately from those acquired through campaigns [133].

Whenever a potential customer responds to the ad, he becomes a lead that can become sales qualified lead, marketing qualified lead and product qualified lead. The number of leads brought each period to the product depends on the acquisition campaign. The quality of the acquisition campaign impacts the lead quality [92]. Moreover, lead metrics are influenced by external factors such as lead profile: company, industry, job role, budget [86]. The user

experience impacts the efficiency rate. The more seamless the user experience is, the easier it is for a user to sign up and use the product [130].

The effectiveness of search engine optimization impacts to traffic in general. Leads impact sales, and traffic is a pointless metric if it does not measure the number of leads it brings [122]. The acquisition strategy impacts traffic metrics because it targets users to the exact pages from different mobile or web platforms. Moreover, the customers can come from paid sources and free (organic) sources [95].

How fast users are adopted heavily depends on the product's user experience and the discoverability of the main features and functions [88]. It is essential to consider the marketing funnel stages when the conversion is calculated since it may vary heavily [126]. If the conversion drops and the product serve user needs, then there might be a bug, or a new competitor will enter the market and influence the aspect [135].

4.3.3. Factors that Influence Customer Success Aspect of the Product

User experience affects both the marketing and growth aspect of the product. If the product's user experience is poor, the other metrics decrease. In this section, let's revise what factors influence the customer success aspect. User experience reflects on the usage of the product, and interestingly, if the customer usage has declined by 50%, it might be too late to take action [49]. That's why it is essential to consider the factors that influence the user experience aspect of the product.

Customer success depends on the user experience of the product, mainly the user journey, how thorough, understandable and enjoyable it is. User journey influences the customer effort score [135]. Weaknesses and decreases in all the customer success metrics are dedicated to pointing out the exact places that the product owners have to improve in the product. It can be the navigation, user journey.

The usage metrics have to be compared over the periods because at the start of the product life cycle, the usage might be low, while during the early adopters, it can grow. If the usage increases, it means improvement [137]. The abandonment rate is affected by the specific pages and functionalities that show that some particular parts of the product are critical for the customers [129]. The place and suitability of the valuable content influence the navigation pattern and navigation depth of the product. Confusing navigation impacts the back and undoes metrics and increases [89]. The user's mistakes and confusion affect the metrics and indicators that improvement has to be done [89].

The extent of how users are engaged with the product heavily depends on their emotional connection with the product willingness to do so and call to action to be involved. The strength of the customer relationship indicates the customer health score [138]. How often the customer needs to use the product also influences the customer success metrics [84]. For example, if the customer needs to use the product once per month, the monthly engagement score can't be high. Moreover, the product-market fit of the outcome impacts the customer success metrics. If customers do not need such a product and do not find any usefulness, then it is a sign to take further actions and improve the situation [139].

Customer onboarding impacts the customer's success and satisfaction. If the user had an awful onboarding which is the first touchpoint with the product, then the user will think that the rest is the same [106]. Moreover, the criteria that the professionals put into achieving the customer engagement scores to be high are also influencing this aspect [81]. Meaning that if the criteria were not chosen wisely, then the whole metric does not show how the user engages.

The decrease in customer satisfaction metrics such as NPS and CSET triggers the action to dig in and understand why. The root cause of users' satisfaction and hence qualitative feedback impacts the satisfaction [128]. Moreover, the stage of the product matters in the customer satisfaction aspect. If the product is young, there is not enough data to measure the NPS accurately [139].

4.3.4. Factors that Influence Stability Aspect of the Product

Product performance influences other aspects of the product. Thus, if there is a poor product load time, the user experience is terrible since the users have to wait until the user can start using the product. That results in lower retention and slower product growth. This section is described what factors impact product performance.

High and low traffic impacts your product performance, such as load time, downtime, server health, what content, and the number of images the product have also influenced the speed at which this content will be loaded. Heavy scripts also negatively impact the load time. That's why it is recommended to keep the pages as clean and straightforward as possible. The quality of the server where the product is stored impacts how many requests it can handle. Besides, the closer the server to the customer is located, the less it takes for requests to travel in the direction of the customer. Suppose the product has a lot of third-party assets such as monitoring tools, data gathering tools, or it simply fetches the resources from other sites. In that case, that will again result in a decrease in performance metrics [105].

This chapter described which factors influence each product aspect that metrics measure. Table 14provides a summary and list of all the factors that affect each of the production aspect as revenue growth, customer growth, acquisition, traffic, engagement, customer satisfaction, product stability.

Table 14. Factors that influence different product metrics categories.

Category of Metrics	**Factors that Influence Product Aspect Categories**
Revenue growth	Product type[132] , product adoption stage product [77], customer acquisition strategy [51], product pricing and plans and upgrades and updates influence metric [113], upselling [134], market trends, customer onboarding experience, seamless user experience, creating of user habits, market changes [136]
Customer growth	Customer onboarding experience, seamless user experience, creating of user habits, market changes , customer loyalty [136], [135]
Acquisition	Budget allocated for the customer acquisition campaign, spending costs, [49], marketing funnel stages [126], quality of acquisition campaign [92], lead profile [86]
Traffic	Amount of leads, lead generation and acquisition strategy [122], search engine optimization [95], marketing funnel stages [126],
Engagement	User journey[135], specific pages and functionalities [129], the strength of the customer relationship [138], product market fit [139], seasonality and usage patterns [139].
Customer satisfaction	User journey [135], product stage [139], choice of evaluation criteria [81], customer onboarding [106], seamless user experience [89], qualitative feedback [128].
Product stability	Traffic volume, content and amount of images, quality of servers, amount of third party assets [105]

4.4. Tools for Measuring Digital Product Metrics

The fourth research question is "What are the tools used to measure metrics for digital products?". This section describes what tools are present and widely used by professionals. Many different tools provide this opportunity for metrics measurement. In this section, the tools and their possibilities will be presented. Since not all the articles contained information about metrics measurement tools (only in 155), the answer to this question will not follow the product aspect structure as in previous ones. Still, it will separately analyse the popularity of different tools mentioned in the researched articles then identify which metrics they can measure and conclude what the product aspects particular metrics are better to use.

Not all the articles focused on the measurement tools that are used for specific metrics. The information about the measurement tools to particular metrics was mentioned 121 times, and the most popular measurement tool is Google Analytics that was raised in 48 articles, second place is taken by HubSpot, which was mentioned in 17 pieces and the third most popular tool is Amplitude that (9 times) that is followed by Mixpanel (8 times) and ChartMogul (6 times) (figure 5). Other tools were measured 1-4 times and considered the least popular.

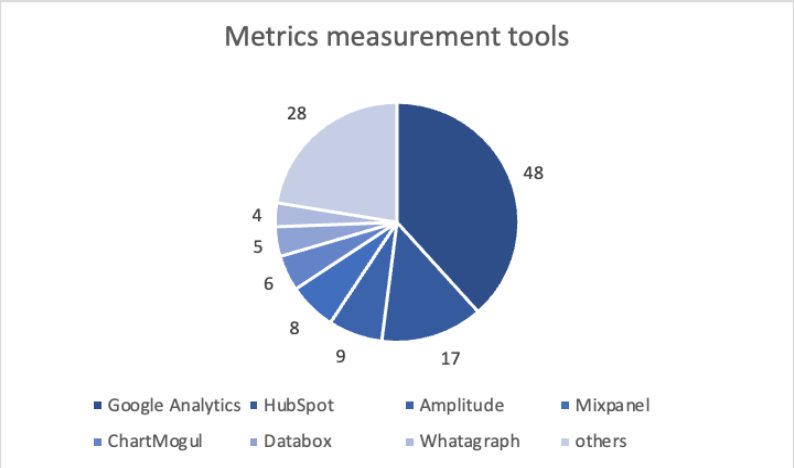

Figure 5. Popular tools for metrics measurement.

