REPORT

Financing Circular Business Models: The challenges of obtaining bank credit for Product-as-a-service models

AUTHORS:

Marcus Linder, Ann-Charlotte Mellquist, Emanuela Vanacore, Lukas Hallquist, Katherine Whalen

Financing Circular Business Models: The challenges of obtaining bank credit for Product-as-a-service models

Authors: Marcus Linder, Ann-Charlotte Mellquist, Emanuela Vanacore, Lukas Hallquist, Katherine Whalen

RISE Research Institutes of Sweden

ABSTRACT

Product-as-a-service (PaaS) circular business models are at a disadvantage in terms of bank financing compared to many linear business models. Such business models generally face significant challenges both in the case of collateral-based and business case-based credit security assessments. The challenges are due to both difficulties in assessing and realising the residual value of the collateral and due to the timeframe of the risk assessment of the business case. Furthermore, the complex services that are the source of competitive advantage for PaaS firms often disqualify customer contracts as collateral. Two of the challenges (low inventory valuation and forced depreciation losses) are traced to accounting and credit regulations. Another five challenges are traced to long-term industry practice. The empirical evidence consists of quotes and summarised data from 38 interviews and 24 survey responses with banks and product firms exploring circular economy financing.

Keywords: Circular business model, finance, product-as-a-service, bank credit, collateral, accounting

1. Introduction

Environmental risks are increasingly viewed as a threat to the modern economy. The World Economic Forum (WEF) recently brought up climate action failure and biodiversity loss as top business risks (WEF, 2022, p. 26). Although the circular economy is a concept that is not without critique (Corvellec et al., 2021) and that has many framings and definitions (Kirchherr et al., 2017), the circular economy is often presented as a plausible partial solution to these types of environmental concerns (Frishammar and Parida, 2019; Jabbour et al., 2019). A circular economy seeks to maximize the value of products, components, and materials over time, and to minimize resource use, emissions, waste, and pollution (Geissdoerfer et al., 2017). The circular economy discourse often emphasises the importance of the business model as an important determinant of firm behaviour and consequent environmental damage (Boons and Lüdeke-Freund, 2013; Linder and Williander, 2017; Ludeke-Freund et al., 2019). One important such business model topic is product-as-a-service (PaaS) circular business models (CBM). PaaS CBM ensure recurrent revenue from products, adjusting incentives of the seller towards longer lived products with minimal maintenance (Linder & Williander 2017). They also internalise the risk of product obsolescence, which was previously born by customers, to sellers (ibid). Examples of well-known corporations experimenting with PaaS CBM are H&M with clothing subscriptions (H&M, 2019) and IKEA with furniture as a service (Ingka Group, 2019). The success of these PaaS CBM will in part be determined by their cost structure. If many PaaS CBM are at a significant cost disadvantage vis-à-vis their linear business model counterparts, this will contribute to a delay in their diffusion and hence a delay in the adoption of circular economy practices in the economy.

This paper presents evidence that today's financial practices will be a common company-level barrier in a circular transition by putting PaaS CBM at a cost disadvantage.

Financing is a way to leverage the time value of money to put future expected money flows to use for projects started today. As such, financing is a solution to accelerate scale-up of a business. Financing enables investment today based on expected future profits. Different sources of financing imply different costs of capital to the business. Businesses with access to lower cost of capital will enjoy a competitive advantage over their rivals. In this paper we show that product-as-a-service based circular business models, which due to their cost structure are particularly dependent on low cost of capital, are at a disadvantage to access one of the lowest cost types of financing: bank credit.

For many environmental problems such as greenhouse gas emissions and biodiversity, the timing of implementation of solutions really matters. One argument in favour of PaaS variants of CBM is that it improves trialability for customers contributing to a higher rate of diffusion (Rogers, 1962). Taking advantage of increased potential rate of diffusion at the company level requires access to capital. Without access to external financial capital, organic PaaS scaling is conversely slower than many other revenue models because of the long payback periods. Thus, the speed of and therefore also the aimed benefits of, a circular economy transition is limited by the availability of financial capital for quick upscaling of PaaS CBM.

Bank financing is a relevant form of financing to consider for three reasons. First, bank credit is a comparatively low-cost source of external capital. For a business with dependence on low cost of capital, such as in the case of PaaS CBM, good access to bank capital will provide a competitive advantage. Second, the linear business model competitors of a PaaS CBM will likely often have access to bank credit, since small and medium-sized firms in Europe are highly dependent on bank credit (European Commission, Directorate-General for Enterprise and Industry, 2014). Third, firms engaging in the circular economy seem to naturally turn to bank financing, as 30% of small and medium sized firms engaging in the circular economy rely on bank credit (Demirel and Danisman, 2019). Anecdotally, we also find that most banks and product companies we meet in our daily work on circular economy consider bank financing relevant for CBM.

