Tampere University of Applied Sciences

How to effectively develop a new data-driven product using an iterative approach

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BACHELOR'S THESIS
November 2020

Bachelor's Degree Programme in International Business

ABSTRACT

Tampereen ammattikorkeakoulu
Tampere University of Applied Sciences
Bachelor's Degree Programme in International Business

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How to effectively develop a new data-driven product using an iterative approach

Bachelor's thesis 50 pages, appendices 4 pages
November 2020

The current research work investigates how to effectively develop a new data-driven product using an iterative approach. For this, the work identifies the most relevant metrics during the product development process, the identified metrics are meant to guide the development direction and provide actionable insights for a better decision making during the different stages and development phases of the product. Besides, this research proposes an agile framework for data-driven product development to support and ensure all threats and opportunities around the development process are properly managed. Given the experimental nature of the research it was carried out following a design science research method and the evaluation was done based on the MESOPS framework for metrics in product development. As a result, it was found that *attractiveness of the offering, degree of similarity among customers, rating for customer's areas of interest, product usability, marketing qualified leads & customer engagement, rating for customer satisfaction and performance rating of the product changes* are the most relevant metrics in the development of a data-driven product. Furthermore, the proposed agile framework consists of an *ideation phase, iteration & testing phase, validation phase* and *post-validation phase*. The framework was designed to consider both the customer and business side of the development process, as well as to facilitate the efficient monitoring of the gradual evolution of the product during the mentioned process.

Key words: product, development, process, metrics, framework, agile

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ABBREVIATIONS AND TERMS

MVP	Minimum Viable Product
SMEs	Small and Medium Enterprises
PD	Product Development
Catapult	Catapult International
DSR	Design Science Research
KPIs	Key Performance Indicators
CTR	Click through rate
CPC	Cost per click
TAMK	Tampere University of Applied Sciences

1 INTRODUCTION

Changing customer needs and dynamic demands require solutions that can react fast enough to adapt to such evolving environments (Shanbhag and Paradede, 2019). Which is why now more than ever companies, especially SMEs, are adopting lean, agile and iterative methods for product development to enable flexibility and allow solutions to evolve along customer's changing needs and demands (Salgado & Dekkers, 2017). However, there is still a lot of discussion regarding the considerations to take into account when developing a new product -specifically using iterative or agile approaches- which suggests there is still room for improvement in terms of indicators and monitoring that ensure a smooth and gradual development process (Schuh, Doelle and Schloesser, 2018). Therefore, the present research work aims to investigate how to effectively develop a data-driven product using an iterative design approach. For this, the research has been conducted as part of a project for the Finnish Company Catapult International since it is currently developing a new data-driven product. The topic under research was covered following the following objectives: **1. To identify which are the most relevant metrics that guide the direction towards a data-driven product should be further developed and 2. To establish an efficient and agile framework for developing data-driven products and make them ready to market.** An emphasis on the adequate metrics leads to a successful development of a product and following a structured and reliable framework boosts efficiency and supports a smooth process development (Croll and Yoskovitz, 2013).

This research work is structured as follows: the first part explains the purpose and objectives and outlines the justification of the research. Part 2 is a state-of-the-art review of product development which lays out and contrasts the most common and updated theories, concepts and views related to the development process of a product. Part 3 explains the underlying methods used in the elaboration of the research and it describes each stage of the product development process end-to-end. This part is followed by the findings and discussions of the results obtained. The conclusions of the research are provided in part 5 and, finally, part

6 contains recommendations and limitation of the results of the research as well as suggestions for future work.

It should be noted that since this research heavily relies on the actual project for Catapult International, and therefore on its schedule, it was limited to the design, iteration and validation process of the product development. However, the research also elaborates on the post-validation phase even when it is not within the scope of the work since up to the moment of finalising the research the new product had not reached the post-validation phase yet (which usually occurs several months or even years after the validation phase).

2 PURPOSE AND OBJECTIVES

This research was conducted for Catapult International (hereafter Catapult), a Finnish company that provides services to help companies in making smart data-driven decisions to achieve an impact on transformation (Catapult, 2020). Currently Catapult is aiming to broaden its offerings and satisfy a more general need within the business development demands of the global market. This arose the necessity of designing a new data-driven product that would match such needs which ultimately will allow Catapult to further expand its service and product line while creating concrete value to its clients.

Even though the basic idea of this new data-driven product seemed to be already established to some extent, there was still some uncertainty with regards of optimal ways to develop it. Therefore, the objective of the thesis was to investigate **how to effectively develop a new data-driven product through an iterative design approach**. It follows a highly empirical approach - given the nature of the research- in order to find out and assess optimal ways to implement an agile product development process. The thesis objective was supported by the following subobjectives:

- **To identify which are the most relevant metrics that guide the direction towards a data-driven product should be further developed.** This to give a more thorough understanding regarding what key performance indicators the development team should look at during the product development process.

- **To establish an efficient and agile framework for developing data-driven products and make them ready to market.** Together with the identified metrics, this provides with a fact-based structure that can be used in future product development processes ensuring all opportunities and threats around it are properly managed.

3 LITERATURE REVIEW

This part of the work describes central concepts and theories related to the process of developing a new product as well as relevant information from previous researches on the topic. Furthermore, it gives a solid background and a concrete landscape of the developments in the field to thoroughly understand the nature of the present research.

3.1 Lean product development

The concept of a lean approach was first derived from practices in Toyota's Production System in the 1990's (Salgado & Dekkers, 2017). Where the company adopted a series of lean principles in their production processes, these principles included a heavy focus on customers, a continuous improvement in quality by waste reduction and an integration of its upstream and downstream processes in its value chain (Liker & Morgan, 2006). Lean principles were later also applied to other fields such as administration, banking, construction, healthcare and product development (Rauch *et al.*, 2016). However, the terminology Lean Product Development (LPD) would still officially appear for the first time in a chapter of the Lean Production book "The machine that Changed the world" in 1991 (Wangwacharakul *et al.*, 2014).

According to Rauch (2016), the definition of Lean Product Development has two orientations: the process-oriented and the outcome-oriented. The first one defines LPD as the application of lean principles on the development process of a product to reduce waste and increase added value. The second, the outcome-oriented definition, describes LPD as a support to the research and development in the improvement of product quality and product functionality. Furthermore, Liker and Morgan (2006) interpret LPD as the approach by which an organization can achieve a continuous improvement through iterations in the manufacturing process, which are meant to eliminate or reduce waste. Similarly, Rauch (2016) agrees that LPD works within the production process where it gathers and gen-

erates ideas, develops and tests potential concepts to ultimately create a successful product which is handled to manufacture. Marodin (2019) builds on that stating that a lean product development approach seeks to increase product quality and added value from the customer side. And seeks to reduce variability in the internal and external processes and to eliminate waste in the production flows.

3.2 Minimum Viable Product

The term Minimum Viable Product (MVP) is widely used in the process of developing a product, such term derives from the Lean Start-up approach and was coined by Frank Robinson in 2001. MVP as a concept was after spread by Eric Ries and Blank from 2009 onwards (Lenarduzzi & Taibi, 2016). Eric Ries (2011) defined MVP as "*a version of a new product which allows a team to collect the maximum amount of validated information or learning about customers with the least effort"*. Posteriorly, building on Ries' definition, Kniberg and Irvarsson described MVP as the product that can be released early and often to validate hypothesis through metrics and A/B testing in order to assess what works and what does not. Similarly, Yli-Hummo stated that the MVP seeks to identify valuable features from the customer view by iteratively experimenting in the market (Lenarduzzi & Taibi, 2016).

It is important to clarify that the minimum viable product (MVP) is actually not a product as it is usually understood. An MVP varies, it can be a prototype, a description, a process or even a slide deck. However, all of these variations have in common a good enough concept that can be understood by investors or customer prospects (Reif, 2017).

3.3 Agile product development

Originally initiated in software development processes, the agile product development concept was adopted to create software more efficiently in terms of time and costs while satisfying customer needs. In this way, Beck *et al.* (2001) in the

agile manifesto introduced several principles for a new approach in software development with a heavy focus on customers. A user-centred approach for customer satisfaction where customers were involved throughout the process. The idea was to provide customers with continuous deliveries of early software versions that would allow the development team to gather feedback and more accurately adjust the product to the customers' needs (Schuh *et al.*, 2018).

The term "agile" in product development is more related to the outcome of the development process. An agile product development approach is used to increase flexibility and improve reaction times when facing dynamic environments. (Zink *et al.*, 2017). A factor that plays an important role in agile product development its is iterative nature which is reflected in the continuous creation and modification of prototypes which are incrementally modified as the development of the product advances. Since products cannot be accurately designed in advance, then it is reasonable to use iterations which allow to tweak, redefine and redesign the products on the way as well as eliminating or reducing uncertainty (Böhmer *et al.*, 2017).

Iterative design approach in agile product development

According to Schuh *et al.* (2017), the dynamic environments where businesses operate nowadays require fast reaction times and increased flexibility so that these businesses can properly cope with the changing requirements of such complex environments. Dou *et al.* (2017) agrees with Schuh and mentions that these changes are not only technology wise but also in the demands of customers. In that sense, Pan *et al.* (2017) states that an efficient way to deal with changing environments is through an iterative design approach where the feedback gathering from users and designers in every iteration is applied in the improvement of the product for the next iteration. This will lead to effectively recognize changes in customer needs and rapidly react to them, and consequently the product development is accelerated, and the life cycle reduced. Similarly, Schuh (2017) emphasizes that for companies to adequately react to dynamic conditions during the development process of a product it is important to carry such development involving the customers. This should be done in a way that customers' specific

demands or requirements can be derived from each iteration and based on these demands implement improvements in the prototype of the next iteration.

Dou *et al.* (2017) argues that an iterative design approach also has to do with the incremental accumulation of knowledge and the efficient utilization of it to fully understand customers' requirements since at the beginning of the development process these requirements are not completely certain. In the same manner, Schuh (2017) explains that during the early stages of product development there is a high level of uncertainty in the market since customers' demands and requirements are not fully identified and are prone to change. Given this, Schuh (2017), Pan (2017) and Diels (2016) indicate that to face the uncertainty a continuous feedback from customers after each iteration is essential to allow the creation of prototypes. These prototypes are used to test and validate the implementations derived from the new customer requirements.

3.4 Prototyping in product development

According to Zink (2017), prototyping is the action of taking design ideas into some form of, usually, physical manifestation. The goal is to assess the landscape where the product is going to perform and identify relevant elements that can contribute towards the final design. Similarly, Schuh *et al.* (2018) described prototypes as a primitive version of the final product which must present a minimum of one feature of the developed design. Furthermore, they add that prototypes can be considered unfinished when compared to the final version since the objective is only to generate findings in a highly efficient manner.

Thomke (2008) identifies two types of prototypes, low and high fidelity. Low fidelity prototypes are often used in the early stage of the development process because these prototypes are low cost and can be implemented in short times to rapidly gather feedback. While high fidelity prototypes are most commonly used towards the last part of the development process to evaluate the proximity to the desired solution and avoid costly risks. Böhmer (2017) agrees with Thomke and states that the expenses for creating a prototype work as an insurance to eliminate or reduce risks in the later stages of the product development. Furthermore,

Zink (2017) and Schuh (2018) indicate that one of the goals of having prototypes is to decrease the level of uncertainty early in the development process which can positively impact the cost and duration of the project.

Based on Brown (2009), Zink (2017) and Schuh (2018), prototypes serve as a testing tool for feasibility, desirability and viability. These correspond to the technology, customer and business perspective of the project respectively.

3.5 The scrum framework

First introduced by Takeuchi *et al.* (1986) in the article *The new product development game,* the term scrum was initially created to describe an approach that brings speed and flexibility in the development of different levels of an organization. According to,Betta *et al.* (2019), the scrum approach was posteriorly formulated by Schwaber and Sutherland in 1995 and it was adapted to deal with dynamic adaptive problems and to develop products with a high value to customers. Schwaber and Sutherland (2017) state that scrum is not a method nor a process and neither a technique, it is rather a framework for product management which helps in the continuous improvement of the development process of a product, the working environment and the team.

Scrum for new product development

Based on Srivastava *et al.* (2017), when it comes to new product development, especially following an agile approach, the workflow of scrum involves the following:

- A product owner; rather familiarized with the product and in charge of maximizing the value to customers.
- A scrum master; eliminates impediments that might arise during the project.
- Scrum team; a transversal team that includes experts of the required different fields for the development of the product.
- Sprint; a small fixed-time box where a team works on a task for 1 up to 3 weeks. Such task comes from a sprint backlog.

- Sprint backlog; information about the requirements and objectives that need to be developed during a sprint.
- Product backlog; requirements of the product set by the product owner.

The scrum approach works by making the sprints deliver a potential product in order to incrementally improve its functionality. The sprint is after reviewed and the potential product assessed, the team reflects on what has been achieved and provide some insights on the goals and requirements for the next sprint (Betta *et al.,* 2019). Srivastava (2017) and Betta (2019) mention that the objectives of each sprint do not change within the sprint time, but the increments obtained from the sprint make up for new requirements that the product owner can add for the next sprint.

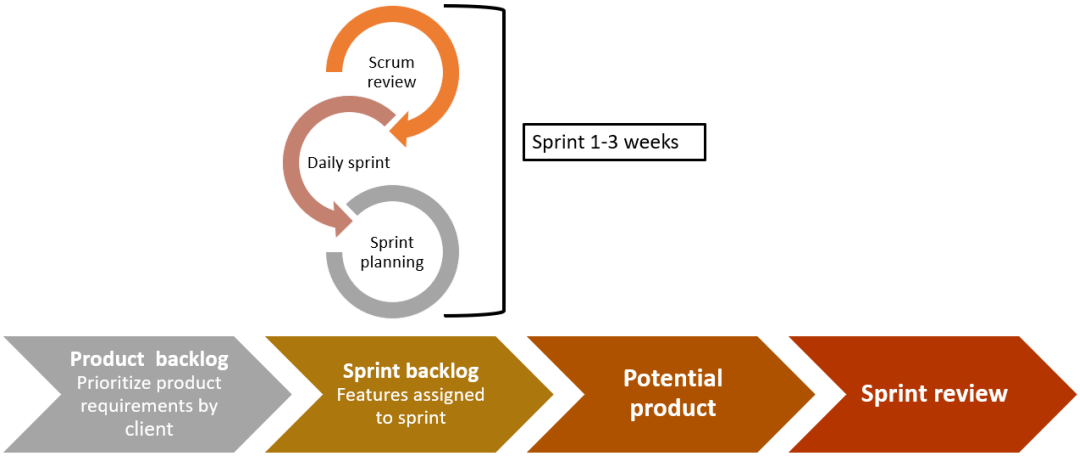

Fig.1. The sprint (*adapted from, Applying Scrum in New Product Development Process, Betta 2019)*

3.6 Metrics in product development: The analytics framework

The analytics framework describes that metrics in product development are defined based on certain aspects. First, the problem the new product is tackling and the proposed solution to that problem (Croll and Yoskovitz, 2013). The reasoning behind this is that the correct understanding of the problem leads to an accurate development of different potential solutions which allows for a broader view of the context and therefore an easier assessment of the best fit for solving the problem. Furthermore, Croll and Yoskovitz (2013) explain that another two important parameters to take into account when defining metrics are virality and scalability.

Virality refers to the number of users the product can potentially acquire and the extent to which these users will promote or recommend the product. Similarly, virality also is derived from the number of features of the product since it is assumed that the user-feature interaction is a driver of virality (Croll and Yoskovitz, 2013). Scalability is related to the potential the product has in order to be sustainable and to drive a constant revenue, in other words, the ability the business model on which the product is based can be repeatable and thus achieve significant growth. Croll and Yoskovitz (2013) indicate that the before mentioned aspects can be represented in a cycle when the development approach involves iterations.

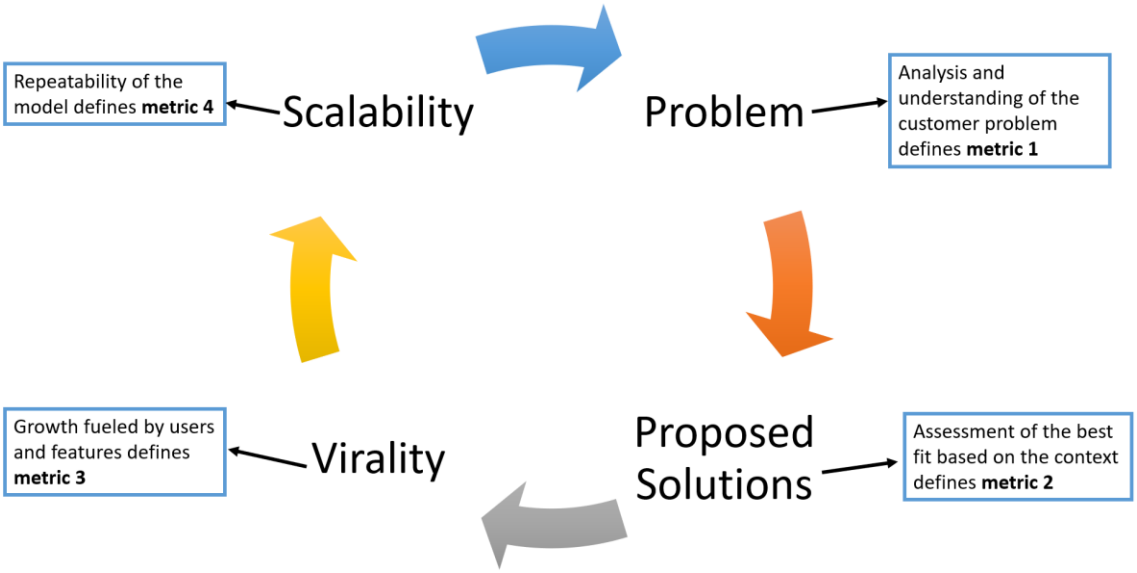

Fig. 2. The analytics framework cycle for defining metrics (*Croll and Yoskovitz, 2013*).

3.7 Metrics in product development: The MESOPS framework

Shanbhag and Pardede (2019) proposed a framework to determine relevant metrics in software product development. This framework provides a structure of six stages or dimensions that consider the most important points in product development which are related to the product central elements.

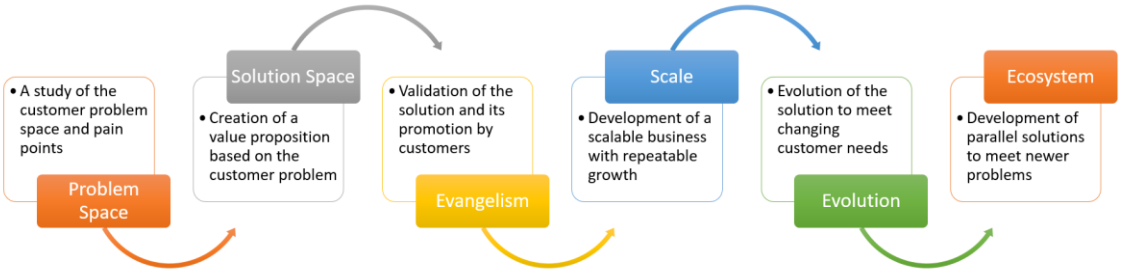

Fig. 3. The MESOPS framework six stages (*Shanbhag and Pardede, 2019*)

As shown in Fig.3, the six stages or dimensions of the MESOPS framework are sequentially established to go according to a product development process. The idea behind this is to gain knowledge and obtain enough relevant information in each stage about the customer's needs since this is rather important for the development of a product (Bajwa, Wang and Abrahamsson, 2017). This information gathering process will help in identifying the main customer's pain points, the context of their problems and their goals, all these will serve as a foundation to determine what metrics correlate the most with the development process of the product as well as the most useful and productive metrics (Shanbhag and Paredede, 2019). Within the MESOPS framework there are specific guidelines for each stage to consider when choosing a metric for the product development process (see Fig. 4.), however; it is worth mentioning that such guidelines are meant for general categorizations and that the metric chosen will depend a lot on the specific nature of the product under development (Shanbhag and Paradede, 2019).

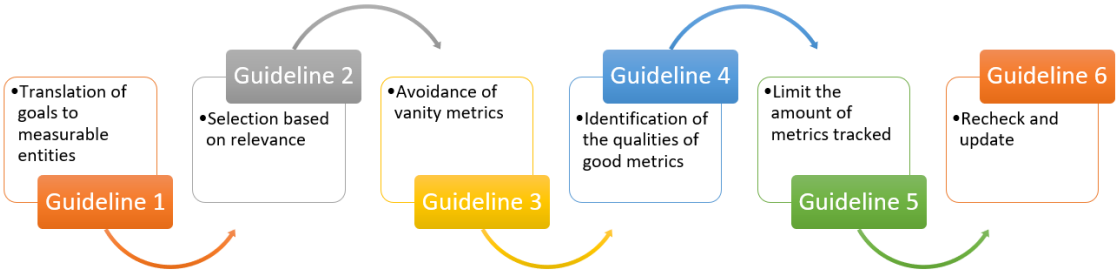

Fig. 4. Guidelines for choosing metrics in product development (*Shanbhag and Pardede, 2019*)

3.8 Design science research method

The design science research method was initially used in the Information Systems field; it goes approximately 50 years back ago when Nunamaker *et al.* (1971) first described *Systems development in Information Systems research* as a research methodology. Similarly, Hevner *et al.* (2004) and Peffers *et al.* (2007) contributed to reinforce such approach as one of the main paradigms in research within the Information Systems and Information Technology disciplines. According to Peffers (2018), it was in 2006 in the International Design Science conference where influential projects following a Design Science Research (DSR) approach were presented and they put a spotlight on DSR, this led DSR to become further used in Information Systems research as well as in other related fields.
The goal of a design science research is to build a new scenario for solving problems instead of describing an existing one (Iivari and Venable, 2009). In a similar way, Horváth (2007) and Baskerville (2015) state that the design science research helps to gain knowledge which is later used in problem solving or solutions creation. Horváth (2007) also mentions that the design science research approach can be broken down into three main phases (1) the exploration of the problem, familiarization of the activities and context and the hypothesis; (2) the iterative design and testing of the potential solution; (3) verification of hypothesis, to validate the research and if possible generalise to other possible scenarios. Pello (2018) indicates that a science design research is heavily focused on the user since it involves the interaction between people and product. Thus, the science design research approach works by finding and taking into account users' needs and perceptions first, and according to that a potential solution is built upon through filtering, iterating, reviewing and retesting ideas until the best possible solution is obtained.

3.9 Catapult International

Catapult International is a Finnish firm based in Helsinki, which helps companies in making smart data-driven decisions to achieve an impact on transformation. This is done by performing data research, analysis and validation of more than

100.000 digital growth companies throughout Europe. Their approach uses technology such as AI, Natural Language Processing, Machine Learning, advanced web crawling and the human factor for the manual validation of data. The company has reached extremely great results and have provided with concrete value to their corporate partners. The firm operates across Europe, having partners who represent the biggest players in various industries - banking, construction, manufacturing, insurance, e-commerce, transportation, mobile, health, living services, and media (Catapult, 2020).

4 METHODOLOGY

Given the rather empirical nature of the present research, the methodology used was based on a Design Science Research (DSR) approach where a combination of concepts and theories related to product development where used. The DSR in this work involves the following:

4.1 Exploration and identification

As mentioned in the objectives and purpose of this research (see 2.), the Finnish company Catapult International is planning on extending its product line by releasing a new data-driven product. According to Catapult (2020), the reason for the desired expansion lies behind an unsatisfied need within the business development growing demands of the global market. Such need appeared as a consequence of the lack of comprehensive but affordable solutions on market researches, specifically in emerging technologies, since most of those researches are meant for large corporations and their prices revolve around 20 000 to 50 000 euros which are high sums of money that small and medium companies cannot afford or that large corporates do not want to commit to (Catapult, 2020). Therefore, Catapult plans to tackle such issue with a new product based on data (data-driven product), meaning that this product will contain all relevant information on emerging technologies in any specific field but based purely on data bases and its respective analysis. And in this way such product will act as a research but the costs of generating it will be rather low when compared to an average market research, allowing the company to price it far below the standard prices for such researches. In addition, Catapult's idea of developing this new "low-cost" product also includes an iterative approach in its development to ensure a fast release of the same (Catapult, 2020).

Having the background information and the context explained, it was possible to identify and define a main research problem in the form of a question: ***how to effectively develop this new data-driven product through an iterative design approach?*** Finding a solution to this problem would be valuable to Catapult since it would involve determining relevant metrics and KPI's in the development of the

product as well as establishing an agile framework for its development. As previously stated, (see 2.) these can be expressed as the following objectives:

- **Subobjective 1: To identify which are the most relevant metrics that guide the direction towards a data-driven product should be further developed.** This to give a more thorough understanding regarding what key performance indicators the development team should look at during the product development process.

- **Subobjective 2: To establish an efficient and agile framework for developing data-driven products and make them ready to market.** Together with the identified metrics, this provides with a fact-based structure that can be used in future product development processes ensuring all opportunities and threats around it are properly managed.

These objectives would ultimately allow the correct assessment of the most optimal ways to implement an agile product development process, ensuring in this manner the fast release of the product.

4.2 Design and development

For the design and development of the new data-driven product the development team of Catapult followed the MVP concept developed by Ries (2011) that involves the collection of all the relevant customer information with the least effort. Therefore, first it was gathered as much available information as possible about the customers from Catapult's customers data base. The information obtained was analysed by the development team to build a preliminary sketch of the value proposition (appendix 1.), which was posteriorly used to create a customer profile that displays the gains, pains and the jobs the new product would tackle (see table 1.). This helped determining in a broad perspective that what Catapult customers look for is reliable information to support decision making in business development.

It is worth mentioning that the customer profiling process also took into account the demographics of Catapult's website visitors from May 2019 to May 2020, in terms of top industries and top job functions (appendix 2.), in order to have a more accurate representation of the target audience the product was meant to address.

Table 1. Customer profile: Gains, Pains and Jobs

Customer		
Gains	Pains	Jobs
• Getting the needed information without second-guessing • Making decisions while being able to trust the information • Having a neutral party to assess the information • Understanding the market and being able to further communicate it. • Finding new relevant information that was not thought of before.	• Manual research work is time consuming • Comprehensive research work is expensive • Not being research experts • Not knowing whether the information is reliable • Not knowing which information is relevant • Information databases are expensive	• Business development • Finding new opportunities • Strategical decision making • Understanding and sharing core information inside the company • Understanding the market • Understanding the competition • Investment and M&A decision making

With the customer profile constructed in terms of *gains*, *pains* and *jobs*, the current offering of the company was laid out in similar terms including *gain creators*, *pain relievers* and *products & services* (see table 2. next page).

Table 2. Current product offering profile

Product Offering		
Gains creators	Pain relievers	Products & Services
• Combining multiple reliable data sources in the research process • Providing the necessary but relevant information in an understandable fashion and format.	• Cost-saving, the offering is a cheaper option for companies when compared to doing the same work in-house • Reliability, data-driven approach + expertise + thorough evaluation of data and data sources. • Providing visibility in trending topics of emerging techs with high understanding and detail. • Bringing variety and broadening the understanding outside domain-level expertise	• Small test research • Tech partner research • Tech investments research • Tech solution research • Tech market research

Having the profile of the current offering and contrasting it with the customer profile helped in better reflecting how the new product could relate and address the customer demands and needs, which posteriorly also allowed to better shape the new product offering as well as the added value it would generate to customers.

As before mentioned, both the customer profile and the current product offering profile served as a useful resource upon which the added value of the new product was established, to some extent. This was described as *a thorough understanding of the ecosystem of emerging technologies in a specific field supported by reliable data and a data-driven approach.* Furthermore, based on the profiles built and the type of data bases Catapult uses, the metrics to be displayed as a part of the new product were also determined:

- **Technology metrics;** number of patents, number of academic studies, word cloud of recurring keywords on the field of interest, technology areas with most development.
- **Industrial metrics;** amount of invested money per Venture Capital Stage, amount of grants, Merger & Acquisitions or other type of capital than Venture, number of partnerships and clients.
- **Investment and company activity metrics;** most active investor entities, amount of money spent on R&D, amount of new companies per year, most

active entrepreneurs, total deals per investor, deal count break down by technologies and deal count break down by verticals.

With the background work done and taking into consideration profiles, metrics and added value, the first version of the design of the new data driven product was drafted to achieve the minimum viable product (see fig4.). And using Reif's take (2017) on MVP, the development and design of this first version or prototype aimed to display good enough the product concept so it could be understood by investors or customer prospects. The MVP is also used later following an iterative approach to gather relevant feedback from clients to further refine and guide the direction of development of the new product.

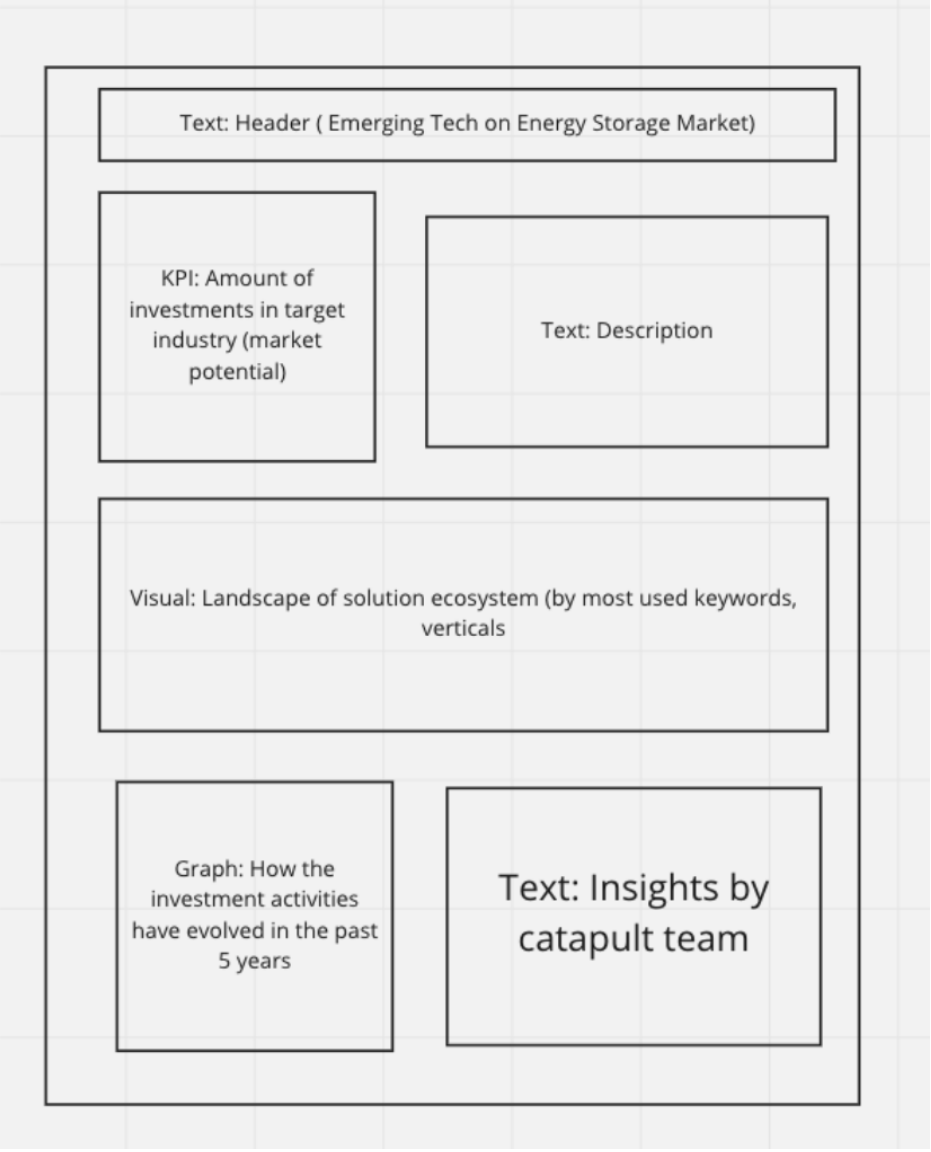

Fig. 4. MVP as a first version of the new data-driven product *(Catapult's Research Team, 2020)*

4.3 Testing and iteration

The testing and iteration of the first version of the product was done, as Schuh (2017) and Pan *et al.* (2017) state, to identify changes in customer needs and be able to quickly react to them which ultimately speeds up the product development process. According to Dou *et al.* (2017), the testing and iterative approach in a product development process has to be done with a continuous involvement of the customers in each iteration in order to keep accumulating knowledge about their demands and be able to afterwards properly validate them. Therefore, the development team, considering the time constraints and resources availability, established a minimum of three tests and iterations which were designed in the following way:

Cold e-mail test & iteration: Because of the easy access to contact information of relevant people working in the business development field from Catapult's customer data base, cold e-mails were deemed an option to evaluate their interest in Catapult's new product. Therefore, this test was designed to assess the open rates of an e-mail containing the first prototype of the product and to receive any sort of feedback about it. The test covered areas where Catapult has most of its customers, i.e. the Nordics, Germany, Spain, Portugal, Central EU and the UK (see table 3.)

Table 3. Cold e-mail data from test 1.

Geographical - Titles	Sent	Opened	Clicked	Replied	Opted-out	Bounced
Nordics, Germany, Spain, Portugal – All titles	455	171	45	33	16	144
Nordics, Germany, Spain, Portugal – Business	178	45	6	8	4	101
Nordics, Germany, Spain, Portugal – Product	129	18	3	2	3	46
Central EU & UK – All titles	1373	406	119	39	29	331
Central EU & UK –Business	747	163	33	6	12	296
Central EU & UK – Product	326	76	14	3	10	65
TOTAL	3208	879	220	91	74	983

From the amount of e-mails sent out, 39.5% were opened which validated that the needs upon the first prototype was built were accurate to some extent. How-

ever, it was not possible to gather extensive or concrete feedback about the content of the product and how relevant such content was for the target audience since the cold e-mail approach does not provide enough space to engage in further discussions around the product. Therefore, the development team decided to tweak a bit the content and make it more thought-provoking to get prospects to start a conversation or provide feedback of some sort. And as a result, it was obtained the second version or prototype of the product.

Videocall interview test & iteration: With the second prototype and considering the before mentioned findings from the first testing and iteration, the development team agreed on using a more engaging test for the second iteration which was a videocall interview with Catapult's customers which are relevant and active players in the business development field. The goal of this type of test was to collect comprehensive information about specific interest areas, technological trends and business development related KPI's customers value the most. This was done through a video call interview where the prototype was introduced to the customers and they were asked to rank certain aspects of the content according to their needs and interests (See appendix 2. for questionnaire).

Table 4. Major take outs from the second test & iteration

Major take outs		
Identified needs	Technologies	Data points for next test & iteration
• To be and stay current/ relevant • To stay competent • To understand the state of the industry • To make right decisions • To prioritise efficiently • To choose the right targets to use or to invest • To use time wisely	• New and active verticals • Where the field is going to go? • What are the competitors doing? • How to take data found into use? • What are the most critical areas? • What actually is the state of the technology found? • Where can I get the information fast?	• Technology vertical activity: What's happening, where, what is relevant? • Vertical Investments: Is this actually used somewhere? how much? is it hype or something concrete? • Emerging tech: What awaits in the future? • Start-up technologies: What is next? what is hot now? • Active investors: Who else is doing this? What are the bigger companies doing?

The feedback and information gathered from the interview test was valuable since it helped to identify the existing common areas of interest in the business development field. It is important to point out that even though such common areas can vary from customer to customer and are context dependant, the information obtained still provided a more clear landscape of the changing customer needs as well as specific areas towards the product development had to be directed.

Catapult's development team continued to further shape the content of the product according to the insights obtained from previous tests and iterations. To do this, the team agreed on developing the content of the product on a specific topic, Artificial Intelligence and Machine Learning. This topic was chosen since at least 50% of Catapult's customer base are closely related to the Information Technology field (Catapult, 2020). Besides, according to Gartner's report of Hype Cycle for Emerging Technologies (2020) artificial intelligence has been peaking for around 10 years already, thus, making it a very trendy topic among other industries than IT.

The content development of the new product at this point consisted of the elaboration of tables, scatter plots and infographics based on data to display all the relevant information and reflect better the industry and technology verticals corresponding to the AI&ML topic. The emerging and fast-growing verticals were identified by analysing the historical data, more precisely the developments of each vertical in two time periods. The first period being between 2005-2014 and the latter one focusing on more recent developments from 2015 up to the second quarter of 2020. The two key determining measures in obtaining the trends of emerging verticals were the number of investment deals generated by companies and the magnitude of investments. With this it was possible to easily identify the most outstanding verticals, for example Autonomous Cars, Fintech, CyberSecurity, Advanced Manufacturing, Internet of Things, etc. Naturally, the inclusion of this information was done taking into consideration those areas of interests previously pointed by customers during past iterations (see table 5.) which resulted in the prototype 3 of the product.

Table 5. Content development focus after second test & iteration

Areas of interest	1st priority data	2nd priority data
Market data	Technology verticals • Totally new verticals • Trending verticals	Venture capital trends
Startup data	Emerging technologies • Totally new verticals	Investment trends
Industry specific KPI's	Active investors in the field Most active technology verticals	Amount of related patents Venture capital investments/year

Experts interview/ test & iteration: With the third version of the new product ready Catapult's development team decided on testing such version with a different audience to gather a more technical and domain-specific feedback, therefore the team reached out to industry experts and the company advisors. The way this test and iteration was performed involved a focus group where the third prototype was introduced, and participants were asked to point out the customer's areas of interest that were not clear or that could be further improved.

Therefore, based on the feedback collected from the industry experts and company advisors, three main areas in the content of the new version of the product were identified to be improved: Market maturity, vertical investments and emerging and grow verticals (See table 6 on the next page). Most of the aspects that need improvement within these three areas were related to increasing the level of detail of the data provided to the customers as well as to incorporating more descriptive information regarding the cases and graphics displayed in the product.

Table 6. Major take outs from the third test & iteration

Major take outs		
Market maturity	Vertical Investments	Emerging and grow verticals

• To define more in detail whether this is going to be an analysis of a well-defined market with clear direction and technologies that are already adapted and bringing value or a more future speculative, predicting and introducing analysis of aspects related to start-up activity, emerging techs and so on.	• To add yearly trends of the vertical investments and distribution of investment activities
	• To give more detail in terms of:
	  • How many deals occurred?
	  • Where does the money go?
	  • What verticals lost momentum?
		• To incorporate verticals that outperform the others
		• To add descriptive examples of such verticals

Furthermore, as part of the focus group, an expert user experience designer was also involved who was asked to provide insights on the overall visual design of the product (See table 7). This to find out ways to improve the interaction quality between the new product and the future users.

Table 7. Major take outs from the UX expert

Major take outs	
Avoid noise	Wording
• Reduce the amount of information or data to support one point. Only share the information that significantly contributes to what you are claiming. Too many details **at once** confuse the users.	• Titles are important, the most valuable information is the title because that is the first thing users notice. The **title should reinforce the data's point.** For instance: **instead of "statistics" prefer "campaign awareness" or even "campaign awareness is increasing".**
• Simplify slides, remove the data that does not back up what you are trying to convey. **Extra information increases noise.**	• Highlight your data's main point by writing it on the slide as a bullet point**. Keep the content short and try to write it as simple as possible.** If possible, highlight that point on any chart displayed along.

4.4 Validation

After the last test and iteration of the new product, Catapult's product development team tweaked the prototype making sure all the feedback previously obtained was carefully considered and included in the product development. Up to this point, such feedback and relevant insights- from the different audiences that were involved in the development process- helped in the overall design of the new product as well as in the elaboration of a rather concrete and comprehensive content. The next step, thus, consisted in the validation of the product to make sure it will succeed when released in the market (Holstein, 2019). The approach taken was based on a social media marketing campaign with the specific goal of promoting the new product to afterward analyse its acceptance or engagement (Keegan and Rowley, 2017). It is important to mention that at this point no efforts were put in selling the product nor it was expected that the campaign would produce any sale or generate leads yet. The campaign was done through Google Ads and Catapult's LinkedIn (see appendix 4.), the target audience for both channels was very specific and heavily focused on the business development field. Based on the results of the campaign it was built the following table:

Table 8. Aggregated result of the marketing campaign (Google Ads + LinkedIn)

Ad group	Status	Ad type	Clicks	Impressions	CTR	Cost	Avg. CPC
Partners & Direct	Ended	Display	919	10 935	8.4%	€63.04	€0.07

According to the marketing campaign's results, it generated a fair amount of impressions and a decent number of clicks which shows that the engagement of the new product is rather positive. When the engagement of a product has a positive trend from the intended users, it reflects that it has been well received and accepted (Holstein, 2019). Even though the results of the campaign show validation of the product to some extent, this has to be taken with a grain of salt and in an ideal scenario it should be further validated. However, given the nature of the project and considering it a pilot that will continue to be developed, for the purpose of this research this validation step was enough to complete the development process of the product.

5 FINDINGS AND DISCUSSION

In order to identify which metrics are the most relevant it was necessary to first determine the different possible metrics involved in the development process of the new product. This was done based on the MESOPS framework since it provides a broader and holistic view of the whole development process when compared to the Analytics framework (Shanbhag and Pardede, 2019). The MESOPS framework, as opposed to the Analytics framework, considers every stage of the product development from the identification of the problem to the validation stage which means that it accounts for all the changes the product undergoes, allowing the generation of a complete metrics ecosystem that facilitates the effective monitoring of the entire product development process (Shanbhag and Pardede, 2019).

5.1 Metrics and indicators in the product development process

According to the MESOPS framework, when determining metrics in the PD process, six stages should be considered: Problem space, solution space, evangelism, scale, evolution and ecosystem (Shanbhag and Pardede, 2019).

Problem space: In this stage the objective is to study and identify the existing problem as well as how customers are affected by it. **From the development process of the new product it was found the following:**

Table 9. Problem space, usage and metrics

MESOPS Central elements	Nature of Usage (Metric use case)	Example Metrics (Based on MESOPS elements)
Problem Space	• Analyzing the current demands in the business development field in terms of research market offerings to identify any gaps where needs are not being satisfied. • Assessing ways to bridge existing gaps in the business development field.	• Availability of current options for market researches, their scope and target audience. • Demands and needs that current options cannot satisfy. Most common demands among customers. • Degree of similarity among customers. Profile of customers that cannot afford current options but with unsatisfied needs.

Solution space: This stage aims to build a potential value proposition for the identified problem making sure the customers' pain points are fully covered and customers' needs completely satisfied**. In this stage was found the following:**

Table 10. Solution space, usage and metrics.

MESOPS Central elements	Nature of Usage (Metric use case)	Example Metrics (Based on MESOPS elements)
Solution Space	• The idea of a new and affordable product as an alternative for costly market researches. • The concept of a data-driven approach, which allows to provide with relevant insights to customers in a fast and reliable way while keeping costs lower compared to standard market researches. • A design that ensures the information provided is easy to understand while keeping the product-customer interaction meaningful and valuable.	• Attractiveness of the offering • Competition in terms of price comparison with other solutions • Availability of data sources

Evangelism: This stage comprises the feedback gathering process from customers and expert advisors as well as the testing and iteration process to shape the product based on the obtained feedback. This is followed by the validation of the product involving the promotion of the same, the goal is to satisfy customers which are expected to further promote the product when they benefit from the value offered by the solution. **During this stage the following was found** (see table 11 on next page)**:**

Table 11. Evangelism, usage and metrics.

MESOPS Central elements	Nature of Usage (Metric use case)	Example Metrics (Based on MESOPS elements)
Evangelism	• To assess and identify those specific areas and trends that are most valuable for the customer. • To find out the most relevant indicators for each of customer areas of interest . • To explore aspects on the product design that efficiently keeps the information flow from beginning to end. • To quickly validate that the new product effectively tackles the identified problem.	• Rating for customer's areas of interest • Rating for the relevance of information within areas of interest • Product usability rating • Marketing qualified leads and customer engagement from marketing campaigns

Scale: The objective of this stage is to take the validated solution and start building on top of it a business model that will allow scalability. This means, taking the product idea and making it perform in a larger scope with more resources where it can generate constant economic growth.

Evolution: In this stage a review to the customer's problems is done in order to identify possible changes in their needs and adapt the product in a way that can satisfy those new needs.

Ecosystem: This is the last stage of the framework which focuses on the exploration of opportunities in new areas that can be built based on the current solution, like for example vertical integration. In other words, the idea is to reach a point where a new problem is identified, and the new solution for such problem is built around the current one and then the whole MESOPS process can be repeated.

From the Scale, Evolution and Ecosystem stages, the following was identified:

Table 12. Scale, evolution and ecosystem; usage and metrics.

MESOPS Central elements	Nature of Usage (Metric use case)	Example Metrics (Based on MESOPS elements)
Scale	• To build a repeatable business model based on the product that can produce constant growth and revenue in a bigger scale.	• Resources availability (Time, costs, workforce) • Sales performance (Prospects, leads, deals)
Evolution	• Review of customer problems • To apply modifications on the product based on the customer needs and demands that have changed.	• Rating for customer satisfaction • Performance rating of the changes made to the product
Ecosystem	• Exploration of growth opportunities in different/newer areas but around and related to the current solution.	• To be evaluated based on MESOPS framework

It is worth mentioning that for the three last stages the determined metrics were identified in a general perspective since -as previously stated- these stages correspond to phases of the development of the product that usually occur months or years after the validation of the new product and at the moment this study was done the development of the product did not reach those phases yet.

Most relevant metrics and indicators

Having determined in a holistic way the metrics in the whole product development process and based on McKinsey & Company's report "Taking the measure of product development" (2018), the metrics were classified in two groups: Product-related and customer-related metrics (See table 12.) From this classification it was possible **to identify and select the most important metrics and indicators**. Which, according to Driva, Pawar & Menon (1999) and Al-Ashaab *et al.* (2016), are the ones that provide the most accurate insights in the different stages of development process while allowing to keep track their performance and outputs. This is also agreed by Croll and Yoskovitz (2013) that argue that the metrics with major relevance in a project tend to have qualities that allow translating the solution objectives into measurable and actionable insights.

Table 13. Classification of identified metrics

Product-related metrics	Customer-related metrics
• Availability of current alternatives for market researches • Attractiveness of the • Competition price comparison • Availability of data sources • Rating for the relevance of information within areas of interest • Product-related resources availability • Product-related sales performance • Performance rating of the changes made to the product	• Customer's demands and needs current options cannot satisfy • Customer profiling, degree of similarity among potential customers. • Rating for customer's areas of interest • Product usability • Marketing qualified leads and customer engagement • Rating for customer satisfaction

Degree of similarity among potential customers: This metrics measures how similar customers seeking the company's offering are, in terms of their needs, pains and gains. The information from this indicator is used to group customers based on the similarity of their demands and from that elaborate accurate profiles of potential customers. This with the objective of having a better perspective of the diversity in customer's needs to easily assess how the proposed solution could satisfy such needs while providing extra value. Therefore, this is central during the early phases of the product ideation since it provides fundamental information for the successful development of the product, which -as stated by Shanbhag and Pardede (2019)- is a characteristic of good and relevant metrics.

Attractiveness of the offering: This metric indicates how attractive the proposed solution is to potential customers. The information from this metric is used to evaluate whether the proposed solution has market potential as well as to predict and forecast market size and potential growth. Furthermore, this metric goes hand in hand with the metric for the degree of similarity among customers, allowing for a more concrete perspective of the product's target audience. Therefore, the mentioned metric is also rather important during the early stages of the product development due to the nature of the insights it provides since it reduces uncertainty at the beginning of the product development (McKinsey & Company, 2018).

Rating for customer's areas of interest: This metric has its role in the iteration phase of the development of the product and its goal is to measure which areas, product-related, are more relevant to the customer. This is important since it will give a better understanding of the aspects that should be prioritized in the development of the product, in this particular case content-wise, and in that way further shape the product considering the customer's interests and requirements. This metric is considered relevant because it focuses on the customer's needs making the constant involvement of customers in the development of the product more productive, which Mckinsey & Company (2018) and Shanbhag & Pardede (2019) deem as another important quality of a good metric.

Product usability rating: This metric also acts in the iteration phase of the product development but instead of focusing on the customer's need it emphasizes the product-customer interaction aspect of the development. The objective of this metric is to indicate how easy the interface design of the product and whether such design facilitates the product to achieve its goal, in this case the communication of information. This metric is important because it allows to track the product design progress and helps evaluate the readiness of the product before validation, which are essential steps in the product development. Besides, it gives the process understandable and comparable information that translates into actionable insights, which according to Croll & Yoskovitz (2013) and Shanbhag & Pardede (2019) are fundamental traits in good metrics.

Marketing qualified leads and customer engagement: These metrics are used in the validation phase of the development process. The goal is to measure the validity of the new product, in this case by assessing the results of the marketing campaign in terms of the leads generated and the customer interactions on the company's social media. Validation metrics are necessary to gain a better perspective and verify that the new product is functional and inviting for the customers and that it will fulfil its function by satisfying the customer's needs. From this, it can be decided whether there are more adjustments to be done or how to proceed to effectively bring the new product to market. Providing substantial value to the development process and helping translate insights into actions, like these

metrics do, are important qualities that have to be present in good metrics (Croll & Yoskovitz, 2013; Mckinsey & Company, 2018).

Relevant metrics post-validation

As mentioned before, the post-validation phase is a phase that the current study does not cover since the actual product has not reached those stages yet. However, based on the previously mentioned findings and according to the literature revised, the followings are considered relevant metrics for the post-validation phase of the product development.

Rating for customer satisfaction: This metric is used once the product has been in the market for some time and customers have had the change to use and interact with it. The metric aims to measure how happy and satisfied customers are with the product. And its objective is to obtain information about whether the product is tackling customer's pains and whether there have been changes in the customer's needs. This is done in order to further improve the offering if needed and in that way provide with better value to the customers.

Performance rating of changes done to the product: This metric goes hand in hand with the previous one, if changes were done to the product then it is used to monitor whether such changes are performing properly and satisfying the customer's needs.

All the before mentioned **metrics** were found **relevant** because they allow to **track the trend and evolution of the product development in each of its phases** which is fundamental for the decision making and it provides with actionable insights that further guide the direction to follow during the development process. Furthermore, those metrics help understanding the behaviour of development process from end to end in a systemic way, including the customer involvement, which plays an important role especially when using an iterative approach. However, it is important to point out that the metrics selected in this study are context dependant, meaning that they have been chosen based on the particular aspects that influence this project and that they can vary in other context where

external factors and other limitations are different from the ones covered in this study.

5.2 Establishing an agile development framework

After following an iterative approach for the development process of a new data-driven product and identifying the most relevant metrics to track and monitor its evolution end-to-end, it was found that an agile development can be structured in four phases: ideation phase, iteration phase, validation phase and further developments phase. All of them incorporating iterative elements and continuous feedback from customers and expert advisors(Schuh *et al.*, 2017; Dou *et al.*, 2017; Pan *et al.,* 2017), From this, it was built a framework for agile development (see figure 5) with the goal of quickly and effectively build a product in small increments, evaluate it, refine it and repeat. It is important to bear in mind that to start with the ideation phase, the framework requires previous research around the customer's pains and gains as well as a solid value proposition of the solution to be developed, this is usually done during the exploration and identification of the problem stage. However, it is worth pointing out that this framework is rather flexible and can be changed according the contextual particularities of the project where it will be applied.

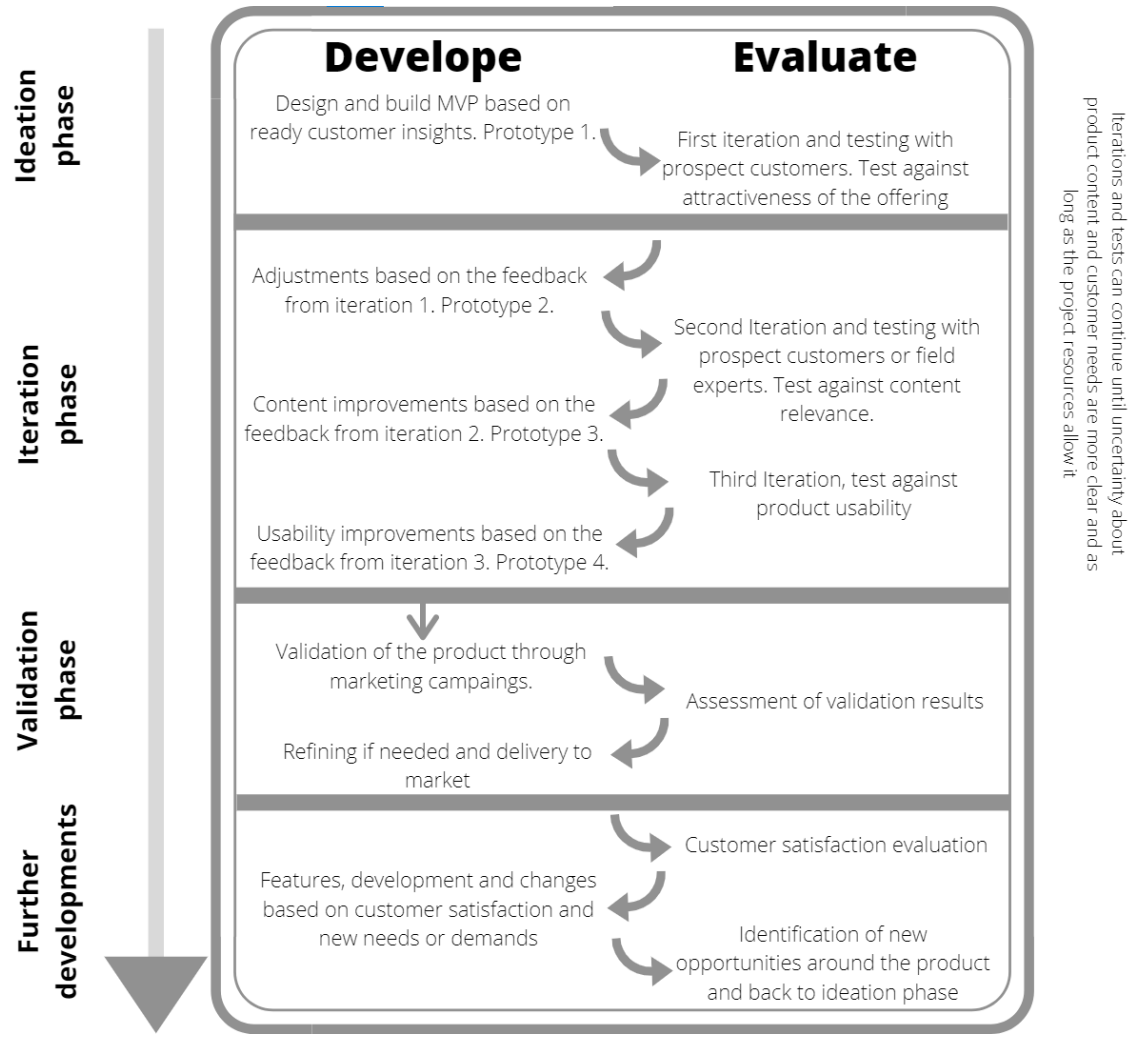

Figure 5. A framework for agile product development

6 CONCLUSION

As presented in the subobjectives 1 and 2 of this research work, the expected results were **to find out relevant metrics and to establish an agile framework to effectively develop a new data-driven product through an iterative approach.** In that sense, the current research provides with a reasonable framework for agile development that allows for the monitoring of the whole process using relevant metrics and KPIs. Similarly, it was determined that the relevant metrics and KPIs are the ones that provide measurable and actionable insights about the process, thus, facilitating the decision making that guides the direction of the process development as well as enabling a constant tracking of the full evolution of the product or solution.

The established framework for agile process development consists of the exploration and identification of the problem stage and 4 development phases: Ideation phase, iteration and testing phase, validation phase and post-validation or further development phase. During the identification of the problem and exploration stage the idea is, once the problem is recognized, to gather as much information as possible about the potential customers taking into account their needs and problems and how the problem can tackle them. It was determined that a relevant key performance indicator in this stage is the *degree of similarity among potential customers*, this leads to the generation of customer profiles that show the diversity in customer's needs which is used to analyse optimal ways for the proposed solution to satisfy customer demands while adding extra value. Next, the development phases start with the ideation phase, where based on the information gathered in the exploration stage the proposed solution is designed in form of an MVP. During this phase, the research concluded that the use of the metric *attractiveness of the offering* as a measurement and monitoring tool for the market potential of the solution is key because it plays an important role in understanding and forecasting the solution's target audience in the early phases of the process development .

For the iteration and testing phase there is an active involvement of the customer and the proposed solution is continuously modified based on the customer's feedback. Therefore, it was concluded that during this phase both metrics *a rating for the customer's areas of interest* and *a product usability rating* are relevant and influential to keep track the effective development of the product. The rating for the customer's areas of interests is used to develop the product prioritising those aspects most valued by the customers and in that way accurately matching their needs. In the same way, the product usability rating is meant to evaluate how good and straight forward is the customer-product interaction which is crucial to consider since this is what ensures that the information provided by the product is properly received and understood by the target audience.

The validation phase is the last part of the actual development of the product in which, regardless of the method chosen, the product has to demonstrate it successfully fulfils the expectations of the interested parties. This a fundamental phase in the development process since it determines whether the solution developed is ready to market and capable of delivering quality value to customers. And in order to measure this, it is necessary to have a validation metric; therefore, it was concluded that a validation metric is of great relevance during the development process. As shown in the research, a marketing campaign was used, this was done on the different social media channels and platforms of the company, and the metric used was *the number of marketing qualified leads and customer engagement*. The objective was to capture information about customer interaction and lead generation produced by the marketing campaign since such information gives a broader view about whether the product fits the customer needs and facilitates the assessment of the product validation.

For the post-validation or further development phase, even though this research did not thoroughly touch those points, it would suggest that *rating for customer satisfaction* and p*erformance rating of changes done to the product* are the most relevant metrics in such phase. This is because, based on the same reasoning used to find the most relevant metrics in the development phase, the post-validation metrics play an important role in keeping track of the gradual evolution of the

product after its validation, whether it be adjusting the product according to customer's changing needs or building a solution derived from the original product that tackles new needs.

7 RECOMMENDATIONS

In the context of the development of a data-driven product through an iterative approach it is suggested that the metrics found in the current research work should be use in a general manner, meaning that they can be changed or adjusted according to the specificity and context of the project as long as such metrics perform in a similar way and accomplish the same goal as the ones described in this research.

Regarding the proposed agile framework for product development, it is recommended to utilize it more as a playbook rather than a fixed process. This means that such framework is flexible and can be adapted based on the team's and business' goals. In addition, it is suggested to bear in mind the feedback quality this framework has since it provides with relevant insights from the human component (customers and experts) of the development process, which is central in an iterative and agile development approach.

It is also recommended that the metrics that were determined as relevant for the post-validation phase are contrasted to prove whether they are effective for monitoring and providing actionable insights during the mentioned phase of the product, this because as previously mentioned the scope of the current research work did not delve into the post-validation part of the process development.

Furthermore, it is suggested to replicate this work using more iterations during the development process as it would increase the number of existing metrics and therefore it could potentially provide with other relevant metrics that can be helpful in the overall development monitoring. Similarly, it should be noted that the project for the company is still on going and for the purpose of this research work the first stage of the product development has concluded with the validation, however; the pilot will be still further validated and developed.

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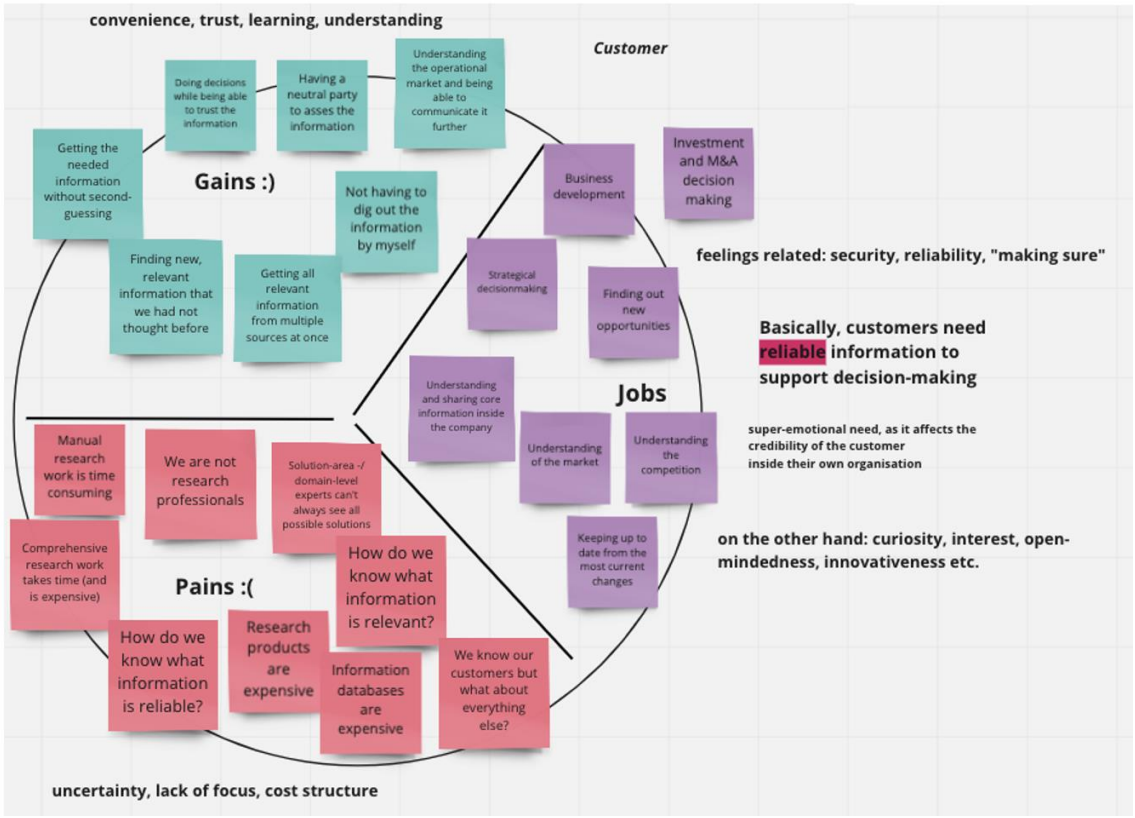
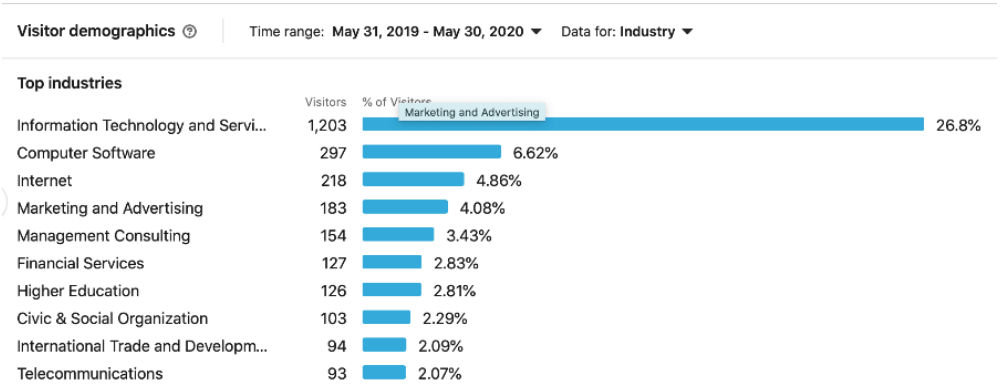
APPENDICES

Appendix 1. Value proposition design process, preliminary sketch

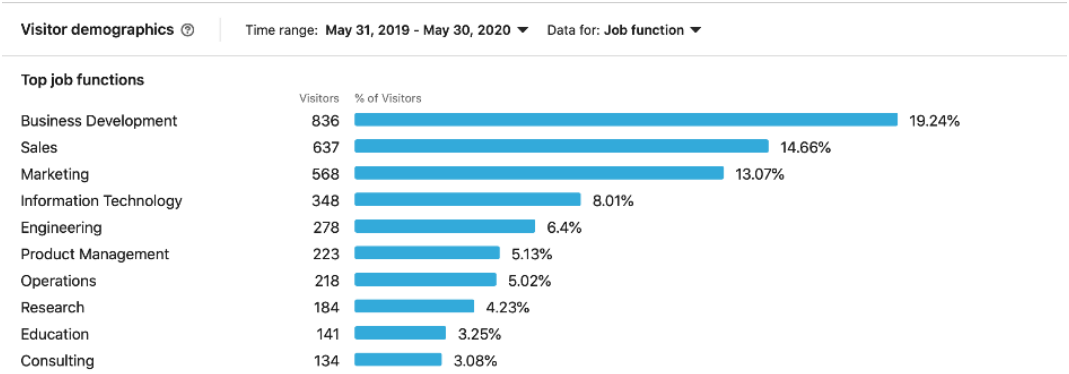


Appendix 2. Catapult International website's visitor demographics from May 2019 to May 2020.

Visitor demographics by top industries



Visitor demographics by top job functions



Appendix 3. Videocall interview questionnaire used in the second testing and iteration

Background questions:

a) What is your role and mission in your organisation?
b) Why does your organisation need research?
c) What is the type of decision making will research support?
d) What is the biggest obstacle in your or your organisation's work right now?

Content aspects to be ranked

a) **Geographical interest areas:** The interviewee had to rank the following areas according his business development interests.
    1. Europe
    2. North America
    3. Europe & North America
    4. Other specific countries or smaller areas.
b) **General market trends:** The interviewee had to rank the following types of information according his business development interests.
    1. General market information
    2. Investment activity information
    3. Technology information
c) **Start-up and venture capital trends:** The interviewee had to rank the following trends according his business development interests.
    1. Start-up trends
    2. Venture capital investment trends
    3. Emerging technology verticals and trends
d) **Market, start-up and technology related KPI's**
    1. Investment amounts per technology verticals
    2. Most active technology verticals
    3. Active investors in the field
    4. Venture capital investments done per year
    5. Public funding grants
    6. Amount of related patents
    7. Investment stages of start-ups
    8. Investments done per year
    9. Companies founded per year

Appendix 4. Marketing campaign results

Google Ads marketing campaign

Ad	Ad group	Status	Ad type	↓ Clicks	Impr.	CTR	Avg. CPC	Cost
	Partners & direct	Campaign ended	Image ad	656	194,300	0.34%	€0.07	€44.16
	Partners & direct	Campaign ended	Image ad	69	12,776	0.54%	€0.07	€5.05
	Partners & direct	Campaign ended	Image ad	65	10,686	0.61%	€0.07	€4.31
	Partners & direct	Campaign ended	Image ad	52	11,595	0.45%	€0.07	€3.66

LinkedIn Marketing campaign

Ad	Ad group	Status	Ad type	↓ Clicks	Impr.	CTR	Avg. CPC	Cost
	Partners & direct	Campaign ended	Image ad	28	11,014	0.25%	€0.08	€2.22
	Partners & direct	Campaign ended	Image ad	12	3,853	0.31%	€0.07	€0.86
	Partners & direct	Campaign ended	Image ad	11	3,464	0.32%	€0.07	€0.76
	Partners & direct	Campaign ended	Image ad	9	3,396	0.27%	€0.08	€0.68
	Partners & direct	Campaign ended	Image ad	6	3,571	0.17%	€0.10	€0.59