Different tools have their possibilities and function better for specific metrics (table 3). Thus, Google Analytics is a tool that is free of charge. It is an excellent tool for tracking traffic metrics. It provides an opportunity to rule out company traffic which means that only outside the office traffic will be tracked and included [104]. Moreover, it tracks unique visitors, compares the amount during the period. The tool allows measuring leads per different channel tracking. In addition, the device can segment the traffic by source [140]. Google Analytics has an opportunity to build metrics dashboards and send them to the relevant people at the company. Data studio is a dashboard builder that works on top of Google Analytics and helps generate good-looking reports based on the data aggregated by the Google Analytics tool [141]. Therefore, Google Analytics is an especially great tool for professionals who do not want to spend money on measurement. It allows them to measure the marketing aspect of the product as traffic and acquisition, partial revenue metric as a month to recover CAC, and the stability aspect of the product.

HubSpot is commonly used for SaaS products. HubSpot can be integrated via API or measure data based on manual import. It can align with the app usage data and then measure it and track it in the background. Moreover, HubSpot provides opportunities to track user engagement, trials engagement, product abandonment. It allows measuring not only the number but also to specify which accounts engage more negligible. Hence, the customer support team can contact such users and discover the root cause. Any customer satisfaction metrics can also be measured

with HubSpot, a customer feedback tooling [49]. Hence, the tool is excellent for measuring growth, marketing and user success product aspects.

Table 15. Metrics measurement tools.

Tools	**Metrics to Measure**
Google Analytics	Site speed [104], load time, unique vs returning traffic, traffic sources [88], conversion rate, month to recover CAC [74]. traffic, marketing, sales, product qualified leads [142]; unique visitors [119], conversion, session duration, total activated users [143], site speed [110]
HubSpot	Recurring revenue, product usage, customer health score, churn rate, customer lifetime value, customer acquisition cost [49]; sing ups [88], marketing, sales, product qualified leads [122], conversion rate [88]
Mixpanel	Sign ups [88], average revenue per account, conversion rate, customer lifetime value, customer acquisition cost [61], retention rate [144]
Amplitude	Average revenue per account/user, conversion rate, customer lifetime value, customer acquisition cost [61], retention rate [144]
ChartMogul	Average revenue per account/user, conversion rate, customer lifetime value, customer acquisition cost [61], recurring revenue [145]

Mixpanel, Amplitude, and ChartMogul have more or less the same metrics that they can measure as customer lifetime value, retention rate, and recurring revenue. They are not specialising in the product stability aspect. Mixpanel specialises in working with web applications and supports digital products as applications. Amplitude is dedicated to "assess and optimise product strategies"[146].

All in all, HubSpot, Mixpanel, Amplitude and ChartMogul are great for measuring revenue and customer growth and acquisition metrics. These tools are not free but allow a lot of customisation and integration to your product. The main HubSpot perk allows engagement metrics such as customer health scores and satisfaction. At the same time, Google Analytics is a free tool and provides an excellent overview of performance, traffic, usage and conversion metrics.

4.5. Metrics Visualisation Techniques

The last research question of this study is "*RQ5: How are metrics for digital products visualised?"*. Visualisation practices for digital metrics are not different from the commonly known data visualisation types. Therefore, I will follow the data visualisation catalogue [146], a library of varying information visualisation methods. The visualisation methods (list of charts) are categorised per the visualisation functions. For example, the comparison method refers to the visualisation method that helps analyse the differences and similarities of values. This method is represented per different charts as bar charts, histograms, box charts and others [148]. Proportions, relationships, distribution, process and techniques, flow, patterns, range, data over time, analysing text, reference tools are all the visualisation functions. This section will follow the data visualisations catalogue and present visualisation techniques digital product metrics. This section will not follow the product aspect structure. Still, it will focus on

the review visualisations' examples used in the papers following the data visualisation catalogue and then summarise visualisation methods per different types.

Usually, product owners use a dashboard to show the metrics outcomes. Dashboards are dedicated to different people at the company, such as executives or product owners. Metrics visualisations are used in the dashboard to present the data. For example, in [49], and attribution report is given, a standard dashboard report includes customer engagement and monetary values. This report helps understand which marketing and product management elements are the most profitable and impactful and help drive new revenue and acquire new customers. For example, the information presented below shows a bar chart's linear attribution to source type in HubSpot (figure 6).

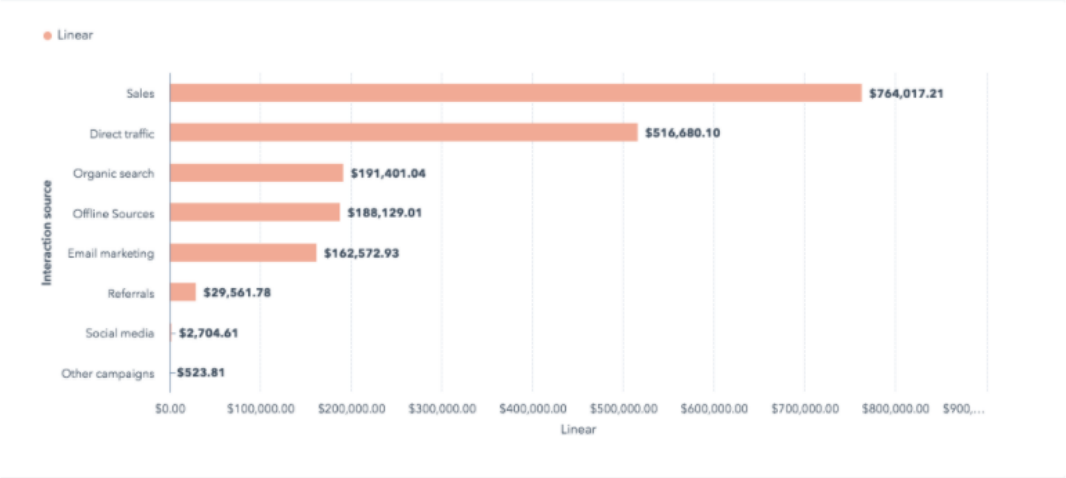

Figure 6. Linear attribution report of marketing source [49].

Such visualisation helps to understand how much money each traffic source brought to the product. The same article also visualises recurring revenue as a stacked bar graph where stacks refer to the existing, new and lost recurring revenue (figure 7).

Figure 7. Visualisation of recurring revenue [49].

Another example of recurring revenue visualisation is presented in [76] and [50] as a line graph of net new, expanded and churned annual recurring revenue that shows the metrics' tendencies over time. In [50] linear chart (figure 8) shows the change of the new recurring revenue, recurring expansion revenue, churned recurring revenue and new net recurring revenue over the year. This graph helps to prove the logical tendencies, such as if the churned recurring revenue is declining, then net regular income and new net recurring revenue are increasing.

Figure 8. Visualisation of recurring revenue example [50]

Moreover, linear graphs in [149] visualise the stickiness ratio (figure 9) and conversion rate [150] (figure 8). The metric is distributed over the period, and such visualisation helps spot increases and decreases of conversion rate in specific dates or periods.

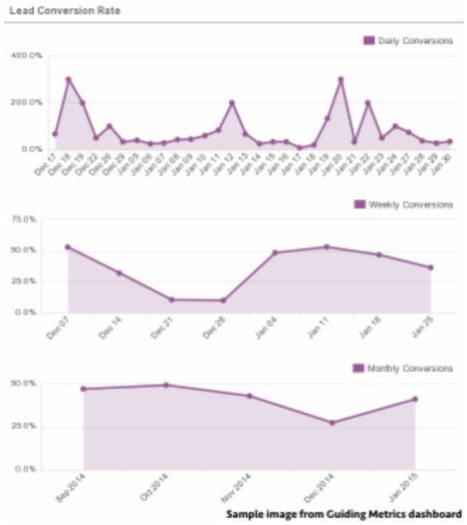

Figure 9: Visualization of conversion

A semi-circle doughnut chart (figure 10) visualises churn rate in [88]. It is divided into three zones: blue, green and grey which respectively apply different speeds of the customer churn and on the top is presented the number of churn for the last month.

Figure 10. Semi-circle donut chart of churn rate [88]

In addition, articles showed examples of dashboards with metrics visualised. For example, the dashboard presented in [83] shows how to visualise metrics for the SaaS product (figure 11). The dashboard displays the number of customers for the past month with the different states of comparison with the previous month, customer lifetime value, and project profit of the product as a number and as a change line graph. It represents the acquisition by the channel reports with the customer lifetime value per channel and profit as numbers.

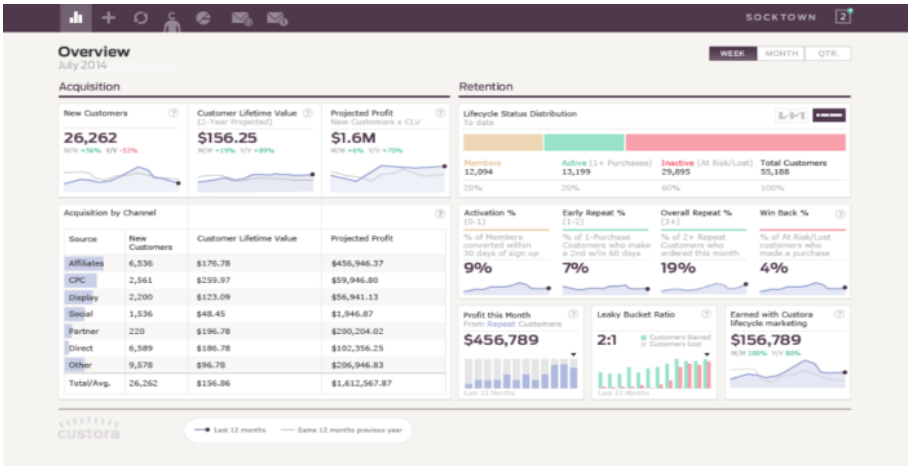

Figure 11. SaaS metrics dashboard sample [83]

This dashboard uses line graphs to visualise the customer lifetime value, revenue profit, and activation. Bullet graph integrated into the table is used to visualise acquisition. In addition, the dashboard also includes the visualisation of retention as a stacked bar graph on the customer retention segmented into the user types as members, active and inactive, compared to the total number of customers. Since Custora, another metric visualisation tool, builds the dashboard, it reflects on the metrics and acquisition managed by this CRM: profit this month, earned with Custora lifecycle marketing [83].

The scatter plot in [102] visualises the net promoter score accompanied by the stacked area graph (figure 12). Since other customer satisfaction metrics are also score based and they define the different amount of customer types, for example, detractor, neutral, promoter, then these methods of visualisation can be applied to other customer satisfaction metrics like net promoter score, customer effort score, customer health score, customer satisfaction score.

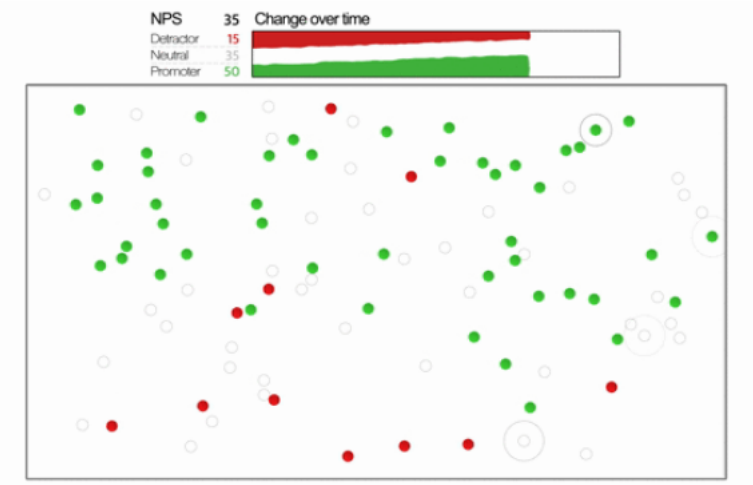

Figure 12. Net promoter score visualisation [102]

In [83] SaaS executives report (figure 13) reflects on the subscribers' growth. New subscribers are shown in the form of a histogram per day. The positive number line visualised the positive amount to the subscribed gained, and the opposing lane visualised subscribers lost. The linear graph represents the growth tendency of subscribers' growth.

Figure 13. SaaS executive dashboard [83].

Dashboard in [88] presents a violin plot to represent the sales-marketing pipeline for the last month and provide visualisation for a total number of leads, MQL, SQL and PQL (figure 14).

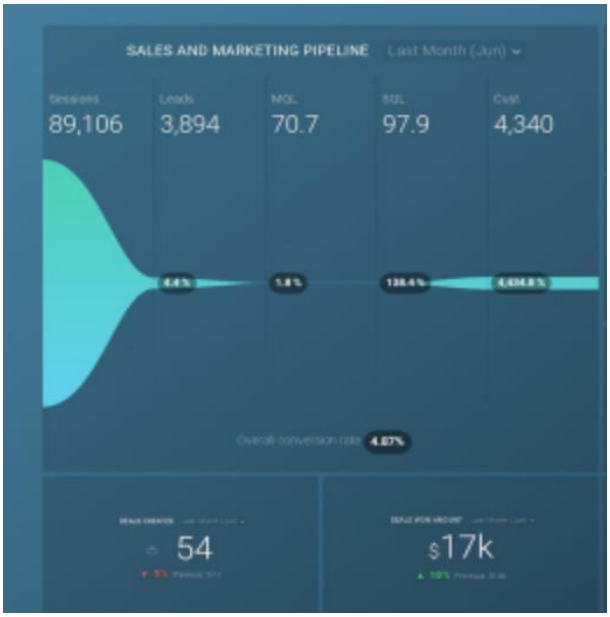

Figure 14: Visualization of sales activities [88].

Also, in [88] presented the dashboard with the visualisation of the direct traffic in the form of the linear graph and a donut chart to visualise the traffic per various sources like emails, referrals, direct (figure 15).

Figure 15: Visualization of traffic [88].

To sum the visualisation practices of digital product metrics, metrics measurements are grouped into the dashboards that help understand the information that metrics provide and spot the problem areas, patterns, and trends from the dashboards. Moreover, such tools for measurement as HubSpot and Google Analytics provides a possibility to build metrics measured in these dashboards using them, which is convenient. Hence, using metrics measurement tools offers an opportunity for professionals to measure metrics and visualise them. The review articles lack the visualisation methods for the stability metrics. The summary of the visualisation methods for each metric is presented in Table 16.

Table 16. Visualisation catalogue types and metrics.

Visualisation method	Metrics
Bar chart [151]	Engagement score, customer acquisition cost, traffic metrics [49]
Stacked bar graph [152]	Recurring revenue with all the types, retention rate [49]
Line graph [153]	Recurring revenue with all the types [50], stickiness ratio [149], conversion rate [149], customer lifetime value, revenue, acquisition, activation , customer growth, traffic sources [49]
Semi-circle donut chart [154]	Churn rate [88]
Violin plot [155]	MQL, PQL, SQL [88]
Scatter plot [156]	Customer satisfaction metrics [102]
Stacked area graph [157]	Customer satisfaction metrics [102]

Chapter 4 presented the answers to the research questions. First of all, it described which metrics measure different product aspects like growth, marketing, customer success and product stability. Metrics were categorised per product aspect as customer growth, revenue growth, acquisition, traffic, customer engagement, satisfaction, and product stability metrics.

The definition of each metric became apparent after the RQ1 answer and how to visualise the metric. Secondly, the information provided by each metric in case of value increase or decrease was defined. Thirdly, factors that influence each product aspect that metrics measure were specified. Then, the tools that product owners can use to measure metrics were defined. The last section described how to visualise product metrics.

5. Discussion and Limitations

The latest chapter of the thesis presented the study results and provided the answers to research questions. This chapter will first discuss the study results, present interconnections of the finding with study-related work and point out exciting insights derived from the research. Secondly, I will present the limitations of the study.

This study answered such research questions as:

- RQ1: What aspects of digital products are measured?
- RQ2: What information do metrics provide to digital product owners?
- RQ3: What are the factors that impact the performance of digital products?
- RQ4: What are the tools used to measure metrics for digital products?
- RQ5: How are metrics for digital products visualised?

The first research question of the study provided clarity that there are four aspects of the products: growth, marketing, customer success, and stability. Growth refers to revenue and customer growth. Marketing consists of acquisition and traffic categories. The customer success aspect contains engagement and satisfaction aspects. Different metrics measure these product aspects and their types and are presented in the research question answer. Related work studies did not cover such broad scope of the digital product metrics aspects and differentiation of what metrics measure these aspects. The survey of the quality and software reliability metrics [10] are somewhat connected to the stability metrics. However, the development team is in charge of software reliability and quality measurement while product owners track the product stability.

Moreover, after the RQ1 answers, it became clear that the stability aspect of the product is not widely covered by professionals when searching for digital product management without the inclusion of the "software" term in the search. This fact resulted in the lack of proof and samples about product stability metrics and can become an idea for further research. The same challenge occurred to finding out the visualisation techniques of the metrics RQ5. On the one hand, product metrics do not have unique visualisation practises and follow standard data visualisation guides. On the other hand, researched articles did not focus on the visualisation but the metrics definition and implication. Moreover, related work analysis did not show academic research on the metric visualisation topic. Following studies can focus on the metric visualisation topic.

The second research question provided an overview of product owners' information from the metric measurement. For example, recurring revenue details how much money customers bring to the product each month or year, which is essential while making a product decision. This finding aligns with the related work-study [6] that presents that physical product metrics are used for decision-making.

The highlight is the connections between different product aspects and their mutual interdependency. For example, product growth relies on the marketing aspect of the product, acquisition specifically. If there are no lead generation and acquisition campaigns, the product will not grow the user base and revenue at the same time. Growth is dependent on customer success. If the product has a poor user experience, then users stop using the product. Hence product loses customers and revenue. User success also depends on product stability. When the picture or form or other interactive product elements are loading slow, the user experiences frustration and wants to quit the experience, leading to the loss of users.

After answering RQ2 and RQ3, it became clear that the main power of each metric is providing information to the professional. The reason why metric is needed is to learn something new.

Therefore, product owners can analyse metric data to drive product decisions based on the metric's information. Notably, metrics have their downsides. If they are checked without understanding the context and broader picture of what can impact the product aspect measured by metrics, the information can be misleading. For example, imagine the digital application in Arabic countries as a product run by product owners. If the professionals check the daily active users today and see a considerable decline compared with yesterday, they might panic. However, if they know about the seasonality pattern of the product usage, then there would be no confusion regarding the rapid metric change. It will appear that this is just a regular weekly pattern when users do not use phones and products respectively because they have Shabbat on that day, and it is not allowed by their culture.

5.1. Limitations

Any grey literature review has its limitation that can impact the study's finding [158]. This study is not an exception. One of the limitations of such type of research is selection validity. It refers to how good the resources presented in the article are. Even though the articles researched went through strict selection criteria and formed a list of sophisticated articles, we can't be sure how thorough the articles were written, designed and if the information in the papers is reliable and complete. To minimise the impact of this limitation, the study supervisor reviewed the study; the author used Zotero as a bibliography management tool and documented each research process step in the review protocol to ensure study repeatability.

Moreover, only Google search was used as a search source which limited the selection of the studies. It was also limited by taking only English sources. However, there might be articles that cover the topic in other languages. In addition, search strings applied to the study might not cover the full scope of the articles on the digital product topic and highlight only specified ones.

Another limitation of the study is data validity, which refers to the study's data extraction and analysis phases. Despite data being extracted into the extraction form, the author subjectively evaluated the quality of needed data, which could lead to inaccurate data extraction at some places and quality threats.

6. Digital Product Metrics Framework

This section presents the digital product metrics framework for digital product owners. This chapter will first discuss what areas are included in the framework and the structure, then describe how to read the framework and provide an example. In the end, I will present to whom the framework is dedicated, and in which use cases to use it. Appendix I presents the complete framework.

Table 17 presents an outline of the framework structure and explains its components. The framework is structured in a table with nine columns. All the columns are tight to the answers to the study's research questions. The first column is "Product aspect", which refers to the aspect of digital product that the product owner would like to measure. Since different metrics belong to the aspect, the framework has coloured the cell with the product aspect for easier reading. There are such product aspects as growth, marketing, customer success, product stability. All these aspects were defined in this review during the RQ1 answer. The growth aspect refers to the increase in the product revenue and customer base, which leads to product success. The purple colour labels the framework section that presents the growth aspect. The marketing aspect relates to all the marketing activities of the product owner, specifically customer acquisition and traffic tracking. This aspect refers to monitoring the activities success targeted to market the product and acquire new customers. These two aspects are separate because not all the users who come to the product after marketing activities will result in product growth; hence, product owners keep these two aspects separately. This aspect is marked in blue colour. The customer success aspect refers to how users present their engagement and satisfaction. It is characterised by orange. Product stability aspect means the product's reliability and stability for the customers' usage. This aspect is marked by red.