In order to understand the specifics of the nature, causes and generality of the barriers to PaaS CBM bank financing, we will answer two research questions in this paper:

1. Is availability of bank financing a problem for scaling PaaS CBM business?
2. If so, what are the explanatory factors from a bank credit process perspective?

The remainder of this paper is structured as follows: Section 2 presents the conceptual framework of product-as-a-service and circular business models. In section 3 we present the research area Circular financing and in section 4 we describe our research method. Next, in section 5 our results are structured around two main approaches banks use to estimate the security of a business loan, the two approaches are: 1) collateral-based assessment and 2) business case-based assessment. Our discussion of the results, limitations and a summary of the paper's theoreticaland practical contribution are found in section 6, and short concluding remarks in section 7.

2. Product-as-a-Service Circular Business Models (PaaS CBMs)

We use the term business model as the conceptual logic for how a company *creates* and *captures* customer value (Björkdahl, 2009; Osterwalder and Pigneur, 2010). *Value creation* in a CBM is based on utilising value retained in products over time and after use (Linder and Williander, 2017). The more value (in use) remains in products over time and after use, the larger the potential to create customer value. The ideal CBM lets customers enjoy products indefinitely without the need for production since no products become obsolete. *Value capture* in a PaaS is based on recurring revenue resulting from continued customer value. We here use the term PaaS as a combined term for Tukker's (2004) terms access or results-based Product Service System-models with ownership risks never transferring to customers. In other words, PaaS is distinct form of recurrent revenue-model enabling CBM, separate from other CBM-enabling recurrent revenue models based on aftermarket transactions such as spare parts and service fees. Taken together, our definition of a PaaS CBM is a business model where value creation is to a large extent based on time-extension of product value-in-use, and value capture is to a large extent based on recurrent revenue directly and contractually correspondent to access or results of product use. Because a PaaS CBM is particularly well suited to profit from superior value retention of products (Whalen, 2020), it commonly benefits from a comparatively large initial investment in goods sold. At least to the extent that higher such investment secures better product value retention. Taken together this has some relevant implications for financing:

A. The delayed cash flow of a PaaS implies a dependence on long-term cost-effective financing to achieve scalability.

B. The increased initial product investment of a CBM implies a larger capital volume that needs to be cost-effectively financed to achieve competitiveness, also in the short term.

3. Summary of prior research on circular economy financing

The importance of finance as an enabler for growing business in general – and for circular business in particular – has been covered in prior literature. Many scholars who have focused on barriers to CBMs and circular economy transition in general have also mentioned that financial barriers might be an important category of barriers (Adams et al., 2017; de Jesus and Mendonça, 2018; Govindan and Hasanagic, 2018; Grafström and Aasma, 2021; Hartley et al., 2021; Kirchherr et al., 2018; Kok et al., 2013; Mishra et al., 2018; Ormazabal et al., 2018; Preston, 2012; Tura et al., 2019; Vermunt et al., 2019). Seles et al. (2022) have

conducted a broad literature study of enablers of circularity, on the other hand, and point at access to financial resources as one such enabler.

Aranda-Usón et al. (2019) argue that the availability of funds, quality of the firm's own financial resources, and public subsidies have a positive effect in stimulating the implementation of CE initiatives in businesses. Uhrenholt et al. (2022) state that financing of CE is essential for enabling investments towards developing business models based on the take-back system. Moreover, Ayati et al. (2022) argue that finance is essential to the formation of Circular Supply Chains. Also, the NGO Ellen MacArthur Foundation (EMF) argues for the importance of access to new financing and risk management tools to support change-in-ownership models, capital investment, funding R&D and new technologies (EMF, 2012, 2013, 2014). As such, it is expected that financial institutions can help facilitate such a transition (FinanCE/CE100, 2016). In particular, financing is deemed to be a key enabler for any business wishing to innovate new business models (Beltramello et al., 2013) including CBMs (Wasserbaur et al., 2022).

Some authors consider the issue in relation to the stage and size of the company. For instance, Briguglio et al. (2021) argue that *start-ups* which are "born circular" seem to encounter fewer barriers compared to business that strive to change into circularity. Henry et al. (2020) in their typology of circular start-ups state that the ones with a service-based model (PSS), which equates to only 9% of the studied sample, face among others, financial constraints, as they are characterised by asset-heavy innovation needs.

Several authors focus on barriers related to *small and medium-sized enterprises (SMEs)*. Rizos et al. (2016) show, based on company surveys, that lack of funding is a key obstacle for SMEs to switch to CBMs and argue that the banking sector struggles to understand and correctly assess risks and potential of the new business models. Salvioni et al. (2022) point out that financial barriers have hindered the adoption of circular practice in Italian SMEs due to their difficulty in raising public and private funds to finance the transition coupled with inadequate understanding of CE. Similar considerations come from Min et al. (2021) in relation to SMEs in China.

On the same wavelength we find de la Cuesta-González and Morales-García (2021) who, by adopting a system approach combining business model perspectives with transition theories, recommend a more coherent, comprehensive, and harmonised system for information, risk assessment, and new co-financing mechanisms and alternative instruments including blended finance or circular finance.

At the policy level, the revised EU Circular Economy Action Plan (European Commission, 2020) highlights the need for sustainable finance and environmental accounting principles to support and complement circular economy initiatives and performance data.

At the institutional level, on the one hand increased interest on circular initiatives has been shown for instance by the International Finance Corporation (IFC), i.e. the private sector arm of the World Bank, (Tonelli and Cristoni, 2018) and by the multinationals' strategic partnerships with the Ellen MacArthur Foundation (EMF, 2020a). On the other hand however, financial institutions appear to be still hesitant to financially support circular companies (Pavoni, 2019) perhaps because of their lack of awareness and trust of profitability within the domain (Fischer and Pascucci, 2017) or because CE projects are typically attributed a higher risk profile as banks rely on historical record and benchmarking to assess risk (Acsinte and Francine, 2015).

At the practical level, several documents in the form of guidelines, overviews, or potential strategies on circular financing for enterprises have been published by various organisations including not financial ones (ABN AMRO et al., 2018; EMF, 2020b; IEMA, 2018; ING, 2015; United Nations Environment Programme Finance Initiative, 2020). Moreover, promising viable options for financing CE investments can be observed from stakeholder collaborations and governmental funding is becoming viable options (Fischer and Pascucci, 2017).

Four prior papers mention specifically financial barriers to PaaS CBM. Two of them make general statements about financial constraints due to asset heavy innovations (Henry et al., 2020) and the need for sufficient financial power for a company to be able to take on PaaS models with retained product ownership (Reim et al., 2021). The third one, (Toxopeus et al., 2021) focuses on solutions and presents three strategies for overcoming financial barriers to CBM in general: Securing customer contracts and pre-orders, building strong networks with banks, suppliers and customers, and reconsider asset design to enable asset-based lending. The fourth paper (Fallahi et al., 2022) also focuses on solutions, listing 13 suggested solutions for financing of PaaS CBM, including using Artificial Intelligence to better assess residual value of used products. Like the present paper, the findings of both Toxopeus et al. (2021) and Fallahi et al. (2022) are based on interviews with employees at product firms and banks. The present paper's contribution beyond Toxopeus et al. (2021) and Fallahi et al. (2022) lies in confirmation of, but also in extension, detailing and structuring of, the identified financing challenges, rather than discussing various solutions. As mentioned in

section 1, the research gap that we aim to close in the present paper is the specifics of the barriers to PaaS CBM bank financing.

4. Method

To examine if financing might be a significant barrier to PaaS CBM scaling, we launched a governmentally funded research project at the end of 2017, in which we joined forces with both product companies that had already mentioned this problem and with financial actors interested in the topic. The list of product companies and financial actors was extended over the project period through snowball sampling from the interviewed companies and colleague researchers, to achieve as much diversity as possible in the sample while still ensuring interest and experience in the research topic. Unstructured thematic interviews were held with professionals at product companies and financial actors to gain an in-depth understanding of the importance of barriers related to financing of PaaS models and of the participant's perspective on how to address the barriers. Extensive interview notes were made by one of the researchers during each interview and reviewed by a second researcher afterwards. In total (over the period 2018 to 2021), 36 interviews were held, lasting between 30 and 75 minutes. Interviews were conducted face-to-face (20), through telephone or on-line conferences (15) or via email (1). 18 interviews were carried out at 12 product companies and 14 interviews at 12 financial actors. The product company interviewees held positions, such as CEOs and Sales Manager (SMEs), and Head of Treasury, Business Area Manager and Sustainability Manager (larger companies). The financial actor interviewees were all managers and/or credit experts in their different fields. In addition, owner (shareholder) representatives from three of the product companies were interviewed. Four interviews were held with three additional expert organisations: the chairman of FAR (the Swedish Association of Authorized Accountants), the chairman of the tax committee of the Swedish parliament and representatives from ACCA (the Association of Certified and Chartered Accountants).

The structuring of the arguments was done partly in parallel with data collection, and in 2018 we printed all the text from the interviews and categorised various quotes with the purpose to better summarise the results for external communication. This is a type of open coding, similar to that described in Hsieh and Shannon (2005). We then presented these results at two academic conferences and a professional accounting association meeting. We used questions and feedback from these

settings to further refine and relabel the arguments and categories. The resultant codes are presented in section 4 below, as the titles of the barriers.

Later, in 2021, we launched a survey with responses from 24 product companies engaging in PaaS models. In the survey, questions were asked about the current financing of the PaaS model and about if financing was a problem for the respondent or not. Some of the respondents spontaneously brought up the below problem categories in free text-questionnaire items of that survey, which we here use and interpret as a second empirical verification of the problem categories. As this manuscript started to take form, we undertook two more interviews with bank experts, for further verification of our problem categories. **Fel! Hittar inte referenskälla.** quantifies the data collection.

Table 1
Summary of number of interviews and responses.

	Product companies	**Financial actors**	**Expert organisations**
Organisations	31	13	3
Interviews	18	16	4
Survey responses	24	-	-

5. Problems with bank financing of PaaS CBM

Based on our survey results, we can confirm that firms wanting to scale their PaaS models confront difficulties relating to financing. When asked to answer the question "How big is the problem of financing for your PaaS business?" on a scale from 0 (no problem) to 5 (showstopper), no respondent answered 0. Our results indicate that the challenge is more pronounced for SMEs than for larger corporates, but that the problem exists for companies of all sizes. **Fel! Hittar inte referenskälla.** lists the survey answers to the question per size category of respondent.

Table 2
Responses on if financing is a hindrance for PaaS CBM scaling.

PaaS firms per size[a]	No problem (0 on a scale from 0 – 5)	Small problem (1 on a scale from 0 – 5)	Medium problem (2 or 3 on a scale from 0 – 5)	Substantial problem (4 or 5 on a scale from 0 – 5)
Micro firms	0	1	5	7
Small enterprises	0	0	2	0
Medium sized enterprises	0	1	0	2
Large corporates	0	3	2	1

[a] Firm size definition according to EU (turnover criterion) https://single-market-economy.ec.europa.eu/smes/sme-definition_en

We demonstrate seven different ways in which PaaS CBM are systematically at a disadvantage compared to one-off-sales. Each section contains a shorthand name, a description of why it happens, one or a few illustrative quotes and a brief comment on how prevalent we expect the challenge to be.

We structure the section according to how banks typically evaluate an application for a business loan. To increase the likelihood of payback of business loans, banks typically assess the available collateral, the business case to be financed and the people involved (Toxopeus et al., 2021). We focus on the collateral (subsection 5.1) and business case (subsection 5.2) assessment. We did not find any indications that PaaS CBM would be at a disadvantage (nor advantage) regarding the banks' assessment of the people involved.

5.1 Collateral-based assessment

Collateral is property of value that the lender can seize from a borrower in the case of failure to repay the loan according to terms. Collateral typically does not affect the chances of business success of the debtor. In terms of risk reduction for the bank, it functions as a fallback for the creditor in case of loan default. Collateral is assessed differently in the cases of inventory financing, object financing and contract financing.

5.1.1 Low inventory valuation

Inventory financing is when property registered as inventory in the debtors accounting is used as collateral for the loan. In a linear economy, most product manufacturers would typically

categorise all their unsold products as inventory and remove products completely from the accounting once sold. Thus, by default products remaining with the product company tend to be accounted for as inventory. There are accounting regulations regarding how items classified as inventory can be valued, requiring rapid depreciation of inventory. Further, credit regulation limits the mortgage (collateral) value of inventory. According to one of our interviewed PaaS companies, this results in a situation where regularly only 25% (50% of 50%) of the inventory value can be mortgaged after a year – a much too low value to help scale a PaaS model. Thus, inventory financing is not suitable after the first year for a business model based on extended value retention and recurrent revenue, such as a PaaS CBM.

This is likely to be fairly difficult to change. As expressed by one of the interviewed bank experts:

> *"Regarding subscription services, mortgages of inventory already exist, but only up to a maximum of 60% of the value. If that needs to be changed to for instance 90% of inventory value, that [change] needs to be cleared with the Finansinspektionen [financial supervisory agency]" – Bank expert*

Because this challenge stems from common accounting and credit regulations, we believe it to be endemic. In our interview study, the challenge was brought up by 2 out of 12 product companies, 2 out of 12 financial actors (or 2 out of 7 banks) and 1 of the expert organisations.

5.1.2 Collectability of collateral

Object financing is when the product taken at market value is used as collateral for the loan. It is commonly used in for instance real estate mortgages. For other types of assets, banks and financial actors often point at the risk of collateral not being possible to locate in case of liquidation. If the realisation of the collateral value is done via asset sales, there is a need to keep track of where the products are so that they can be collected and liquidated. The fear is that this will be more difficult and time-consuming if the collateral consists of many movable and distributed objects (such as furniture or garments) rather than more stationary objects (such as real estate or machinery).

One financial institute manager expressed it thus:

> *"We see a considerable difficulty in control of where units are located in a rental model. There is a risk that "the security runs off". We have no capability to control this, and all of that risk needs to be taken by the owner or rentier." –Financial institute manager*

This challenge seems to be based on the perception and experience of banks and financial institutes. We therefore expect it to vary between industries, customer segments and institutional regimes. In our interview study, the challenge was brought up by 2 out of 12 product companies, 3 out of 12 financial actors and 1 of the expert organisations.

5.1.3 Cost of liquidation

> *"I have spoken to our financial company. They consider the admin too costly. Theoretically it's possible, but to systematise, label and manage baby prams will become too costly for them per product." – Bank expert*

A second consideration with object financing is the transaction costs involved in liquidating the objects used as collateral. Assets with existing structured second-hand markets, and thus well-known residual values, are common as bank collateral. For instance, real estate, vehicles, and some machinery and equipment. These can often be liquidated at a known exchange value at any point in time in case of default of the debtor. Using other types of products/assets as collateral poses difficulty for two reasons:

1. A non-structured second-hand market (such as Tradera or Blocket) implies more work and more specific knowledge (non-existing at the bank) to be able to liquidate the asset.
2. Lower-valued assets imply a higher cost per asset to administer the object financing model.

If there are no established processes for asset liquidation, the administrative costs for the bank of liquidation will be significant, especially in the case of numerous low value assets. This challenge seems to vary between jurisdictions. In Sweden, an industry practice of a per-object pricing model dominates the market of object financing, which makes object financing prohibitively expensive for low value items. That is, the price (cost of financing) of the object financing service is set individually per item, which renders the cost of liquidation high for many low-cost assets. However, in other countries, such as the Netherlands, there exists a different type of price model which makes large homogenous product fleets more attractive (or at least less unattractive) to finance via object financing.

In our interview study, the challenge was brought up by 5 out of 12 product companies and 3 out of 12 financial actors.

5.1.4 Contract value specificity

When asset-based collateral cannot be used, contract-based collateral is often a suggested solution. This means that the future value of the contracts (in other words the cash flow) is considered the collateral rather than the asset itself. For the bank this is often deemed risky if the contracts are short, but the main problem for the bank is the difficulty to realise the value of the contracts in case of default of the debtor. A realisation means that someone else than the original debtor needs to continue delivering on the contracts. The bank is often not fit to do this itself, hence this model requires other parties to take over the contracts. This is both a new – and potentially cumbersome – type of collaboration situation for the bank, but more importantly these actors may not exist in a new market with new product-service offerings. As expressed by one bank expert exploring contract-based collateral:

> *"If the collateral is the contract, what happens at bankruptcy? If the service provider cannot deliver the service, then the bank will have to find a new partner to take over the contracts/service delivery. So, it's like a "back up service market". This can of course be a challenge for start-ups/new service markets." – Bank expert*

The more services that have been added to the offering (perhaps to achieve competitive advantage and non-imitability via services), the more difficult to replicate for a "stand-in partner". Or in the words of an interviewed entrepreneur:

> *"The credit companies need a plan for how to take over the [customer] contracts and assets. It is easier with products that are already well-established (with many possible buyers), such as coffee machines. The more complex the service, the more challenging the contract." – Manager at product company*

This challenge is mostly independent of regulations and financial industry practice and more dependent on the number of capable competitors. In our interview study, the challenge was brought up by 1 out of 12 product companies, 2 out of 12 financial actors (or 2 out of 7 banks) and 1 owner representative.

5.2 Business case-based assessment

The business case-assessment is the estimated probability that the collateral will not be needed as such. Typically, a good business case means that the debtor's revenues minus costs will

exceed the agreed payback plan of the loan. The business case is typically assessed using a combination of historical data, comparison to benchmark objects, heuristics about timing and review of financial projections. Below, we summarise our findings regarding each of the 3 assessment categories one by one for the case of PaaS CBM. For each category, PaaS CBM is typically at a disadvantage.

5.2.1 Benchmark values

The probability of future positive cash flow and profitability is assessed using benchmarks and historical financial data. A good benchmark is another firm operating the same business model in the same industry and in the same or similar market. When these benchmarks are not readily available – a situation very likely for PaaS CBM in new industries or in new geographies – the bank finds it challenging to assess the strength of the business case, and they regularly will turn down the credit application with reference to high risk and no track record.

> *"Biggest challenges: 1 [of 2] The models are new, innovative (character of start-up/not proved) which make them risky in general. No track record. Risk assessment is always retrospective. This makes it difficult." – Bank manager*

This challenge is not unique to PaaS CBM. Nevertheless, it constitutes a real barrier for PaaS firms needing finance to scale their operations. In our interview study 1 out of 12 product companies and 4 out of 12 financial actors (or 4 out of 7 banks) stated difficulties related to history, track record and hindsight.

5.2.2 Loan payback timing

The business case assessment of the bank includes both the projected results and the projected cash flow of the debtor. Standard bank loan repayment time frames of 3 – 7 years forces a repayment pace of the debtor, which will aggravate rather than alleviate the initial cash flow challenge of the company, where large investments are needed in the products used in the PaaS CBM. The inherent long-term perspective of PaaS CBM – both in terms of product value retention and profitability potential – is at odds with the standard time perspective of bank loan repayment. A payback time of 5 years does not provide financing matching the economic life of the assets when products will continue to create value over much longer periods of time. This was most explicitly described by two of the credit experts.

"It is always a balance between profitability in the short term and repayment capacity in the long term. The boundary is at around three years." – Bank expert

"Bank credit financing must be possible in relation to the idea. So, repayment time of 3 – 5 years. Innovation loans can be a bit less strict in terms of repayment time. The repayment capacity is an important part of the total assessment." – Credit institute expert

This challenge is generic, due to international bank industry practice of 3 – 7 year-loan payback times and related credit ratings. It will not affect all PaaS CBM equally due to differences in product lifespans. In our interview study, 2 out of 12 product companies, 5 out of 12 financial actors and 1 owner representative mentioned the challenge of short payback periods.

5.2.3 Forced depreciation costs

"Profitability determines if a circular business model gets financed." – Bank manager

With a business case-as-security, the magnitude of future projected profits determines the financeability of the PaaS CBM. Profits are defined as revenues less costs. An important category of costs in any CBM is depreciation of assets. Depreciation is an estimated reduction in value of an item and is treated as a cost on the income statement. Because it is an estimation, and because it affects profits and taxes and investors and creditors, the levels of allowed estimates are highly regulated. As expressed by a bank manager, musing about solutions to the challenge of inventory as collateral:

"Today's accounting rules: The assets are forced to be moved from inventory to fixed assets. [But still] depreciation towards zero, though the asset would then still generate revenue." – Bank manager

But in a CBM, the logic of value creation is centred around products retaining their value between uses. Further, the cost structure of a CBM is centred around value retention, often incurring many other costs such as maintenance and repairs to achieve this goal. As mentioned above, a business with circular ambitions will likely opt to incur higher initial investment costs to acquire products that better retain value. This means that in the cost entry of the income statement, a CBM will incur costs twice – once for activities and resources meant to prevent loss of value to the asset, and once as a heuristic, regulated depreciation of the asset value. In other words, the income statement

of a CBM is likely to overestimate costs and underestimate profits under accounting practices favoured by banks assessing the business case for a loan.

These accounting practices are international (through Generally Accepted Accounting Practices), so this disadvantage is likely to be very generic. In our interview study, the challenge was brought up by 5 out of 12 product companies, 5 out of 12 financial actors and 1 of the expert representatives.

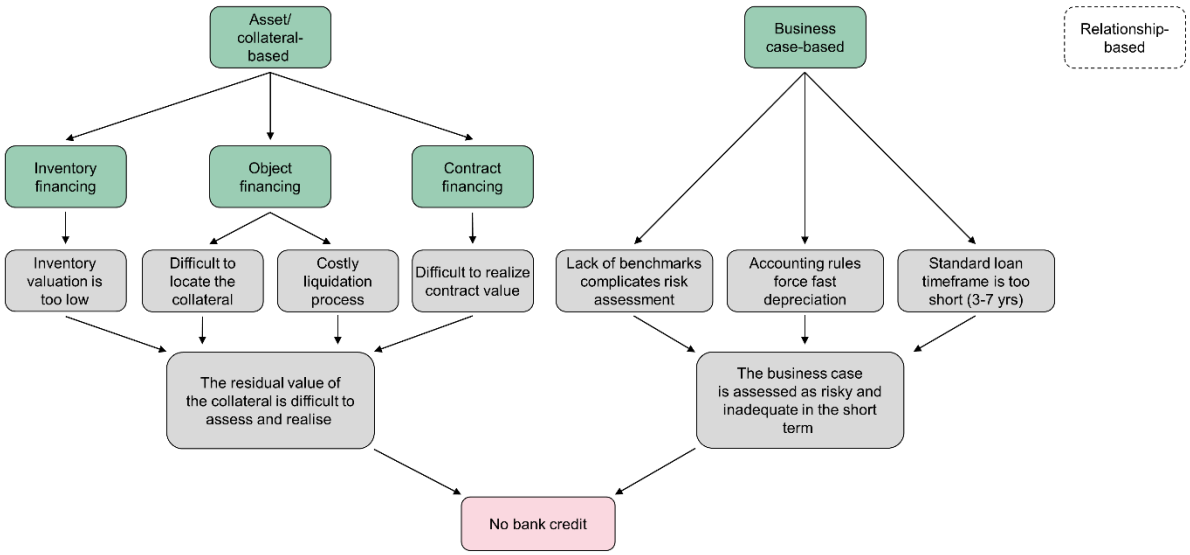
5.3 Summary of PaaS CBM financing challenges

Fel! Hittar inte referenskälla. below summarises the number of contacted organisations that spontaneously brought up each of the challenge categories in the unstructured interviews, and figure 1 summarizes and structures the detailed findings of challenges for financing PaaS CBM.

Table 3
Frequency of the various PaaS CBM financing challenges in the original unstructured interviews.

	Product company (incl. owner representative)	**Financial actors**	**Expert organisations**
Organisations	12	12	3
Collateral-based			
Low inventory valuation	2	2	1
Collectability of collateral	2	3	1
Cost of liquidation	5	3	
Contract value specificity	2	2	
Business case-based			
Benchmark values	1	4	
Loan payback timing	3	5	
Forced depreciation costs	5	5	1

Figure 1
Structured findings of challenges for financing PaaS CBM



6. Discussion

We have shown that it is challenging to finance a PaaS CBM via bank loans. We have added further empirical evidence and detail to the claim (Beltramello et al., 2013; Grafström and Aasma, 2021; Kirchherr et al., 2018; Toxopeus et al., 2021; Vermunt et al., 2019) that financing likely is a barrier to a circular economy transition. We can answer our first research question "Is availability of bank financing a problem for scaling PaaS CBM business?" with a "yes". Consequently, we proceded to answer our second research question "what are the explanatory factors from a bank credit process perspective?", in order to understand the speecifics of the nature, causes and generality of the barriers to PaaS CBM bank financing. We have illustrated the answer in Figure 1, adding clarity to existing literature's more general claims that financing can be a barrier. Our results – although based on a small sample – also seem to confirm earlier studies (Henry et al., 2020; Rizos et al., 2016) showing that smaller firms and start-ups are more likely to encounter the problem.

We have shown that challenges are caused by a mix of internationally convergent regulation and semi-regulation (bank risk and credit rating regulation, and depreciation rules under GAAP/IFRS) and long-term industry practices (benchmarks, payback schedules). This proves the generality of the problem and means that PaaS CBM can be expected to be disadvantaged in terms of bank loans in many countries and for a long time ahead. By showing this, we help validate previously, more superficially explored CBM barriers related to lack of

access to finance (Acsinte and Francine, 2015; Fischer and Pascucci, 2017; Hartley et al., 2021; Pavoni, 2019; Vermunt et al 2019). For instance, Vermunt et al. (2019) briefly describe that 7 out of 8 interviewed PaaS CBM product firms consider financial barriers to be significant barriers. This paper contributes with both more detailed causal explanations and generalisability over time and between countries. Aranda-Usón et al. (2019) sent a survey to 1,000 companies, receiving responses from 87, and found that circular activities in general (not limited to PaaS CBM) was quite dependent on internal (equity) and government-backed financing. Our paper helps explain why bank loans were underused. Demirel and Danisman (2019) discovered via a dataset of 5,100 small and medium-sized European firms that traditional debt finance was uncorrelated to CBM revenue growth whereas equity financing (angel and venture capital) was positively correlated. We help explain that result partly, by showing that one oft-celebrated growth-oriented type of CBM – PaaS CBM – likely was at a disadvantage for traditional debt financing in their dataset – and that we have reason to expect similar results for other countries and over time. Toxopeus et al. (2021) categorised their interview findings in a matrix with rows from the Osterwalder et al. (2005) business model ontology and columns from the three main credit security categories collateral, business case and relationships. Fallahi et al. (2022) adopted a similar structure of asset-based and business case-based solutions for financing of PaaS CBM. Both papers focus on solution strategies, while our paper add structure and detail to the problem description.

We have also added empirical evidence to the the perception of financing as a barrier to PaaS CBM via two separate data collection methods from a sizable number of Swedish banks and financial actors, and Swedish product companies, with confirmation from financial actors from the United Kingdom and the Netherlands. The number of positive responses regarding perceived barriers and the perceived generic causes of the barriers give cause to expect that interested professionals (product companies, banks) also outside our sample would recognise the problem categories below. Especially among small firms. The validity of the causal linkages is however limited by the cross-sectional design and must be evaluated on conceptual grounds.

We acknowledge that the data collection of our study was based predominantly on input from Swedish actors, resulting in a geographical limitation of our study. Nevertheless, our results point at the need to further explore a number of areas, and we see particular potential in the following topics:

- Exploration of the whole potential theoretical space of financing for PaaS CBM. We began our exploration of bank financing from a point of departure where our company partners exploring CBM with us, up until that point, had used equity financing. While equity financing is very suitable for

validating the business model and initial proof of scalability, it seems too expensive during later up-scaling given that the product longevity is meant to provide a cost advantage in a CBM. Future research should continue the work of Fallahi et al (2022) and explore and search for more suitable solutions in between those two extremes.

- Better tools for market value estimation of PaaS CBM future adaptive designed products in case of default. Such tools, if audited by third parties, might allow banks and other stakeholders to be more comfortable with departing from current depreciation heuristics. And for PaaS CBM operators to gain important information about their products.
- Customer financing and non-conventional financing technologies based on local knowledge. For instance, a lending solution based on distributed staking in debtors' payback ability in order to generate a likelihood-estimator of payback. Solutions where actors with insight (e.g., customers) can assess the likely viability of the specific PaaS CBM instead of banks assessing it using general heuristics supposed to fit all firms perhaps administrated via blockchains, perhaps via a deposit system.
- The policy and regulation space needs to be explored further. For instance, we found that rules pertaining to asset depreciation rates matter for PaaS CBM. The rules for asset depreciation are often enforced by tax agencies and are sometimes changed locally for some industry or initiative by parliaments. Also rules and institutions around loan payback times and linked credit ratings hinder scaling of PaaS CBMs through bank credit. Future research should explore regulatory solutions to the problem explored and explained in this paper.

In terms of practical and strategic implications, we suggest the following:

- For banks these problems are likely to constitute a potential business opportunity. By seeking to resolve the issues presented above, on their own or together, banks can gain access to the market of circular economy innovator firms. By doing so quickly, some banks may gain early mover advantages.
- For policy makers, we urge a reconsideration of current depreciation regulation, loan pay-back times and credit rating systems, as well as the use of accelerated depreciation as an incentive for environmental action. This will reduce one of the obstacles to scalability for circular business models.
- Product firms experimenting with product-as-a-service circular business models should not assume the availability of low-cost bank financing as they scale these offerings. Instead, businesses should explore the

alternative strategies to reduce the cost of financing their ventures, for example those explored in Fallahi et al. (2022).

7. Concluding remarks

We have in this paper asked if bank financing is a problem for scale-up of PaaS CBM business, and if so, what the explanatory factors are. We have based our conclusions on a summary of the available literature, a survey, and interviews with 18 product companies, 16 financial actors and 4 expert organisations. We conclude that yes, low availability of or high cost of bank financing is likely to be a problem for scale-up of many PaaS CBM.

We also conclude that the explanatory factors are numerous and intricate. For example, three of the many explanatory factors which we have explained in detail are: (1) A PaaS CBM source of competitive advantage (non-imitability through complex services) is directly at odds with bank security assessment, since the non-imitability disqualify customer contracts as collateral, (2) Country level differences in object financing pricing affect the (perceived) cost of collateral liquidation, meaning scale-up internationally and locally in some countries will likely be more challenging than in others and (3) International de-facto accounting regulation (GAAP/IFRS) forces short payback times for inventory collateral and negatively affects the business case projections.

These results should be viewed in light of that the diffusion of circular economy business practices is likely to contribute to a reduction in environmental harm from business. One of the most popular business model innovations to leverage the circular economy, in both practice and scientific literature, is product-as-a-service circular business models. These business models quickly incur high capital requirements, and current regulations and financial practices are likely to further increase their cost of capital. This is likely to delay the uptake of circular business models, delay the transition to a circular economy and thereby cause the environmental crises of our time to deteriorate rather than be solved.

References

ABN AMRO, ING, RABOBANK (2018) Circular Economy Finance Guidelines. https://www.abnamro.com/en/images/Documents/040_Sustainable_banking/Publications/ABN_AMRO_Circular_Economy_Finance_Guidelines_2018.pdf. Accessed 16 Apr 2019

Acsinte, S., Francine M (2015) Assessment of access-to-finance conditions for projects supporting Circular Economy (Rep.). European Commission. http://www.eib.org/attachments/press/innovfin-advisory-report-on-circular-economy-executive-summary-public.pdf. Accessed 1 Jul 2022

Adams K, Osmani M, Thorpe A, Thornback J (2017) Circular economy in construction: current awareness, challenges and enablers. Waste and Resource Management 170(1):1–11. https://doi.org/10.1680/jwarm.16.00011

Aranda-Usón A, Portillo-Tarragona P, Marín-Vinuesa LM, Scarpellini S (2019) Financial Resources for the Circular Economy: A Perspective from Businesses. Sustainability 11(3):888. https://doi.org/10.3390/su11030888

Ayati MS, Shekarian E, Majava J, Waehrens VB (2022) Toward a circular supply chain: Understanding barriers from the perspective of recovery approaches, Journal of Cleaner Production 359:131775, ISSN 0959-6526. https://doi.org/10.1016/j.jclepro.2022.131775

Beltramello A, Haie-Fayle L, Pilat D (2013) Why New Business Models Matter for Green Growth. OECD Green Growth Papers, OECD Publishing. No 2013/1

Björkdahl J (2009) Technology cross-fertilization and the business model: The case of integrating ICTs in mechanical engineering products. Research Policy 38:1468–147

Boons F, Lüdeke-Freund F (2013) Business models for sustainable innovation: state-of-the-art and steps towards a research agenda. Journal of Cleaner production 45:9-19

Briguglio M, Llorente-González LJ, Meilak C, