



Bridging the gap between financial institutions and Product Service Systems to foster the Circular Economy transition in the Netherlands

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Preface

Throughout the Sustainable Development master, I listened many times to successful cases of sustainable businesses. Looking for a way to grasp what the path to becoming a sustainable business meant, I stumbled upon the concept of the circular economy.

After reading the book by Kate Raworth, *Doughnut Economics: Seven Ways to Think Like a 21st-Century Economist* (2017) I decided to take on the Circular Economy course taught by Ernst Worrell. Thanks to this course I understood that the Circular Economy offered very concrete guidelines and pathways to reach sustainability in businesses with a clarity I had not encountered before.

The opportunity to analyze barriers to the transition to a CE through Product-as-a-Service has opened my understanding to how systemic this transition is and how so many stakeholders need to come together to make this transition a reality.

Throughout the sea of literature and newly written articles on this unfolding topic every day, I could not have concluded this thesis without the enormous patience, much necessary and appreciated guidance and support of my supervisor Ernst Worrell and the always relevant literature and valuable feedback provided by my internship supervisor Elisa Achterberg. The very useful feedback on my research proposal provided by my second reader Kei Otsuki was incredibly instrumental to restructure the initial idea for the thesis and to develop a sense of writer/audience awareness throughout the writing of this work.

Thank you, Ernst, Elisa and Kei, for your support and encouragement throughout the way!

“

Owning a good makes sense if that good increases in value so owning a house makes sense. Owning any disposable good doesn't make sense so therefore you should rent it.”

–Walter R. Stahel

Summary

The historically high material consumption and natural resource extraction demands action is taken to reverse the trend of an economy that creates value based on the linear model of take-make-waste at high and irreversible environmental costs. The urgency to change this trend is clear from the fact that materials being reused has dropped from 9.1% to 8.6. in the last couple of years. A smart alternative to the linear model of production and consumption is the circular economy to close material loops and release the stress on producing more with increasingly more scarce natural capital.

To reach the goal of becoming fully circular by 2050, research emphasizes the need to support the growth of Circular Business Models that follow strategies of reusing, refurbishing, repairing, and recycling products to extend the use of life of products. Product-as-a-Service is analyzed in this thesis as it is one of the circular businesses with the most potential to mitigate harmful environmental impact. This is so because it connects profitability to the incentive of producing more circular designs since manufacturing, a more efficient use, and a recovery of the value after use.

Despite its benefits, PaaS faces barriers to obtain financing that is essential for its growth. This thesis searched for the barriers to PaaS financing and analyzes potential solutions to overcome these bottlenecks from the perspective of financiers in banks and investment funds. Interviews with financiers on their experience financing PaaS and literature on the relevant financial concepts are the main methods to achieve this goal.

The barriers identified are financial risk triggers, regulatory and circularity-related bottlenecks. The pathways to overcome them are equally threefold and require intervention not only from banks but also from the Dutch government and European institutions to materialize.

Key words: Circular Economy, Circular Economy Transition, Circular Business Model, Product as a Service, Product Service Systems, Lending Technologies, Innovation Finance

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Abbreviations

BS Balance Sheet

CE Circular Economy

CB Circular Business

CBMs Circular Business Models

EBA European Banking Authority

ECB European Central Bank

LTs Lending Technologies

PaaS Product-as-a-Service

PF Project Finance

PSS Product Service System

SMEs Small and Medium Enterprises

SFL Sustainable Finance Lab

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Introduction

Societal-scientific background and relevance

The economies of today follow a linear business model based on natural resource extraction to create value. Natural resources are processed through manufacturing into final products that are sold, used, and discarded as waste. This take-make-dispose model accounts for dramatic natural resource depletion and is contrary to sustainable practices. We now consume 1.7 times the earth's production capacity, and with a continuously growing population, demand for goods will continue its upward trend (oliverwyman.com, 2017). It is expected that by 2030, three billion middle-class consumers enter global markets driving an unsustainable overuse of resources, higher prices and volatility (Ellen MacArthur Foundation, 2014). Experts anticipate that essential elements as gold, silver, iridium, and others will be depleted in the next 5 to fifty years (Ellen MacArthur Foundation, 2014). Henckel et al. (2014) concluded that global consumption of the 17 scarcest metals including copper and zinc needs to be reduced to stay within sustainable limits. In the Netherlands, some companies have already been struggling with the security of natural resources (Bastein and Rietveld, 2015). The Dutch government committed to becoming fully circular by 2050 and halving the use of raw materials by 2030 (Government of the Netherlands, 2021). The country has one highest material consumptions in the world as it consumes 3 times what the Dutch ecosystem can produce (oliverwyman.com, 2017) and the average material footprint in 2017 was more than twice the world average and 13 times larger than low-income countries (UN Stats, 2019).

In a linear model where manufacturers sell their products in one-time transactions, once the sale is made, producers lose control over the product as ownership is transferred to consumers (Circle Economy, 2021). The incentive for producers to make profit is thus to sell as much as possible regardless of the quality of the products or the longevity. Manufacturing goods with a relatively short lifespan is engrained in the linear model business logic to increase profit (oliverwyman.com, 2017). Under such a system, profits are private while the waste that ends in landfills and the scarcity of resources is a public problem not borne by producers (Sauvé, Bernard, & Sloan, 2016).

The urgency to transition to a Circular Economy

The urgency to move away from the linear model has led researchers, policy makers and business owners to look for alternative economic models compatible with limited natural resources and with environmental impact accountability. This has never been more important than now when not only the reuse of resources has not increased, but the number of materials being reused has dropped from 9.1% in 2018 to 8.6% (Circle economy, 2020).

In this context, the Circular Economy (**CE**) has gained traction as an economic system that allows to mitigate the negative effects of production and consumption on the environment by shifting the value of products and services away from the sale value to integrate the entire material life cycle of products. The CE rests on the principle of closing material loops by fully or partially restoring products or components through reusing, repairing, refurbishing and ultimately recycling. The R-ladder defines six different strategies (R1 to R6) to reduce the use of new resources. Different R frameworks exist but in all of them the strategies higher up the ladder (1,2,3...) require fewer resources, reducing the environmental burden. These strategies are namely:

R1: Refuse and Rethink which points at foregoing certain products completely or using them in a multifunctional way.

R2: Reduce, which aims at making products more efficient to use already at the manufacturing stage.

R3: Reusing products to extend lifespan

R4: Repairing and Refurbishing products to extend their lifespan and adapt them to new standards.

R5: Recycling resources by separating residual flows, processing them, and reusing.

R6: Recovering energy from certain materials.

The Covid-19 pandemic has shed light into the fragility of global supply chains and the need to create resilient local opportunities in remanufacturing, repairability and reusability as would a CE (Ellen Mac Arthur, 2020). The CE's goal is to extend the value of products across time to avoid unnecessary waste and mitigate virgin materials resource extraction (Lewandowski, 2016). By gradually decoupling economic activity from the consumption of finite resources, the CE can be a vehicle to reach environmental sustainability goals and to create new economic opportunities.

It is expected that renewable energy will mitigate 55% of global greenhouse gas emissions but the remaining 45% need to be mitigated by changing the current design of products and manufacture (Ellen MacArthur, 2020). According to the Ellen MacArthur Foundation (2021), if only the steel, aluminum, cement, plastic, and food sectors adopted CE principles, an amount equal to the total emissions from transportation could be reduced. Currently, half of the world's carbon emissions result from the extraction of natural resources, a shift to a CE would help reduce this (Watts, 2019).

The benefits of the CE are not only environmental but also economic (WEF, 2014). The adoption in Europe of CE principles in mobility, construction and food could represent 1.8 trillion euros in savings by 2030 and in China, a similar strategy could represent savings of 16% of Chinese

projected GDP (Ellen MacArthur, 2020). In terms of employment, the CE represents an opportunity for job creation for remanufacturing globally and recycling, even though this would depend on the particularities of regional labor markets (Ellen MacArthur, 2020).

Circular Business Models

Research on the CE has primarily focused on the technical aspect of material efficiency and waste reduction, but more researchers emphasize the need to focus on business models and value chains to facilitate the transition to a CE (Rosa et al., 2019). Circular business models (**CBMs**) play an essential role in this transition since most CBMs are startups and startups integrate CE principles better than already existing businesses (Schaltegger, et al. 2016; Schneider & Clauß, 2019).

There is a wide range of CBMs that focus on different aspects of the R ladder and often a combination of them. For example, substitution of virgin materials by recycled materials, design easy to disassemble modules to facilitate recycling and reuse, design to extend the lifetime of the product and sharing business models. To categorize the different types CBMs activities, we refer to the Value Hill framework (figure 1). The Value Hill divides the value of a product in three phases: the pre-use phase where value is added progressively through mining, production, and distribution. The focus for CBMS in pre-use is to design products that can retain value in the long term. The second phase is in-use where the product reaches its highest value. CBMs at this stage focus on strategies to optimize the use of the product by increasing the productivity of a product by providing thorough repair, maintenance, life extension, reuse or by creating sharing platforms or developing a Product-as-a-Service. The third phase is the pos-use stage where the product loses value and where CBMs focus on retaining some of the value by remanufacturing, refurbishing, or recycling with the objective of flowing the secondhand products into the use phase again where value can be added again up-hill (Achterberg et al., 2016).

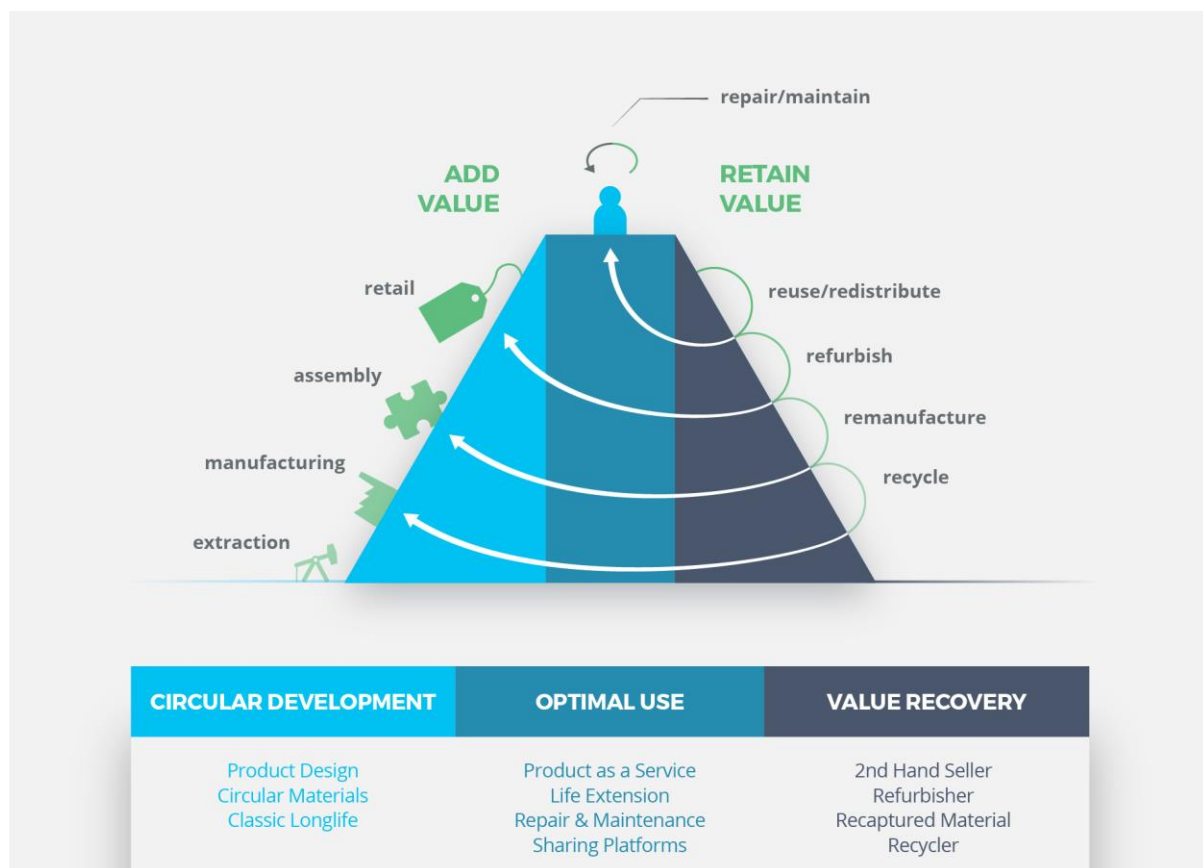


Figure 1: Value Hill Framework (Achterberg et al., 2016)

Barriers Circular Businesses (CBs) and the challenge of financing

CBs face diverse barriers to grow and scale up. Startups in particular face more barriers than linear models (Bouwens, 2021). Challenges range from technical issues like how to design circular long lasting products and how to integrate them into existing supply chains, to more cultural or behavioral barriers such as reluctant consumers due to an unclear perception of the circularity of products, etc. According to Thomas Bouwens, barriers to scaling up CBs are threefold: economic, regulatory, and financial (Van Soest, 2021, 3:40).

Firstly, economically it is still cheaper to use newly extracted materials and resources which makes circular products often more expensive than linear products. Having a circular product that is functionally the same as a linear product but more expensive makes it difficult for CBs to build a business case. Consumers in general also require more convincing to choose the circular product over the cheaper linear alternative. Secondly, regulation also plays a role in hindering the growth of CBs. This is the case of waste regulation that restricts the use of certain waste as input for new products which makes it difficult for CBs to recover value from the post-use phase of the Value Hill and reincorporate this value into the supply chain. Behind waste regulation there is often a concern for consumer health and protection but often the rules are non-sensical or outdated and

make it difficult for businesses to innovate their products to become more circular. Lastly, some CBs have a different revenue and cost structure from linear businesses that often banks are not familiar with and therefore refuse to finance (Van Soest, 2021, 3:40).

Before deciding to finance a business, banks first screen the financial health of businesses and assess the type of lending technology (LT) or methodology for financing they will use to extend credit (figure xx). During the screening and underwriting phases of the decision-making process, a risk assessment of the business takes place. If the credit is approved, the terms of the credit contract are structured, and the bank monitors the fulfillment of the contract during the repayment period. The current risk assessment that takes place during the screening phase is compatible with linear business models but do not adapt well for CBs (Kenniskaarten, 2021). CBs have a different revenue flow, different interdependencies with partners and customers. CBs often require more than one form of capital, the types of contracts and the time span during which they recover revenue is longer than in the LM (Toxopeus, Achterberg et al., n.d.). As a result, when screening a CB, banks perceive them as too risky under the current model (Personal Communication SFL, 2021).



Figure 2: Four steps of the financial decision-making process (based on Berger and Udell, 2006)

Despite the difficulty of financing, there is a growing interest in de-risking the funding of CBMs, as the risks of the linear economy become more obvious as many banks and pension fund still invest in fossil-fuel intensive businesses that once environmental regulation becomes stricter, will lose a lot of their value, potentially hurting savings, and pensions (Netherlands and you, 2019). CBs will require an estimated €400–500 million in capital over the next five years and Dutch banks have expressed individual and collective engagement in financing the CE (ABN AMRO, 2015; ING, 2015; MVO Nederland, 2016; Rabobank, 2015). This opens the door to discuss with financiers their perception on the remaining bottlenecks. While other countries are more centered in the material efficiency aspect of the transition to a CE, the Netherlands has focused more on the entrepreneurial angle of the transition and how to support it, which makes it an interesting study ground to analyze barriers to financing CBs (Ellen MacArthur, 2021).

In the Netherlands, over 80% of finance for Small and Medium Enterprises (**SMEs**) which is the category CBs often fall, is dependent on bank credit and around 30% of SMEs involved in circular innovation rely on debt (figure 3). Next to banks, the Netherlands also offers market-based financing such as venture capital, private equity or bonds (Achterberg & Van Tilburg, 2016). This research will focus primarily on the barriers for banks but will also include barriers perceived by private investment funds. The term “financial institutions” in this thesis refers to banks and investment funds alike. When a distinction is made among them, the specific financial institution is named accordingly.

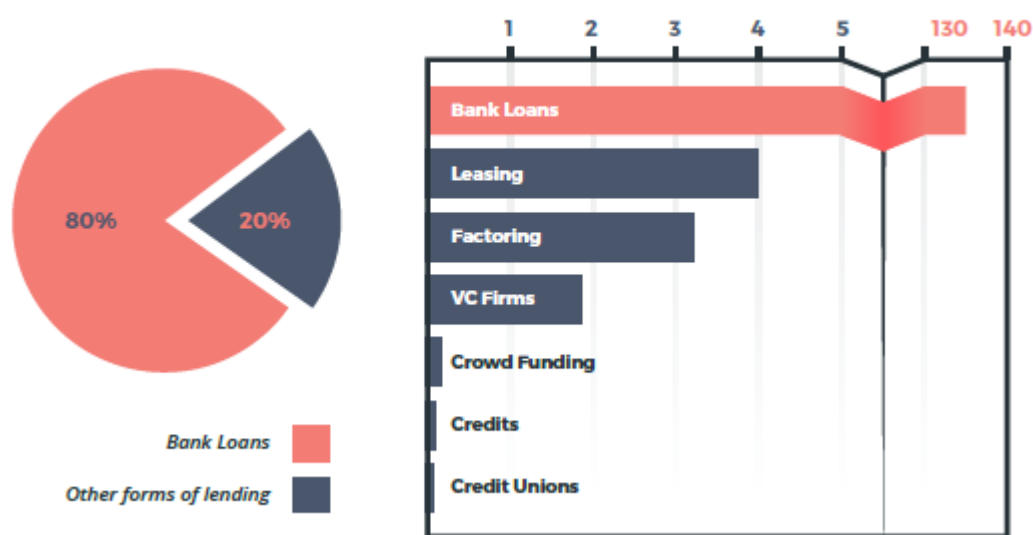


Figure 3: External financing for SMEs in billion euros. Adapted from Dutch Banking Association (Achterberg & Van Tilburg, 2016)

Literature on what businesses perceive as barriers to access financing are not uncommon to find, but what proves more difficult is to understand from the financiers' perspective the risk triggers that lead to rejecting financing CBs. Risk triggers are indicators that show the borrower is unlikely to pay back a loan under acceptable conditions under the financial institution's guidelines. Examples of variables that may become risk triggers for banks are the payback time of a loan, the tenor of the loan (for how long the loan is extended), the amount of the loan, and the type of customer base. Understanding what these triggers are and how they can be overcome is the objective of this research

Research gap and objective

The gap identified in this research is that on the one hand, there is an increasing demand for funding from which is also necessary to achieve the goal of the Dutch government to become fully circular by 2050. On the other hand, banks, and other financial institutions in the position to grant financing for CBs through different lending technologies, operate under a linear model risk assessment logic that views CBMs as too risky and hence unfinanceable.

Understanding from the financiers' perspective what the concrete barriers are and how they can potentially be overcome is the main goal of this research to bridge the gap between this demand for funding that enables a CE transition, and a dry supply given high perceived. To do so, I focus on one specific CBM known as Product-as-a-Service (PaaS) or Product Service System (PSS) as a proxy for CBs and located in the in-use phase of the Value Hill (figure xx).

Research Question

The research question guiding this thesis is the following:

How can current barriers to financing circular business within financial institutions be overcome to foster the transition to a circular economy in the Netherlands towards the 2050 goal?

SQ1: What are the current barriers to financing circular businesses perceived by financiers?

SQ2: Which lending technologies are used to fund circular PaaS models?

SQ3: What are the most important financial risks perceived that prevent PaaS to be financed?

SQ4: What strategies can financial institutions implement to enable more PaaS financing?

The structure of the thesis is as follows: The first section introduces relevant concepts such as PaaS, lending technologies and other relevant financial terminology in detail. The second section focuses on the methodology and section 3 presents the results. In the result section, the first chapter presents the barriers to PaaS financing from the perspective of financier and chapter two present the potential solutions to overcome these barriers. Finally, the fourth and last section presents the discussion the conclusion and recommendations for policy and further research.

Research Framework

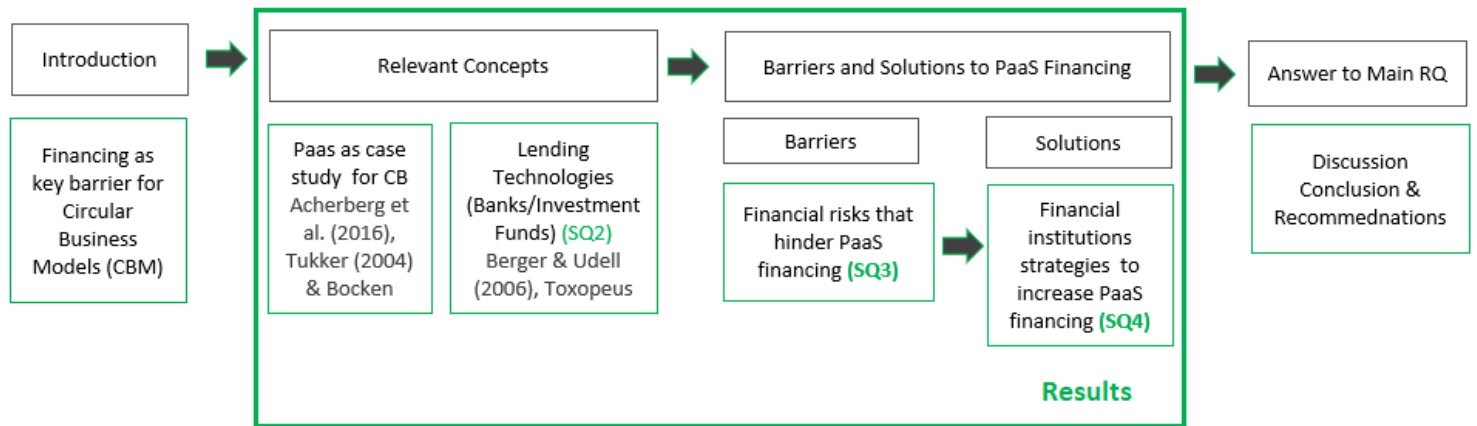


Figure 4: Research Framework

I. Definition of relevant concepts

Product Service System/Product-as-a-Service

In this research, we focus on the case of PaaS as proxy to study CBMs. It is not a specific company that is analyzed, but rather the revenue model of PaaS. Instead of selling a material product in a one-time deal PSS provides a function that has both tangible and intangible value for users (Tukker, 2004). The term Product Service System is more often used in academia and reflects better the systemic nature of PaaS that brings together different stakeholders throughout the supply chain to be successful. Product as a Service (PaaS) is more widely used in business jargon to mean the same as PSS (Rombouts, 2020). Throughout this thesis, both terms will use without distinction. Some well-known examples of PaaS are Swapfiets which is a subscription model business that for a monthly fee provides consumers with bikes that can be repaired and given maintenance to extend their usage. Swapfiets remains the owner of the bicycles and has invested in circular design to reach a zero-rubber-waste life cycle and recently partnered with another company to improve performance and extend the lifespan of the tires (Swapfiets.com, 2021). Just like Swapfiets are known as bicycle-as-a-service, there are other examples of PaaS such as Bundles that provides washing machines as a service and takes care of the maintenance, repairs and recovery of the machines once their lifecycle is over, MUD jeans who provide jeans-as-a-service for a subscription fee. Other PaaS can also provide immovable assets as a service as façade-as-a-service where a PaaS repairs and maintains a building façade retaining ownership of the façade which is detached of the building. The possibilities of the types of assets that can become a PaaS are thus very broad.

Under PaaS, producers retain ownership of their product and remain responsible for the full lifecycle of their product including residual waste resulting from the production process (Board of Innovation, 2021). By retaining ownership PSS gives incentives to the producer to extend the life cycle of products since the design (pre-use) and has incentive to extend the value of the product as long as possible and recover as much of it in the post-use phase. In this sense, PaaS connects the pre-use stage of the Value Hill to the post-use value recovery phase. The picture below depicts the place of PaaS as linking pre-use and pos-use through the example of a washing machine as a service, but the concept is valid for other asset categories as well.

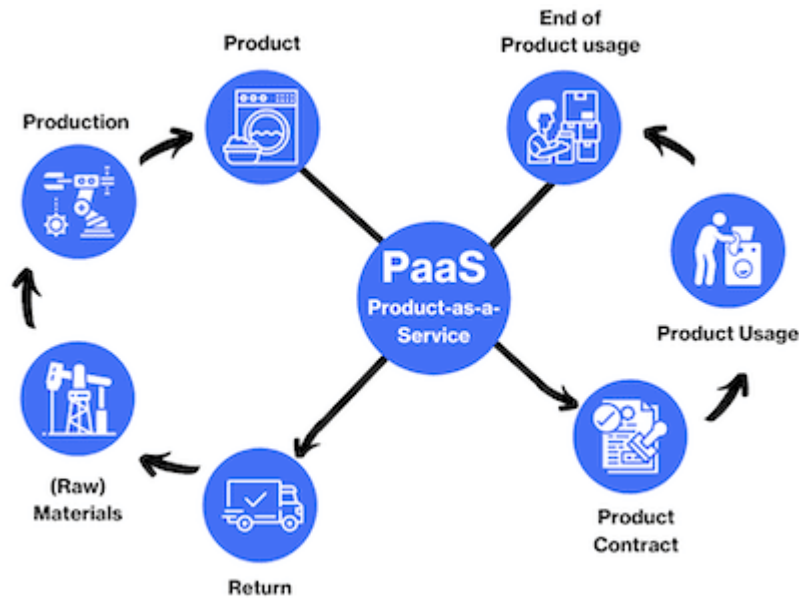


Figure 5: PaaS as integration of pre-use, in-use, and post-use of a product (www.firmhouse.com)

It is important to note that a PSS is first and foremost a revenue model and does not imply the circularity or sustainability of a business (KPMG, 2019). However, because of ownership stays at the producer level contrary to linear models where assets are sold and thus ownership is transferred to consumers, PaaS links profitability of a business to the long-term value extension of the asset (SFL Personal Communication, 2021).

Thanks to remanufacturing, it is estimated that PSS can reach material and energy reductions up to 80% (Linder & Williander, 2017). Bocken et al. (2016) mention 3 main strategies for business to transit from a linear to a circular model, namely by slowing, narrowing, or closing the resource loop

- Slowing by extending lifetime or providing sustainable consumption incentives
- Narrowing by replacing parts / repairing / sharing, and
- Closing by reducing waste.

Tukker (2004) offers a categorization of PSS in 8 archetypes depending on how product-oriented or service-oriented a PSS is (figure 6). The more service-oriented, the larger the potential of PaaS to mitigate harmful impacts to the environment as less material resources are used, and products are given more lifecycles (Tukker, 2004). Ironically, the more service-oriented, the more PaaS struggle to obtain financing.

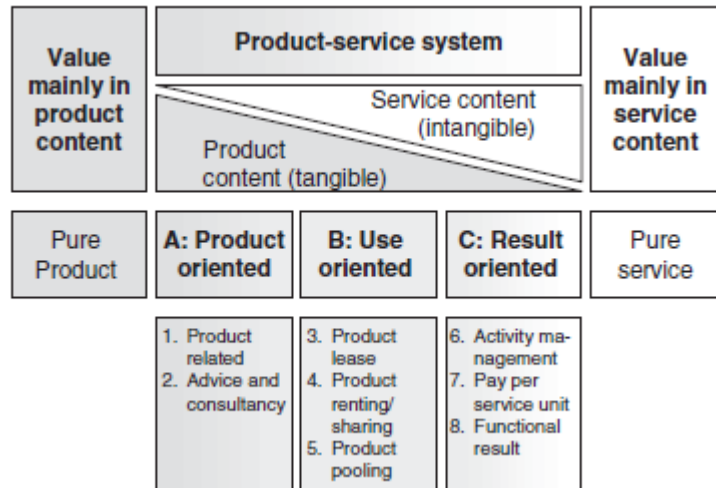


Figure 6: PSS Archetypes (Tukker, 2004)

Lending Technologies

A second concept that is important to define and understand is that of lending technologies. LTs are methodologies used by banks and other financial institutions to grant credit by reducing the risk of default of the borrowers. Broadly speaking, we can distinguish three main types of lending technologies often combined in practice (Achterberg, Van Tilburg 2016).

1. cash flow/ information based
2. asset-based
3. relationship-based

Since each LT focuses on different aspects of a firm's operations, we refer to Berger & Udell (2006) as a framework to understand the specificities of different types of LTs and the requirements from financial institutions to CBs to pass the screening and underwriting phases.

Financial Statement lending

Under Financial Statement lending, the borrower is evaluated through an audited financial statement of its business. To obtain credit, the borrower must prove a strong financial condition reflected in the solvency ratios calculated from the statement. The terms of the loan and the decision to lend are based on the strength of the balance sheet and income statements. The expected future cash flow of the company is regarded as the primary source of repayment. This type of lending is most suitable for companies with available transparent financial statements (Berger & Udell, 2006).

Cash flow-based lending

Based on expected future cash flows; a business can borrow money backed by their past and projected future revenues. The financial institution analyses the company net income, credit rating, and its enterprise value. As a result, the business can obtain financing faster, since an evaluation of collateral is not required (investopedia.com, n.d.) This type of financing is good for companies that generate significant amounts of cash from sales but don't have a lot of physical assets to be used as collateral for a loan. Banks or creditors create a payment schedule based on the projected future cash flows and an analysis of historical cash flows. The net amount of cash generated from account receivables and payables can be used to forecast cash flow. The amount of cash being generated is used by banks to determine the size of the loan.

Revenue-Based Financing (RBF)

Revenue-based financing allows a business to obtain capital from investors who receive a part of the business's gross revenue in exchange for the money invested. Gross revenue is the income from sales, without considering the expenditures of the business. Investors then receive a determined fixed percentage of the business' income until a preestablished amount has been repaid. This amount is usually three to five times the original amount invested (investopedia.com, n.d.).

Compared to a term loan, RBF allows for lower and payments during the first years when revenues are also low. Payments to investors have a proportional relationship to how well or bad the firm is doing. If sales fall, the royalty payment to investors falls as well but if sales grow, payment to investors will also increase which can limit how much the business reinvest from its own profit (elementfinance.com, 2021). If sales fall off in one month, an investor will see his or her royalty payment reduced. Likewise, if the sales in the following month increase, payments to the investor for that month will also increase.

Small business credit scoring

Small business credit scoring consists of business owner information and firm information that is input into a prediction model that yields a score for a potential loan. Information such as personal consumer information from credit bureaus and commercial credit bureaus are looked into. This model is suitable for companies with little or opaque information on the firm but substantial personal credit history from the owner. Given that it is relatively risky, the loan amounts resulting from this type of technologies vary around 100 and 250 thousand euros with high interest rates (Berger & Udell, 2006).

Asset-based lending

Under asset-based lending, the potential opacity problem that might arise under credit scoring for example, is compensated by focusing on the firm's assets, a subset of which is pledged as collateral which becomes then the primary source of repayment, hence the name. The collateral usually is in the form of accounts receivable and inventory and the amount of the credit that is granted is related to a dynamic estimation of what the value of collateral assets would be at liquidation. The value of the collateral then is reassessed daily for accounts receivable and on a monthly or weekly basis for inventory. One of the advantages of this type of lending is that the amount of the credit is little related to the overall creditworthiness of a firm but is fundamentally based on the value of the collateral. The liquidation value of the collateral must always exceed the credit exposure.

Fixed-asset lending

Through fixed-asset lending, underlying assets that are not sold in the normal course of business (Equipment, vehicles or real estate) are pledged to the lender as collateral. Unlike asset-based lending, the monitoring of collateral is much simpler since the pledged assets are identified by a serial number or deed so that if the borrower wants to sell a fixed asset by transferring the title, it needs previous agreement from the lender. The lender monitors the timely repayment of the amortization schedule of the assets placed as collateral. The coverage ratios are the main financial analysis to assess whether the firm will be able to meet the amortization schedule.

Factoring

The lender, called factor, purchases the accounts receivable as a collateral asset. Factoring is different from asset-based lending in that factoring includes only accounts receivable and not the inventory and the underlying asset- the accounts receivable here- are sold to the lender. The underwriting process here is based on hard information about the value of a borrower's account receivable.

Leasing

Leasing is the technology whereby the lender known here as lessor purchases fixed assets and simultaneously enters a rental contract with the lessee that specifies a payment schedule. The contract often contains an option whereby the lessee can purchase the assets at the end of the lease at a pre-specified price. The underwriting decision here is primarily based on the value of the asset being leased.

Relationship Lending

Under relationship lending the financial institution requires less hard information on the company since most information is acquired through direct contact with the borrower and is gathered overtime, observing the firm's performance in different dimensions. Since the information is often assimilated by the loan officer or financier, it is not easily observed, and it is also not easily verified or transmitted to others.

Other relevant terminology:

Balance sheet (BS)

A balance sheet is a financial statement that provides a snapshot at the health of a company's finances. Along with the income statement and statement of cash flows it is a key instrument to evaluate a business. It contains information on the assets, the liabilities and shareholder's equity in a company, where the shareholder equity is all assets minus all liabilities (investopedia.com, n.d.).

Collateral

A collateral is an asset with value that a borrower makes available to the lender to secure a loan. In case a borrower fails to pay back the loan, the lender can seize the collateral and sell it to recover the loss. In that sense a collateral helps reduce the risk of lending. It can consist of real estate or other assets such as a savings account or a car.

II. Methods

The research adopted qualitative methods through literature research and interviews to answer the research questions.

Literature review was instrumental in situating access to funding as one of the many challenges that CBs face. Also from the literature, relevant reports, and academic papers on how different LTs have been used to finance PSS in the past were gathered. Moreover, from literature review information on CBs experience to access funding was obtained. The information was sourced mainly through academic research engines such as World Cat and Google Scholar, and snowball sampling was employed to identify the most relevant publications available. Next to the writing of the thesis, an internship with the Sustainable Finance Lab (**SFL**), allowed me to access research papers. The SFL also granted me access to transcripts of interviews to CBs that helped in answering sub questions.

My research in the context of the internship was part of a workgroup lead by the SFL where financiers from leading banks in the Netherlands built a community of knowledge to share their struggles in financing PaaS. The goal of this workgroup is to move from a tailor-made PaaS financing to a more standardized way to finance it. The road on how to achieve this will be condensed in a white book, for which this research will potentially serve as partial introduction.

The second most important data source for thesis was the content of seven semi-structured interviews with financiers from 4 Dutch banks and 2 impact investment funds who have experience in screening and financing PaaS. Questions and answers via email were also exchanged with 2 members of the Circular Accounting Coalition to better understand the technicalities of certain financing barriers from an accounting perspective. A podcast on circular businesses and the obstacles they face was also an important source of information and was accessed through the Utrecht University Website. The details of all interviews can be found in table 1 below. The table also includes information on contact attempts that for diverse reasons could not be interviewed for this thesis.

Bank	Employee	Date
Bank 1	Employee 1	June 9
Bank 2	Employee 1	June 17
	Employee 2	June 28
Bank 3	Employee 1	June 18
	Employee 2	June 18
Bank 4	Employee 1	June 24.In person meeting
	Employee 2	June 24.In person meeting
Bank 5	-	Contact made but interview not possible
Investment Fund 1	Employee 1	May 17
Investment Fund 2	Employee 1	June 23
	Employee 2	July 9
Investment Fund 3	-	Contact made but interview not possible

Table 1: Interviews and contacts for data obtention

For the interviews I collaborated with SFL to design a script that funneled questions from a general overview of what financiers perceive as barriers to questions about how their experience contrasts with the barriers reported in the literature. Request for consent on both the recording, scripting and subsequent use of the content were made explicit and interviewees were informed that any use of the content would be anonymized, and direct quotes would be used only subject to previous request and approval. A previous background check on the specific job of the interviewee was made to ensure that the person had had experience with financing PaaS. This was an important step to filter only financiers who could discuss specific PaaS business cases they evaluated themselves in order to grant financing or not. Interviewees were contacted via email through information available on the SFL database and from bank's website, reports and employee's LinkedIn profiles. The interviews were conducted along with my internship supervisor from Sustainable Finance Lab, Elisa Achterberg. The fact that many of the interviewees were already familiar with my supervisor facilitated to create an atmosphere of trust where financiers knew beforehand the research aim and that the information they provided would be dealt with anonymity. Except for one bank interview that took place in person, the rest of the interviews took place via Zoom or Microsoft Teams. In total 7 interviews took place between May and June.

By having direct communication with financiers, I was able to obtain firsthand information to answer my research questions. Another goal when interviewing financiers was to have information on the concrete way PaaS businesses were financed to fill the gap on which lending technologies are used, the tenor of the loans, the pricing, the payback period, the type of collateral, etc. The input from financiers that succeeded in funding a PaaS was as valuable as that from financiers that despite having PaaS financing in their scope, did not finance PaaS. This allowed to have a clearer view on which barriers or risk triggers would be considered unsurmountable barriers by financial institutions during the screening process and which characteristics would be difficult to overcome

but still allow a PaaS to be successful in obtaining a loan. Before every interview, I asked for financiers to prepare one case study of a PaaS that got funding and one that did not, and to go as much in detail as possible on the conditions of the funding.

At the end of every interview, financiers were asked to refer us to other relevant people who could share about their experience in financing PaaS. This helped expand the list of potential interviewees and having a contact who acted as intermediary helped obtain faster replies.

III. Results

In this section, the result from the analysis of literature, reports and interviews is presented in three chapters. The first chapter touches upon the barriers and risk triggers perceived by financiers to finance PaaS. They are namely threefold, and they are structured in the following way: 1. financial risk triggers, 2. regulatory/legal barriers and 3. sustainability/ circularity barriers. Barriers are identified at the screening and/or underwriting stages prior to the financing decision is made (Figure 2).

Even though financial institutions largely face the same barriers, a distinction is made between how banks and investment funds evaluate some specific challenges. This distinction helps develop stakeholder-specific recommendations in the discussion section at the end of this thesis. At the end of the first chapter a table is presented to visualize the barriers most frequently reported.

The second chapter of the results presents the enablers to overcome the barriers discussed in the first chapter. The enablers are extracted from the scripts of the interviews to financiers and from literature. The solutions to the barriers of PaaS financing follow the same categorization as the barriers, namely: 1. solutions to overcome financing barriers and mitigate financial risk triggers, 2. solutions to overcome regulatory/legal restrictions and 3. solutions to overcome sustainability/ circularity barriers. It is important to mention that the solutions do not imply barriers are overcome but rather that they can mitigate risks or obstacles to further financing PaaS. It is also worth mentioning that some of the solutions are more complex and require long term implementation, depending on the stakeholders involved and the type of change that needs to be implemented. At the end of the second chapter, a table summarizes the solution per category.

Finally, the third chapter presents the barriers to obtaining financing and solutions from the perspective of circular PaaS businesses. The results are extracted mainly from literature review and the purpose is to compare how they differ from the barriers and solutions viewed from the financiers' perspectives in chapters 1 and 2 of the results.

1. Barriers to PaaS financing

Financial institutions that were interviewed have few PaaS as customers relative to the total amount of other business models they finance. The number of PaaS financed range from 0 to 10. Moreover, some institutions had potential PaaS customers they decided not to fund. The results in this chapter are based on both the PaaS that received financing but also on the cases that were rejected. In a few cases, financiers referred to specific lending technologies

they used to finance a PaaS, but in many cases the discussion about the pros and cons of lending technologies was without direct connection to a specific business that was financed or that was screened.

1.1 Financial risk triggers

Throughout the interviews, the lending technologies discussed with financiers to fund PaaS were term loan, vendor lease, asset-based financing, cash-flow financing and revenue-based financing. A term loan which is a loan issued for a fixed amount with a fixed repayment schedule and an interest rate that may be fixed or floating (variable). Since the cashflow of PaaS is often unpredictable, no bank interviewed used this rather rigid LT structure to finance PaaS.

The other lending technologies proved to have pros and cons when they were applied to PaaS. Banks look at different variables that are important for the risk assessment of in the screening and underwriting phases. Below, these variables are discussed in detail in relation to PaaS.

Lack of historical data

Under cash flow financing (CF), financial institutions extend a loan looking at the income from the past and future projected earnings. Both historical and projected income data are relevant to determine variables such as the amount of the loan, the tenor of the loan (how long will the loan last) and the interest rate. Future cash flow of the business is the main back up or collateral for the loan. Many circular PaaS are startups that lack any historical cashflow data and only have estimates on the projected future earnings. All banks interviewed reported not being able to underwrite a PaaS under cashflow financing with no previous records of cashflow (Bank 1, 2, 3 & 4 Personal Communication, 2021). The riskier the loan, the higher the interest rate and the more expensive the repayment of the loan (Achterberg & Van Tilburg, 2016).

Exceptions were made however for PaaS businesses that were part of a larger linear business that decided to start a PaaS as a small part of their business. In those cases, the linear part of the business started financing PaaS with their own equity and only for the scaling up phase, they contacted the bank to extend them a loan (Bank 1, Employee 1, Personal Communication, 2021). The risk of the PaaS part of the business not having a sufficient historical or projected cash flow was covered by the cashflow of the larger linear holding as a collateral. In other

words, the PaaS itself without the back up of a linear company behind would not have been financeable otherwise with CF financing.

Long payback period

The payback period of a loan refers to the amount of time it takes for a financial institution to recover the loan. This variable is considered by financiers to decide on whether to grant a credit or not. The shorter the payback period, the less risky it is to lend money. To calculate the payback period the total amount of the loan is divided by the annual cash flow of the business (investopedia.com, n.d.). In the case of PaaS, the initial cash flow is often low since the inflow from sales takes time to grow and outflows or expenditures to purchase assets mainly are usually large in the beginning. Even PaaS that have a positive net cashflow (inflow minus outflow), the margin that remains is not much which means that repaying a full loan would be very difficult and from financiers' perspective, too risky. The long payback period is a problem under cash-flow financing but under vendor lease/ asset-based financing as well.

To give an example, if a washing machine costs 200 euros to produce, a linear model with a loan for that amount can sell it for 400 euros, make 200 euros of profit and repay the 200 euros of the loan once the machine is sold. In the case of PaaS, many washing machines are bought and rented out under a subscription model. This means the loan to cover the cost of the machines was very large but assuming a recovery of 20 euros per month per machine, recovering the cashflow required to cover the cost of the loan would take years. The long payback period connects to another risk trigger for financiers: a negative EBITDA.

Negative EBITDA

EBITDA means Earnings Before Interest, Taxes, Depreciation, and Amortization and it is a profitability measure of businesses and is also a rough way to estimate the cash flow available for businesses to pay the debt of long-term assets (Investopedia.com, 2021). It is often the case that due to large initial expenses in equipment and assets, PaaS have a negative EBITDA during the first or the first two years of operation. In the balance sheet of the businesses this looks like very large liabilities and no profit. A business with a negative EBITDA for so long is seen as unfinanceable by banks' risk assessment, regardless of the projected profit figures for the next few years (Bank 1, Employee 1, Personal Communication, 2021).

Revenue-based financing (RBF)

Given the above-mentioned risk triggers, cash flow financing was hardly ever extended to PaaS. However, Investment Fund 2 used revenue-based financing to fund PaaS, which is similar to cash-flow based financing. In cashflow financing, future cashflows act as collateral for the loan. Under RBF revenue is used as collateral but as repayment scheme for the loan. Investors receive a fixed percentage of gross revenues but the amount if this payment is variable since it depends on the sales made by the business every month. The advantage of RBF for PaaS startups is that while there is no revenue made, there is no pressure for businesses to repay as would be the case with other LTs that have a fixed repayment schedule regardless of revenue. On the flipside, once revenue flows increase, the cost money that goes to repaying the debt also increases.

Investment fund 2 extended startup loans where businesses would repay 25 to 60% of their revenue and the loan would be repaid when startups repaid 1.5 times the loan amount (Investment Fund 2, Internal Presentation, n.d.). The duration was between 2 and three years and the loans were backed with assets and customer contracts. In addition to loans, Investment Fund 2 offered to invest in equity, meaning that instead of extending a loan the Fund could also obtain a stake in the company. In case for instance the startup defaulted partially, loan repayments could be turned into shares. Even though this is not intrinsic to Revenue Based Financing, this form of financing is considered a hybrid between debt and equity instrument and is also known as revenue share investment (Investopedia.com, n.d.). Finally, an additional benefit for startups was that for the first 3 years they could repay interests only and the 1.5 capital ratio could be repaid in 6 years (Investment Fund 2, Internal Presentation, n.d.).

Despite the flexibility this financing instrument offers, Investment Fund 2 faced several problems financing PaaS. PaaS took a long time to start repaying, and once they covered the share to repaying the loan, the remaining margin was too low at the end of the month for them to reinvest and scale up. Around 70% of startups did not survive after the first year of RBF since the cost of the debt was too expensive (Investment fund 2, Employee 2, Personal Communication 2021). After several PaaS startups that got initial support, none of them could financially survive without the capital injection of the fund. Due to lack of profitability, Investment fund 2 did not survive. More on the barriers faced by this fund will be explained in the following sections of this chapter.

Vendor Lease (asset-based financing)

Vendor lease is an asset-based financing LT that by being specific for the leasing of assets, is rather well adapted to PaaS revenue model. Through Vendor Lease a company can acquire assets that are leased the company's customers. The customers in turn can repay the business or sometimes they can even directly repay to the bank (Bank 1, Employee 1, Personal communication, 2021). The challenges to finance PaaS through vendor lease are explained below.

Extended Balance Sheet

One of the most often encountered risk triggers in financing PaaS both in literature and mentioned by financiers is that PaaS comes with a heavy balance sheet. As PaaS business owners retain ownership of the products instead of transferring it to their clients, PaaS are considered an asset-heavy businesses. When a business purchases equipment, this is reflected as a liability in their balance sheet. In the beginning of the operation, PaaS such as Bundles that offers washing machines as a service, need to purchase large amounts of equipment and after that purchase, they start making revenue based on the subscriptions and pay-per-use cashflow from customers. The balance sheet is the basis for the solvency ratio which is an indicator of a business' ability to meet its long terms debts obligations (Investopedia.com, n.d.). The debt to assets ratio, which is a part of solvency ratio, measures how healthy the cashflow is compared to the depreciation of the company's assets. In the case of PaaS, this ratio is usually 15% or 20%, whereas a healthy solvency ratio is considered above 30-35%. The extended balance sheet and the negative impact on the solvency ratio of PaaS is an important risk triggers for banks that renders them unfinanceable for banks (Bank 1, Personal Communication, 2021). In reality, far from being a liability, from a circular perspective the ownership of assets is the reflection that companies take charge of the maintenance and long-term usability of their assets, but this has no value on itself to mitigate financial risk as of now (Circle Economy, 2021).

"[...] a growing balance nowadays is still interpreted as risky, in the circular economy this will signal that companies are taking long term responsibility for their products" (Achterberg & Van Tilburg, 2016)

Collateral

Under vendor lease or asset-based financing, the financial institution extends a loan based on the value of the pledged asset. Assets can be anything from immovable goods such as buildings or machinery to inventory.

PaaS products have no or very little residual value. The residual value refers to the remaining estimated value of a fixed asset at the end of its useful life and depends on whether there exists a secondhand market where the product can be commercialized or buyback agreements of companies that can re-use the products or components (Achterberg & Van Tilburg, 2016). (investopedia.com, n.d.). For most PaaS products or simply products in general there is no second-hand market where the value of the asset after one or more lifecycles is well known and that there is a market for it. Cars for instance have a well-known secondhand market but some real-case PaaS such as decorative flowers or baby clothing that has several life cycles are types of assets that for banks bear no residual value. Another problem is the inexistence of re-use or components parts to add value to a product after its useful lifecycle has ended to reintegrate into a value chain.

Every asset depreciates over time, meaning an asset's value is used up overtime and in the end it has a certain value known as residual value. The problem for PaaS and other circular businesses is that banks depreciate assets to zero over time, which leaves little incentive to re-use the asset. This problem also hints at the need for PaaS to have a connection in the pre-use phase with manufacturers that design with the idea of retaining value over several lifecycles and also the need to have a market for re-use or component parts that enables value retention.

Type of asset: Movable vs immovable

The nature of the asset as movable or immovable plays a role in asset-based financing as well. If the assets financed are immovable or fixed (for instance part of a building), it is very difficult for banks to collect them in case of default. This is clear in PaaS such as Road-as-a-Service or Façade-as-a-Service (Fischer, 2020). In case of default, not only would it be very difficult to assign some residual value to a façade, but it would be practically impossible to recover the road or the façade themselves to resell and recover some monetary value. In banking terminology this is known as having no grip or break on the assets, and thus having no coverage for the loan (Bank 1, Employee 1, Personal Communication, 2021)

Movable assets as bicycles or phones are in theory easier to collect. Many PaaS businesses offer movable assets as a service which despite in theory being easier to collect. However, movable assets across too many users is equally daunting for a bank to collect, starting by the problem of tracking and tracing these assets and bearing the costs related to collection.

Type of customer base: B2C vs B2B

Connected to the type of asset, the type of customer base PaaS target is also relevant for financiers to consider. PaaS that target Business to Customer markets rather (B2C) rather than Business to Business markets from financiers' perspective bears the problem of how will assets be collected. The tracking and tracing of assets can be extremely expensive and may discourage banks to consider the assets as collateral (Achterberg, Tilburg, 216).

Banks find Business to Business (B2B) PaaS models easier to finance because their revenue stream is more predictable and stable than B2C. Moreover, banks can also run a credit check of the borrower's customers and have more certainty on the creditworthiness of the stakeholders. Banks can thus extend loan with larger tenors and better repayment conditions than B2C. This was the case of a B2B PaaS provider of e-bikes that had as a client a food delivery service instead of having a multiplicity of individual customers (Bank 2, Employee 2, Personal Communication, 2021).

There is however a large demand for B2C PaaS businesses as is the case of mobility services, also known as Mobility-as-a-Service such as Swapfiets where despite the potential to reach a large customer base, pay-per-use revenue schemes render future revenues unpredictable and the risk of having no or low usage periods exists. From a circularity perspective PaaS allows to use assets and resources only when needed by paying pay-per-use or a monthly subscription that can be interrupted but from a financing perspective, the more flexibility in the revenue model, the less predictable the cashflow. For financial institutions, this translates as higher risks and thus, more expensive financing as banks try to mitigate the risk by increasing the cost of funding (Bank 2, Employee 1, 2021).

Startup financing loan size

A finding from the interviews is that PaaS startups require an initial capital of 100 to 00 thousand euros (Investment Fund 2, Internal Presentation, n.d.). This amount, some financiers shared, is too small in terms of profitability for too big a risk. Lending from half a million euros

onwards seemed to be a more reasonable amount for banks to finance. This leads to the question of whether banks are the best option to provide financing to PaaS in the early stages. As Bank 4 shared, PaaS businesses entail a long-term view on profit and it is the case that because of the small size or because of not having enough demand for PaaS financing, some banks choose to focus on business opportunities that can bring some profit in the short term. However, if banks represent 80% of SMEs financing in the Netherlands, there is clearly a need to fill the need of financing from these businesses.

The risk triggers presented here are agreed upon across banks and funds interviewed. Unlike banks, investment funds have more flexibility on how much risk they are willing to take and how much they can bend internal financing methods to customize lending technologies available to finance PaaS.

1.2 Regulatory barriers

Next to the risk triggers derived from different LTs, other barriers mentioned by financiers were in relation to regulation. After the 2007-09 financial crisis, the Basel Committee on Banking Supervision (Basel III) also imposed new regulation on banks, increasing risk aversion (Achterberg & Van Tilburg, 2016). Regulations to control and prevent money-laundering have also contributed to putting banks on the center of public scrutiny and to limit reckless risk taking (Bank 1, Employee 1, Personal Communication 2021).

Regarding asset-based financing, PaaS often lack assets with residual value or that are easily collectable that can act as collateral. However, some PaaS do have subscription contracts with many customers that represent the in-paper promise of future revenue. Contracts like these could in theory serve as projected income and act as collateral for PaaS to obtain financing. However, European Banking Authority (EBA) and European Central Bank (ECB) regulation establishes that the bank's rights on the contracts are not considered as coverage against a loan. Only a pledge on the assets of the company can be considered as collateral and this excludes contracts (Bank 1, Employee 1, Personal Communication 2021).

Furthermore, other national regulations also indirectly hinder PaaS financing. Under Dutch law, the concept of *natrekking* on Article 4 of Book 3 of the Dutch Civil Code states that a thing/business joined to a principal thing/business (*zaak* in Dutch) in such a way that it cannot be separated from it without significant damage being caused to one of the "zaak", becomes part of the principal "zaak" (juridischwoordenboek.nl, n.d.). In the context of CBMs, this is an obstacle that undermines ownership rights. In the construction context for instance, equipment that is

attached to a building such as solar panels or a heating pump in the form of as-a-service means that the asset ownership risks being transferred from the PaaS who offers the service to the owner of the building (Bank 4, Personal Communication, 2021).

1.3 Circularity-related barriers

Another less formal but also important barrier to financing PaaS is the circularity requirements that each financial institution imposes to fund businesses. As stated before, PaaS is foremost a revenue model that gives incentives for businesses to become circular since the value retention of the assets overtime is directly linked to profitability. PaaS have however different degrees of circularity and there are no standardized criteria to determine to what extent a PaaS is considered circular.

In the context of banks, circular PaaS apply to the specific section of the bank that funds sustainable/ circular businesses. Banks interviewed have different ways of categorizing PaaS according to their circularity. Bank 1 for instance structured PaaS in 3 categories: 1. Fully circular PaaS business (of this kind there are practically no businesses financed), 2. Businesses looking to have financing to start a PaaS next their otherwise linear business model and 3. Linear businesses that already started the transition to a circular PaaS three or four years ago funded with their own internal financing possibilities and looking for bank financing to scale up the circular part of their business. Bank 4 provides has almost no circular PaaS financing since it deems the opportunity for profit too low while and they consider themselves a bank with a positive sustainability-related reputation, therefore their circularity criteria is high (Bank 4, Employee 2, Personal Communication, 2021).

Only Investment Fund 1 had financed a 100% circular PaaS. The rest of PaaS screened and financed by banks are a hybrid combination of PaaS with linear and circular characteristics. This shows how difficult it is for many PaaS to begin as fully circular and manage to survive and scale up. Circularity criteria was in general more stringent in the case of impact investment financing, while in the case of banks the circularity criteria were not always enough to reject funding.

The reasons why many PaaS struggle to become more circular it that many PaaS buy a product from third party but are not manufacturers of their own product. As a result, they have very little influence in the product design for it to endure several lifecycles, and also to have components that are repairable and easy to include back in the supply chain at the end of its useful life. The lack of accessibility to product parts and components limits the possibility of reuse or repair. This was the case of a phone business that leased a well-known brand of

smartphones for a monthly subscription but could not reach an agreement with the manufacturer to take the batteries to repair and hence after once the useful life of the phone was over, instead of only changing parts of it, there was a need to replace the used phones by entirely new ones. This made the subscription cost rather expensive for consumers and the company did not survive. A similar example for laptops with a very good circular proposition had to be excluded from financing due to the lack of leverage power over manufacturers to take-in batteries and reuse the components (Investment Fund 1, Impact investor 1, Personal Communication, 2021).

Conversely, when the business did achieve a high circularity level, if the assets had little value or the revenue structure was too flexible, this weakened its potential to obtain financing. This was the case of PaaS financed by Investment Fund 2, who as a circularity goal for the businesses they would fund, they expected to avoid the manufacturing of 100 thousand devices (and reducing CO2 emissions by doing so) and increase the asset lifetime value (the amount of times an asset can be rotated) to three times. Most PaaS could not comply with these requirements but those who did, had a weak financial case to be considered profitable. The trade-off between profitability and circularity eventually lead to Investment Fund 2 to close their operation due to a lack of PaaS candidates that met profitability and circularity criteria sufficiently (Investment Fund 2, Impact Investors 1 & 2, Personal Communication, 2021).

Having at least a part of the business that is linear makes it easier to obtain bank financing while for investment funds, the lack of circularity was often a cause to reject an otherwise financially solid business proposition.

Financial risk triggers	
Risk trigger	Description
Lack of historical data and low initial revenue	PaaS Startups lack historical cashflow. Their projected cashflow the first years is usually low. This hampers cash flow based financing that claims future cashflow as collateral.
Long Payback Period	Revenue is built up slowly making it difficult to meet fixed payment schedule
Negative EBITDA	PaaS have negative profit the first 1-4 years.
Extended Balance sheet	PaaS are capital intensive and accumulate assets as liabilities in BS. This triggers down solvency ratios (20-25%)
Collateral	Under Asset Based Financing, assets are collateral. However PaaS assets often have no residual value and no second hand market
Type of asset	Movable vs Immovable If movable--> easier collection if immovable (Attached to building)--> bank has no grip on asset
Type of customer base	B2C models make collection of asset difficult because of tracing challenge and unpredictable income B2B models provide better grip on asset, stable revenue and creditworthiness
Loan Size	PaaS require 100-500K to start operating Banks find the amount too small to finance given risks
Regulatory Barriers	
Barrier	Description
Increasing Regulation	Banks become more risk averse
No contract as collateral	Subscription contracts are not accepted as collateral. Assets alone are.
Natrekking	Confusion in terms of asset ownership. Uncertain asset collection in case of default
Circularity barriers	
Barrier	Description
Linear-circular combination	Full circularity is hard to achieve Most PaaS are a hybrid of linear and circular
No influence on supply chain	PaaS that don't manufacture their product struggle to have a circular design and access repair parts
Profitability-Circularity trade-off	The more flexible the PaaS, the more circular but more risky and less financeable

Table 2: Barriers to PaaS Financing

2. Solutions to overcome barriers and enable PaaS financing

2.1 Financial mitigators

The most common mitigation factor for banks so far to finance PaaS encountered is parting from an existing linear customer who started a PaaS transition in part of their business. By having as collateral sound financial statements or assets in the larger part of its linear business, banks can afford to finance an otherwise unfinanceable PaaS. However, many PaaS are startups without the back up of a larger linear holding, thus innovative ways to financing PaaS are needed.

In general, financiers agreed that there are sufficient financial instruments to finance PaaS but what is lacking is a framework for assessing PaaS and a shift in perspective on how to steer existing financial instruments into the relatively less-known field of PaaS. Educating Relationship Manager to raise awareness among financiers on potential profitability stemming from PaaS is for instance a simple but important step towards de-risking PaaS financing (Bank 2, Employee 2, Personal Communication, 2021).

Project Finance (PF)

To allocate more financing to circular PaaS, a key element is for banks to assess the business model and the risks in a different light than current linear risk assessment.

Risk assessment is conducted by algorithm that require certain information on the business structure as input and determine whether the business can be financed within safe limits. Depending on the type of business, the model used to assess risk varies. PaaS is currently evaluated just the same as linear businesses without taking into account aspects like the ownership retention at the producer level or recovery of asset's value at the end of their useful life. Throughout the talks, financiers agreed on the need to consider PaaS as a separate business model entirely, which in theory should entail, a different model for risk assessment.

Project Finance is a form of financing that was mentioned several times as a potential LT to finance PaaS. PF is a loan that is repaid by the business with the cashflow generated by the business. The borrower places the business assets rights and interest as secondary collaterals. Secondary collateral refers to accounts, accounts receivable, inventory and general intangibles. Project finance is especially attractive because businesses can obtain funding off-balance sheet. This

means that the assets or liabilities do not appear on the business' balance sheet while remaining part of the company (investopedia.com, n.d.). This offsets the risk of the growing balance sheet risk trigger mentioned in the previous chapter in financing barriers. Just like companies financed under PF, PaaS have an initial period of negative EBITDA and revenue cashflows are generated only after a heavy initial investment in assets (capital intensive businesses). In terms of reducing risk, PF is a convenient financing structure since it allocates risks among multiple stakeholders who invested in the project (Rajgor, 2011).

As an experiment, Employee 1 from Bank 1 used the risk assessment algorithm to evaluate a PaaS. As a result, a PaaS that would usually be considered unfinanceable was deemed suitable for funding under the alternative PF risk assessment (Bank 1, Personal Communication, 2021).

As much as a similar scheme would benefit PaaS in the risk assessment, to apply for PF, several conditions need be met. Banks usually consider PF for projects that require an initial capital around 5 to 10 million euros, much higher than the usual initial funding requirement for PaaS below half a million euros (Bank 2, Employee 2, Personal Communication, 2021). Moreover, PF is a financing strategy usually restricted for very capital intensive often infrastructure-related projects where the underlying value of the assets financed is high and the expected revenues for investors are very high as well. Common projects financed by PF are offshore wind farms or roads construction. Much lower market value products such as phones, headphones or washing machines in PaaS would not qualify for PF financing under the current requirements. For PF to be applicable to PaaS, its potential to generate stable and long-lasting revenues thanks to a longer lifecycle of assets would need to be recognized by banks as a risk mitigator (Achterberg & Van Tilburg, 2016).

Bundles

To overcome the challenge of financing products with low capital intensity and low residual value an innovative way of financing PaaS would be to bundle circular projects together in a sort of fund. Instead of financing one particular businesses, financial institutions could become investors or stakeholders of the bundle itself. This would allow to share risk among multiple stakeholders just like in PF and would overcome the difficulty for banks to extend loans that are too small (Achterberg & Van Tilburg, 2016).

Government subsidies as collateral

To mitigate the risk trigger of no historical data and low payback periods that make cash flow financing very difficult for PaaS, resorting to governmental subsidies was generally well accepted by both banks and fund investors as collateral (Bank 1, Employee 1, Personal Communication, 2021). An important advantage for circular PaaS is that there are specific funds only for green/ sustainable companies can request with no need to compete with linear startups. Some examples of funding available for companies to develop and scale circular businesses are funds provided by Regional Development Agencies (*Regionale Ontwikkeling Maatschappijen*) committed to investing in sustainability and innovative SMEs (ROM.nl, n.d.), or green innovation subsidies where sometimes the government provides up to 90% of the loan (Bank 1, Employee 1, 2021; rvo.nl, n.d.) The European Investment Bank through its European Fund for Strategic Investments and the “EU Finance for Innovators” Program is also providing financing and advice to circular businesses (European Union, n.d.).

2.2 Legal/ Regulatory solutions

Contract as collateral

Under asset-based financing, banks take assets as collateral. A strength of PaaS overlooked by banks is the network of subscription contracts with a large consumer base. Unlike banks bound by EBA regulation not to underwrite loans with contracts as collateral, but investment funds can. Investment fund 2 took 2 types of coverage for their loans: assets and customer contracts (Investment Fund 2, Internal Presentation, n.d.). A flexibilization of the EBA regulation for banks could allow to expand accepted collaterals and reduce current risk perceptions. This would be particularly useful for technologies such as asset-based financing. In the case of PF mentioned above, contracts can be considered as collateral. Given the proximity of PaaS to the revenue model of businesses financed through PF, including contract as collateral would expand current financing capabilities.

Clear ownership definition and contract standardization

In connection to the barriers identified in section 1.2 above, modifying the *natrekking* concept in a way that assets attached to other assets can have a separate ownership is essential for banks to be able to consider these assets as collateral (Bank 4, Personal Communication, 2021).

Finally, an effort is needed to standardize certain aspects of PaaS contracts with banks is needed to reduce the cost of financing. Currently, financing of PaaS is done through tailor-

made contracts that cost more resources for banks both in terms of time and money, which makes them less attractive on top of the already challenging financial barriers discussed before.

2.3 Sustainability/Circularity solutions

Linking financing to circularity benchmarks

Some banks interviewed mentioned linking the achievement of circularity criteria to offering their customers a better price for loans (Bank 4, Employees 1 & 2, Personal Communication, 2021). In practice, the bank asks for an upfront minimum circularity requirement to take a business as customer and then establishes a gradual where against the loan, PaaS commits to reaching certain circularity/ benchmarks thresholds upon which the bank can extend the amount of the loan or offer more competitive rates. This is a smart strategy to overcome the profitability vs. circularity trade-off mentioned before. Financial institutions like Bank 4 or Investment Fund 1 and 2 that place a high weight on circularity as precondition for financing can with a scheme like this grant financing to profitable CBs that are not yet circular enough but have the potential to become so.

Stimulate Relationship Lending

The lack of a common framework or methodology for financial institutions on how to measure circularity hampers the possibility to replicate and standardize the approach to financing PaaS (European Commission, 2020). Such a framework would provide CBs with an objective set of criteria against which to determine minimum circularity requirements to obtain financing. The European Commission's Sustainable Finance Action Plan will soon introduce an EU Taxonomy and Sustainable Finance Disclosure Regulation (SFDR) aimed at expanding disclosure and reporting requirements from investment firms, asset managers and other market participants on Environmental, Social and Governance (ESG) issues (bloomberg.com, n.d.). Standardizing criteria for circular businesses financing could also help financial institutions to be ready ahead of this new regulatory imperative.

Since the degree of circularity of a business is very subjective and largely dependent on the mission and vision of the CBs and entrepreneurs, assessing the degree of circularity requires from banks a building a closer relationship with their customers. For this purpose, the third large category of lending technologies, relationship-lending is suitable for financiers to acquire in-depth information on entrepreneur's goals and strategies to increase circularity.

Financial Risk Mitigators	
Solution	Description
Use Project Finance Risk Assessment to screen PaaS	PF and PaaS share similar revenue structure and is a better fit than linear risk assessment model. The problem of the growing balance sheet and negative EBITDA are offset
Bundles	Group different assets into bundles to distribute investor risk among different stakeholders
Government subsidies as collateral	Accept government subsidies for circular businesses as collateral against loans
Regulatory Solutions	
Solution	Description
Contract as collateral	Push for EBA regulation change so that suscription contracts can act as collateral against loans
Nattreking modification	Allow for distinct ownership of assets that are within eachother
Standardize contracts for PaaS	Reduce money and time costs for banks to make tailor-made contracts
Circularity Solutions	
Solution	Description
Link financing to circularity benchmarks	Offer price incentives on loans against achievement of circularity thresholds
Stimulate Relationship Lending	Since standardizing circularity criteria is difficult, increase efforts to bring together ginanciers to entrepreneurs to understand circularity degree and motivations

Table 3: Solutions to PaaS Financing

IV. Discussion, Conclusion and Recommendations

Discussion

Limitations of the research

During the interviews, it was sometimes difficult to bring financiers to talk beyond the general challenges and talk about specific case studies of real PaaS businesses they financed or rejected funding. It was also difficult to have access to the specificities of the risk assessment model of each institution as well as the circularity criteria for PaaS.

Financiers are learning by doing, and not all of them have experience in financing PaaS, let alone a 100% circular PaaS. As a result, the source of experience is rather limited to a handful of players. Given the limited number of interviews and financiers to whom we had access to, it remains difficult to generalize the results of this research.

Theoretical implications

The results of this research allow hopefully a deeper understanding on financiers' perception on risk triggers against CBMs through the case study of PaaS. The access to real life case studies allowed lay out the most used lending technologies.

Moreover, having interviews with both banks and investment funds also contributed to have a wider perspective on how different financial stakeholders might view barriers and solutions to PaaS financing.

The possibility to have access to a great amount of confidential information either in the form of unpublished reports by my host internship organization, during interviews when financiers mentioned concrete businesses financed or during one in-person meeting with a bank, the information gathered as input would have been practically impossible to find openly through publicly available resources and was extremely valuable in adding to the existing knowledge about circular business financing.

Avenues for future research

Given the limited amount of time. Several follow up questions and research topics can be derived from this work. Regarding the solutions to overcome the barriers, it would be relevant to determine how could a project finance-like financing scheme be adapted to finance PaaS. This is an important avenue of analysis that could lead to interesting practical guidelines for financial institutions in the future.

A second relevant topic would be to identify which type of assets are more easily financeable under PaaS. Is it capital-intensive goods that can be asset-financed or rather luxury goods that might possess a higher residual value than other products? Some sources hint at the fact that PaaS are more suitable to finance products with high usage costs and high service expenses. Further dissecting the suitability of products for this revenue model as well as the circularity potentials per product type are all relevant questions that would expand the frontier of knowledge on this topic.

Although there are possibly many others, a third research topic worth considering is what are the chances of reaching a high degree of circularity for PaaS that are not in control of manufacturing and what would be forms of reaching supply chain level financing when different firms across the chain have very different risk profiles.

Conclusion

All in all, PaaS faces several barriers to obtain financing as was made clear during this research. However, being the circular business model that offers most incentives to link profitability to longevity of assets and closing material loops through resource recovery and circular design, clearing the way for more financing through banks is imperative. The transition to a circular economy in the Netherlands needs banks on board of the transition since they represent 80% of external financing for SMEs.

Across financial institutions, there is a common agreement that the barriers and risk triggers to financing PaaS are roughly the same. Another agreement is that the instruments needed to finance PaaS already exist. What is needed is a different approach to risk and innovative ways to adapt current lending technologies to a nonlinear business model.

In terms of financing, education within banks is necessary to shift the concept of value from sales-only to include the value of long-lasting relationship between CBMs and customers through subscription contracts that secure stable cashflow streams for years, recognize the

residual value of assets that can be reintegrated into a supply chain and regain value and eventually generate profit. A change in how assets are depreciated to zero at the end of their useful life needs to be reevaluated.

Innovation finance needs to increasingly play a role so that project finance-like financing can be adapted to PaaS and so that technology can be incorporated in creating bundles of assets that allow to share risks among more than one stakeholder. The traditional view of banking as one bank against one customer to finance one-time sales is one that needs to be more resourceful by resorting to governmental subsidies as collateral, progressively lobbying for contracts to be valid collateral to underwrite loans and slowly but steadily standardize the approach to PaaS financing until the market not only accepts circular businesses more, but sees the potential of profit and sustainability potential when perspective is shifted from short term to long term profit making.

Some financiers mentioned that the difficulty to finance PaaS is that bank's first mandate is to care for people's savings who entrusted financial institutions by making wise and low-risk investment choices. What can be a better and safer bet for customer savings than investing in business models that are based on stable and durable cashflows as opposed to linear businesses that sooner or later will be confronted with internalizing the cost of environmental and social harm, causing their value to drop.

Recommendations

Going forward, different stakeholders can contribute to increasing PaaS financing in different ways.

What Banks can do:

Banks can think outside the box and consider screening PaaS through risk assessments models more suitable to its revenue model as is the case of project finance.

Banks can also partner with other financial institutions to offer financing to already proven CBs that have a proven business case and need scaling up.

Finally, banks could join efforts to standardize contracts for PaaS and minimum circularity criteria that makes it clear for businesses what their expectations are.

What the Dutch government can do:

The government could push at the EU level to change banking regulation in a way that under certain conditions and for the purpose of achieving circularity goals, contracts can be accepted as collateral for loans.

The government can also further clarify ownership rights of assets to avoid uncertainty for banks on whether they can have a grip on assets pledged as collateral under asset financing.

Finally, the government could further increase its procurement coming from circular businesses to stimulate the cashflow necessary to build a strong profile to request bank financing.

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