The second column of the framework is "Product aspect category". Each aspect has its categories that refer to the building blocks of one aspect. The growth aspect refers to the customer growth and revenue growth metrics and represents metrics dedicated to tracking customer growth of the product and revenue growth, respectively. Product marketing categories include acquisition and traffic categories. The acquisition category refers to the metrics that provide an overview of the success of the customer acquisition strategy.

The customer success aspect consists of engagement category and satisfaction metrics. The engagement category refers to customer engagement success, whereas satisfaction metrics tell how customers are satisfied with the product. In contrast, traffic metrics reflect on the product traffic and give knowledge on the customer segment. The product stability aspect means product reliability for customers usage, how a product performs and is available for its users. Further in the framework, all the digital product metrics are presented per these product aspects and their category.

As you can see from the table 17, there are visual elements that help to mark the categories and aspect sections boundaries. The waved line, , indicates the end of the product aspect category so that when product owners read the framework, they can understand that this is an end of the metrics category. While the triple line,  , means the end of the product aspect.

Table 17. Outline of digital product metrics framework.

Product Aspect	Product Aspect Category	Factors that Impact Product Aspect Category	Metric Name	Definition	How to Measure the Metric	When value is Low Then …	When Value is High Then …	Tools for Metric Measurement	Visualisation Method
Growth	Revenue	*Presents list of factors that influence product aspect category per product aspect category*	*Presents the metric name*	*Presents the listed in previous column metric definition*	*Described the formula or data for metric value calculation*	*Presents what it means when the value of the metric after calculation is low per each metric*	*Presents what it means when the value of the metric after calculation is high per each metric*	*Lists the tools for the metric measurement. If empty, then it means there was no evidence in the review*	*Presents the visualisation method per metric. If empty, then it means there was no evidence in the review*
	Customer								
Marketing	Acquisition								
	Traffic								
Customer success	Customer engagement								
	Customer satisfaction								
Product stability	Product stability								

The third column is “Factors that impact product aspect category”. This column presents the factors that the product category aspects depend on and their influence. For example, the factors influencing revenue growth category are product type [132]

Product adoption stage product [77], customer acquisition strategy [51], product pricing and plans and upgrades and updates influence metric [113], upselling [134], market trends, customer onboarding experience, seamless user experience, creating of user habits, market. All the factors listed in the second column were chosen based on this grey literature review results and were more thoroughly discussed in the RQ3 answer. All the factors are presented jointly per the product aspect in the framework.

The next column is “Metric name”. This column, row by row, lists the metrics that belong to the specific product aspect category. For example, recurring revenue is a revenue growth

metric. After the “Metric name” column follows “Metric definition” and “How to calculate metric” columns. The first one defines the metric presented in the third column, and the third one describes how to calculate the metric value. This knowledge was taken to the framework from the answers to the RQ1.

The sixth and seventh columns of the framework are named “When the value is low then …”, “When the value is high then …” were formed based on the RQ2: “What information do metrics provide to digital product owners?”. Respectively, it described what it means when the metric's value is low and high in the form of the facts lists. For example, from the framework, we can learn that when the value of recurring revenue is down, that means that the product is not growing, and when the value is high, that refers to the fact that the product is profitable and has a market fit.

The following framework column is “Tools for metric measurement”, which presents tools to measure the metric value. For instance, HubSpot and ChartMogul are tools for measuring recurring revenue. RQ4 answer is the ground for this column. The last column of the framework is the “Visualisation method”, which provides the visualisation method for metric presentation. This column is based on the RQ5 answers of the thesis.

The framework has special marks next to some metrics names as “*” and “◦”. The first one indicates metrics relevant for subscription-based products, for example, SaaS. The second one highlights the appropriate metrics to consider during the early adapter product stage.

Metrics are categorised per product aspect and its category. So, when product owners open a framework, they can see the list of metrics, their definition and calculation guidelines with the information when the metric is high or low, tools and visualisation per each of the metrics. In addition, the framework also provides a report on the factors that influence product categories. Let’s consider the use case when the framework can become relevant. For example, the product owner sees fewer new customers using the product and wants to know why and what it means. The product owner will open the framework and find a customer growth section. The framework would learn that customer onboarding experience, seamless user experience, creating user habits, market changes, and customer loyalty [136], [135] might influence that product aspect. Then product owners will check the metrics that they can use to measure the customer growth as churn rate, retention rate, viral coefficient. From the framework, professionals would know the definition of the metric and how to calculate it. For example, the product owner will measure in HubSpot or ChartMogul viral coefficient for the last half a year per month and see that the previous month's value is lower than previous ones. By checking the framework, the product owner would know that existing customers do not bring new ones [72], and that was not the case before. Hence, the product owner will start to look at the factors that might impact the value, such as customer onboarding experience, seamless user experience, creating user habits, market changes, and customer loyalty [136], [135]. Since these factors influence the product aspect, product owners can understand what changed since last month so that customers stopped recommending the product to other people.

The digital product metrics framework is dedicated to helping product owners measure digital products and their success. There are multiple use cases when product owners can use the framework. Firstly, it is relevant when they want to measure the success of their digital product. Secondly, a framework is practical when there is a need to understand product metrics and use them. Thirdly, the framework can help when product owners want to troubleshoot changes in the digital product and understand the root cause of those changes.

7. Conclusions

The field of product management is freshly new, and there are many functions that the profession requires. One of them is an assessment of product success by using product metrics. However, there are a lack of evidence and research on the topic of digital products metrics; thus, it is a challenge to identify what metrics to use for the professionals. This thesis aimed to research digital product metrics topic and determine what product aspects different metrics measure, what information they provide, what factors influence the characteristics measured by metrics, how to visualise metrics, and which tools to use for metric calculation and visualisation. The study's main contribution is the digital product metrics framework that provides the professionals with guidelines on the choice of metrics. When professionals use the framework, they can choose the metric for their needs and learn how to use it.

The grey literature review extracts and analyses the topic's data and provides an empirical answer to the research question. The research followed the plan designed in the review protocol (Appendix I) to ensure the study's repeatability. Two hundred eighty-one (281) articles were examined as a part of a grey literature review to answer study research questions. Data from the reports were extracted into the data extraction form that followed the structure of research questions. After that, the data was analysed, and the answers to the research questions were provided.

Analysis of grey literature showed four digital product aspects that product owners measure as growth, marketing, customer success and product stability, including their categories as revenue growth, customer growth, acquisition, traffic, customer engagement and satisfaction, product stability. Each type has metrics that can define the success of the chosen product aspects. This research provided an overview of product owners' information when the metric decreases or increases. Moreover, the study defined the factors that impact each product aspect, which will help product owners know and own a comprehensive picture of the product success and be aware of what to consider during the measurement of product aspects. In addition, the study defined tools for digital product metrics measurement as Google Analytics, HubSpot, Mixpanel, Amplitude, ChartMogul. The study found out that visualisation of digital product metrics followed common data visualisation practice and presented what visualisation method product owners should choose for different metrics.

The study's outcome and main contribution is the digital product metrics framework built based on the research questions answers. The framework guides the product owners on the digital product metrics per different product categories. Product owners can use the framework to understand why particular parts of the product are not performing well or when they want to identify employing which metrics measure the product aspects. It provides a definition and measurement guidelines for each metric, describes the meaning of metrics value drops and rises, defines the tools and visualisation methods used while metric measurement and interpretation. In addition, the framework specifies the factors that product owners should look at when they analyse a particular product category. In general, the framework is dedicated to simplifying the lives of digital product owners when they need to choose metrics to measure digital product success.

There are several opportunities to continue this research and contribute to the digital products metrics topic. Firstly, the metric visualisation topic can be covered separately and provide an extent to the framework developed in this study. Secondly, the product metrics can be researched not from the theoretical perspective but from the actual companies. Hence, researchers can conduct interviews with professionals to get more evidence on the motivation to use product metrics and their importance. Moreover, this study can be digitalised, and the framework can be published on the Internet to serve product owners daily.

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Appendix I. Digital product metrics framework.

Product aspect	Product aspect category	Factors that impact product aspect category	Metric name	Definition	How to measure the metric	When value is low	When value is high	Tools for metric measurement	Visualisation method
Growth	Revenue growth	Product type[132] , product adoption stage product [77], customer acquisition strategy [51], product pricing and plans and upgrades and updates influence metric [113], upselling [134], market trends, customer onboarding experience, seamless user experience, creating of user habits, market changes [136]	Recurring revenue °	Amount of generated revenue and is used in subscription-based products such as SaaS [57].	$Recurring\ revenue = Average\ revenue\ per\ account * total\ amount\ of\ accounts$ [49]	Product is not growing [53], Product is not profitable [53]	Product is profitable, Product has market fit	HubSpot [49], ChartMogul	Stacked bar graph [152] [49], Line graph [153] [50]
	Revenue growth		Net recurring revenue churn °*	Estimation of the revenue loss per period based on the product downgrades, subscription cancellation, a user leaving that includes the revenue generated from the expansion and upgrades [64].	$\frac{Churn\ recurring\ revenue - added\ recurring\ revenue}{Total\ recurring\ revenue\ at\ the\ beginning\ of\ the\ period}$ [65]	No or less threat to profitability of the product [68]	The thread to the profitability of the product [68]	HubSpot [49], ChartMogul	Stacked bar graph [152] [49], Line graph [153] [50]
	Revenue growth		Expansion recurring revenue °	Revenue that is made through upgrades and upsells from existing customers [60].	$\frac{\frac{Total\ expansion\ revenue\ at\ end\ of\ period - Total\ expansion\ revenue\ at\ start\ of\ period}{Total\ expansion\ recurring\ revenue\ at\ start\ of\ period} * 100}$ [61]	Product is less profitable [65]	Possibility to deliver more value to the customers Product is profitable [65]	HubSpot [49] ChartMogul	Stacked bar graph [152] [49], Line graph [153] [50]
	Revenue growth		contracted recurring revenue °	Committed recurring revenue of SaaS products [62].	*Amount of revenue that is planned each period from the signed contracted or requested product service* [62]	Low growth expected [68]	High product growth expected[68]	HubSpot [49] ChartMogul	Stacked bar graph [152] [49], Line graph [153] [50]
	Revenue growth		New recurring revenue °	The revenue which is brought by acquiring new customers [63].	*Sum the amount of the revenue that came from the new users during the period* [63]	Low growth from the new customer [68]	Strong growth from the new customers [68]	HubSpot [49], ChartMogul	Stacked bar graph [152] [49]

Appendix I. Digital product metrics framework.

Product aspect	Product aspect category	Factors that impact product aspect category	Metric name	Definition	How to measure the metric	When value is low	When value is high	Tools for metric measurement	Visualisation method
	Revenue growth		Churn recurring revenue *°	The revenue lost because of cancellations, stopping using the product and downgrades [60].	*Sum of the revenue that is lost during periods because of cancellations, stopping using the product and downgrades* [60]	No monetary losses from the customers [68]	Company loosed customers faster than acquires them (higher then new recurring rate) [68]	HubSpot [49], ChartMogul	Stacked bar graph [152] [49]
	Revenue growth		Customer lifetime value	"Amount of money customers pay during their engagement with the product" [66].	$\frac{1}{Churn\ rate}$ [68]	The product will not be profitable over time [83]	The product will be profitable over time [83] Define the customer segment that the product owners must focus [83]	HubSpot [49], Mixpanel, Amplitude , ChartMogul	Line graph [153]
	Revenue growth		Revenue churn *	The revenue that was lost because of cancellations, stopping using the product and downgrades [60].	$\frac{total\ revenue\ lost\ during\ the\ period}{revenue\ at\ the\ start\ of\ period} * 100$ [49]	There is a product market fit Successful user experience and customer onboarding [73]	Loss in the revenue Urgency to improve customer acquisition and retention strategies [73]	HubSpot [49], Mixpanel	Semi-circle donut chart [154] [88]
	Revenue growth		Average revenue per account	The average revenue that every user brings per period [64].	$\frac{Recurring\ revenue}{Total\ number\ of\ customers}$ [51]	Too many free trial accounts/user [115]	Customers move to the higher billing plans. Good balance between free subscription and paid accounts 106]	ChartMogul [61], Amplitude, Mixpanel,	

Appendix I. Digital product metrics framework.

Product aspect	Product aspect category	Factors that impact product aspect category	Metric name	Definition	How to measure the metric	When value is low	When value is high	Tools for metric measurement	Visualisation method
	Revenue growth		Revenue	Total income generated on the product over a defined period [54].	*Sum of the revenue generated during the period* [54]	Product is not profitable [54]	Product is profitable [54]	ChartMogul [61]	
	Revenue growth		Gross margin	Measurement of money that is left after sales activities deducting the cost of goods sold [69].	$\frac{Total\ revenue - development\ cost}{Total\ revenue} * 100$ [79]	Too much money is spent on the operational activities [112]	Normal amount of money is spent on operational activities [112]	HubSpot [49], Mixpanel	
	Revenue growth		Return on investment	Measuring of how long it takes to return back investments that was spent for the product [71].	$\frac{Total\ revenue - Total\ investments}{Total\ investments}$ $\frac{LTV}{CAC}$ [55]	Product is less interesting for investors. It is not profitable to invest in the product. It will take a long time to make a product profitable [117]	Product is in the interest for the investors. Product is profitable .[117]	HubSpot [49], Mixpanel	
	Customer growth	Customer onboarding experience, seamless user experience, creating of user habits, market changes , customer	Churn rate *	The number of customers or accounts leaving the product over a defined period and is defined as from the percentage of the overall customer count [67].	$\frac{Number\ of\ churned\ customers}{Total\ number\ of\ customers}$ [74]	Product loses money by users stop using There is a product market fit Successful user experience and customer onboarding. [73]	Product loses money by users stop using it. Urgency to improve customer acquisition and retention strategies. [73]	HubSpot [49], Mixpanel	Semi Donut chart [88], [154]

Appendix I. Digital product metrics framework.

Product aspect	Product aspect category	Factors that impact product aspect category	Metric name	Definition	How to measure the metric	When value is low	When value is high	Tools for metric measurement	Visualisation method
	Customer growth	loyalty [136], [135]	Retention rate *	The percentage of customers that retained over the defined period and continued to use the service [67].	$100\% - churn\ rate$ [59]	Customers stop using the product and therefore improvements on retention strategy are needed [68] Low customer loyalty [109]	Product owners can focus on the current customer base and invest into the customer retention programs but not acquisition [68] High chances that current users recommend the product to prospective users [108] High customer loyalty [109]	HubSpot [49], Amplitude, Mixpanel	Stacked bar graph [152] [49]
	Customer growth		Viral coefficient	The percentage of the customers who joined the product through referral and became active users [73].	*Investigate the percentage of customers who joined through referral* [73]	Existent customers do not bring new ones (value less than 1) [73].	Each of the customer bring at least one new customer (Value more than 1) [73].	HubSpot [49], Mixpanel	

Appendix I. Digital product metrics framework.

Product aspect	Product aspect category	Factors that impact product aspect category	Metric name	Definition	How to measure the metric	When value is low	When value is high	Tools for metric measurement	Visualisation method
Marketing	Acquisition (marketing)	Budget allocated for the customer acquisition campaign, spending costs, [49], marketing funnel stages [126], quality of acquisition campaign [92], lead profile [86]	Customer acquisition cost	"The total cost of sales and marketing efforts that are needed to acquire a customer" [59].	$\frac{Sales\ and\ marketing\ costs}{Amount\ of\ new\ customers}$	The product is profitable Money investment spent on the customer acquisition is low [83] If the lifetime value three times bigger then customer acquisition cost then the product is profitable [113]	Money spent on the customer acquisition cost is high There is a risk pf product profitability [83] If more than customer lifetime value then the product is not profitable [113]	HubSpot [49], Amplitude , Mixpanel,	
	Acquisition (marketing)		Month to recover CAC	How long it takes to recover the costs spent to acquire the customer [80].	$\frac{CAC}{Recurring\ revenue * Gross\ margin}$	Customers become profitable fast [84]	It takes long time until customers are profitable [84]	Google Analytics	
	Acquisition (marketing)		LTV to CAC	Ratio of the customer lifetime value and customer acquisition cost [81].	$\frac{LTV}{CAC}$	Customer acquisition strategy needs revision It take more money to acquire customers than they bring profit [113]	Customer brings more money that were spent to acquire them [113]		

Appendix I. Digital product metrics framework.

Product aspect	Product aspect category	Factors that impact product aspect category	Metric name	Definition	How to measure the metric	When value is low	When value is high	Tools for metric measurement	Visualisation method
	Acquisition (marketing)		Marketing qualified lead	The number of the users that visit a product and, through their behaviour, show interest in using it or purchasing it [75].	*Amount of leads that are qualified for marketing activities* [75]	Show the failure in the marketing campaign [86], [81]	Define the customer segment for the product Show the success of marketing campaign [86], [81]	HubSpot	Violin plot [155] [88]
	Acquisition (marketing)		Product qualified lead	The number of users whose behaviour shows that they are ready to purchase the product [75].	*Amount of leads that passed sales activities and are prospective product users* [75]	Failure in acquisition campaign [86], [81]	Shows who are the potential customers of the product, help to target and upgrade marketing campaigns towards the right personas Success of marketing acquisition campaign [86], [81]	HubSpot	Violin plot [155] [88]
	Acquisition (marketing)		Sales qualified lead	The number of users who are already using the product but have not purchased it yet or have a free version of it and are potential customers to whom the product can be upscaled [75].	*Amount of leads that passed marketing campaign and are prospective sale leads* [75]	Show the failure in the sales acquisition campaign [122]	Show the success of the marketing acquisition campaign [122]	HubSpot	Violin plot [155] [88]

Appendix I. Digital product metrics framework.

Product aspect	Product aspect category	Factors that impact product aspect category	Metric name	Definition	How to measure the metric	When value is low	When value is high	Tools for metric measurement	Visualisation method
	Acquisition (marketing)		Lead velocity rate	Growth of leads per period [51].	$\frac{Qualified\ leads\ this\ period\ -\ Qualified\ leads\ last\ period}{Qualified\ leads\ last\ period\ *100}$ [63]	Forecast that product owners need low amount of leads every month to achieve product goals [51]	Forecast that product owners need high amount of leads every period to achieve product goals[51]	HubSpot	Violin plot [155] [88]
	Acquisition (marketing)		Cost per lead	Measurement of how cost effective marketing acquisition campaigns [82].	$\frac{Cost\ needed\ for\ lead\ generation}{Amount\ of\ leads}$ [82]	It is cheap to get a product lead [120]	It is expensive to get a product lead [120]		
	Acquisition (marketing)		Click through rate	The ratio of the users who view the acquisition campaigns such as email links, social media posts, call-to-action statements [82].	*Percentage of users who viewed acquisition campaign and landed on the product* [82]	Users are not engaged or have low engagement with the product [120]	Users are engaged with the content Hight lead quality [120]		
	Acquisition (marketing)		Adoption rate	The percentage of product key features a user has used in a given timeframe [85].	*The percentage of product key features a user has used in a given timeframe* [85]	Users use the product in a very concentrated way	Broad product usage[85]	HubSpot	
	Acquisition (marketing)		Conversion rate	The number of leads who became customers [68].	*Ratio of amount of customer that were leads* [68].	Failure of advertisement campaign [88] The acquisition campaigns should be revised	Success of advertisement campaign Increase in the prospective customers and product leads [88]	HubSpot, Amplitude, Mixpanel, ChartMogul	Linear graph [149], [153] [149]

Appendix I. Digital product metrics framework.

Product aspect	Product aspect category	Factors that impact product aspect category	Metric name	Definition	How to measure the metric	When value is low	When value is high	Tools for metric measurement	Visualisation method
	Traffic (marketing)	Amount of leads, lead generation and acquisition strategy [122], search engine optimization [95], marketing funnel stages [126],	Social traffic	The total amount of web traffic (amount of users) that is found about the product through social media channels [86].	*The percentage of users that came to the product through social media campaign.*	Shows that customers are not coming from the social media campaigns.	Shows that customers are coming from social media campaigns	HubSpot	Bar chart [151] [49]
	Traffic (marketing)		Mobile/desktop traffic	The amount of traffic from on the mobile/desktop devices [88].	*Percentage of users that are using product on mobile/desktop device.*	Shows that majority of users are on desktop devices	Shows that majority of users are on mobile devices	Google Analytics [88], Mixpanel	Bar chart [151] [49]
	Traffic (marketing)		Organic traffic	The amount of customers that reached the product not from the different campaigns but organically [88].	*Number of users that came to the product without any campaign.*	If it is lower than paid traffic, then it shows that majority of users learn about the product through paid campaigns [63]	If it is higher than paid traffic then it means that less money can be invested into the advertisement campaigns and the product grows naturally [63]	Google Analytics [88]	Bar chart [151] [49]
	Traffic (marketing)		Unique/returning traffic	The ratio between new users of the product and repeating users of the product [86].	$\frac{Amount\ of\ unique\ users}{amount\ of\ returning\ users}$	Shows that most of the product customers are already existent users [123]	Shows that a lot of the product customers are unique and new users [123]	Google Analytics [88], HubSpot [49]	Bar chart [151] [49]
Customer success	Customer engagement (customer success)	User journey[135], specific pages and functionalities	Time on page	How much time the user spent on the particular page of the product before navigating away [86]	*Amount of the time in minutes/seconds user spend on different pages of the product*	Users do not spend much time on the product [124]	The content of the product is engaging [124]	Google Analytics [74]	

Appendix I. Digital product metrics framework.

Product aspect	Product aspect category	Factors that impact product aspect category	Metric name	Definition	How to measure the metric	When value is low	When value is high	Tools for metric measurement	Visualisation method
	Customer engagement (customer success)	[129], the strength of the customer relationship [138], product market fit [139], seasonality and usage patterns [139].	Sign ups, sign ins	The number of people signing-up for a service compared to a prior time period while sign -ins is the number of people signing-in to the product or service compared to a prior time period [89]	*The number of users sign ups, sign ins per defined period.*	Users sign in or sign up to the product not often [89].	Users sign in or sign up to the product often [89].	HubSpot [49], Mixpanel	
	Customer engagement (customer success)		Product usage	Amount of engagement customers are using the product. These engagements include number of logins, sign ups, amount of time spent using the app, amount of features or add-ons they use, amount of active users [49].	*Number of engagement customers are using the product. Engagement activities should be defined.*	Indicates the problems with the customer satisfaction Threat of the churn [125]. If the product usage is declining to 50% it can mean that it is too late to take action [49]	Users are happy to use the product [125] High engagement	HubSpot[49]	
	Customer engagement (customer success)		Active users	The count of users who used a product within a given timeframe [85]	*Sum of users who used a product within a given timeframe*	The product engagement is low [83]	The product health Indicates the segment of the most active users [83]	HubSpot[49]	

Appendix I. Digital product metrics framework.

Product aspect	Product aspect category	Factors that impact product aspect category	Metric name	Definition	How to measure the metric	When value is low	When value is high	Tools for metric measurement	Visualisation method
	Customer engagement (customer success)		Activation	A number of users taking a specific action to derive value from the product. Users face the moment of activation when they first realize the product value of themselves [95]	*Number of steps user takes to perform value action. Value action should be defined.*	It takes less time for the user to receive product value [127].	It takes more time for the user to receive value from the product [127]	HubSpot[49]	
	Customer engagement (customer success)		Stickiness	The ratio of daily active users and monthly active users forms product stickiness ratio [90].	$\frac{Daily\ active\ users}{Monthly\ active\ users}$	Users are less engaged with the product [126]	Users are more engaged with the product [126]	HubSpot[49]	Linear graph [149]
	Customer engagement (customer success)		Product engagement score	Combines adoption rate, stickiness and growth is product engagement and refers to a measure of how engaged your users or accounts are in a given time frame. It's a model that scores each of your users based on (a) the number of times they do certain things in your product; and (b) the importance of those activities [85].	*Average between adoption, stickiness and growth* [96]	There is a poor active customer relationship and customer engagement improvements are needed [128]	There is a good active customer relationship [128]	HubSpot[49]	Scatter plot, stacked area graph [156] [102] [157]
	Customer engagement (customer success)		Conversion rate	Measurement of user engagement with a particular feature or functionality [92].	*Ration of users who completed to use the feature to those who started to use it.*	Feature experience needs user experience optimization [130]	Feature experience is clear to the user [130].	Google Analytics, Amplitude, HubSpot [85], Mixpanel, ChartMogul	Linear graph [149]

Appendix I. Digital product metrics framework.

Product aspect	Product aspect category	Factors that impact product aspect category	Metric name	Definition	How to measure the metric	When value is low	When value is high	Tools for metric measurement	Visualisation method
	Customer engagement (customer success)		Bounce rate	The percentage of users who visited only one page of the product and left it [92].	*Ration of users that opened only one page of the product and dropped.*	Pleasant and relevant first user experience [129]	Unpleasant or irrelevant user experience [129]	Google Analytics	
	Customer satisfaction (customer success)	User journey [135], product stage [139], choice of evaluation criteria [81], customer onboarding [106], seamless user experience [89], qualitative feedback [128].	Net Promoter score	Measurement on customer satisfaction loyalty by asking the users "How likely are you to recommend [product] to a friend or colleague?". Users are asked to provide rating from 0 to 10 where 10 means that they are likely to recommend the product and 0 means that they are least likely to recommend it [99].	*Users need to provide a rating from 0 till 10 while answering the question "How likely are you to recommend [product] to a friend or colleague*	Customers are not likely to recommend the product 66]	Customers are likely to recommend the product [75]	HubSpot	Scatter plot, stacked area graph [156] [102] [157]
	Customer satisfaction (customer success)		Customer satisfaction score	An individual satisfaction measure of the user interaction with a product. The customer is asked the question: "How would you rate your overall satisfaction with the service you received" [58].	*Ask user to rate your product on 5 point scale by answering "How would you rate your overall satisfaction with the service you received"*	Low customers loyalty and the need to take actions to improve it [128]	High customer loyalty [128]	HubSpot	Scatter plot, stacked area graph [156] [102] [157]

Appendix I. Digital product metrics framework.

Product aspect	Product aspect category	Factors that impact product aspect category	Metric name	Definition	How to measure the metric	When value is low	When value is high	Tools for metric measurement	Visualisation method
	Customer satisfaction (customer success)		Customer health score	Score value to how often a customer uses a software product and how much they rely upon it [94]	*Define the scores for each of the user actions and sum them per user.*	Customers experience frustrations during the product experience 57]	Customer thinks that the product deliver a superior customer experience or the customer [65]	HubSpot	Scatter plot, stacked area graph [156] [102] [157]
	Customer satisfaction (customer success)		Customer effort score	Touchpoint metric that measures usability by checking how easy it was for the user to accomplish their goal [101], for example, a request fulfilled, a product purchased/returned, or a question answered [102]	*Ask users "On a scale from "Very Easy" to "Very Difficult", how was your experience?*	Low customer loyalty and engagement, likeness to churn [49]	High customer loyalty and engagement [49]	HubSpot	Scatter plot, stacked area graph [156] [102] [157]
Product stability	Product stability	Traffic volume, content and amount of images, quality of servers, amount of third party assets [105]	Site speed	How fast the product downloads [104]	*The velocity of the product loading*	The product loads fast and user enjoys the experience [62]	The product loads too slow and there is a thread that the user will churn [62]	Google Analytics [104]	
	Product stability		Load time	Measure of how quickly the site is loading when a visitor requests to see it [105]	*The time it takes to load particular parts of the product*	Product content is available for the users seamlessly [62]	Users can see the product content because it is not loading [62]	Google Analytics	

Appendix I. Digital product metrics framework.

Product aspect	Product aspect category	Factors that impact product aspect category	Metric name	Definition	How to measure the metric	When value is low	When value is high	Tools for metric measurement	Visualisation method
	Product stability		Cost of customer maintenance	The cost of all the engineering, support, account management and customer service as well as billing activities and physical infrastructure [62].	*Sum of the all the costs involved into the maintenance of the product*	The product development strategy is efficient [62]	The product development strategy is not efficient [62]	Google Analytics	
	Product stability		Product downtime	How often the product face outages [105].	*Time in percentage when the product was down*	Users can use the product in most of the times	Users can't use the product often [62]	Google Analytics	

* - refer to the metrics that has to be considered during early adaptor product stage
° - refer to the metrics that are related to subscription-based products only

 - end of the product aspect

 - end of the product aspect category

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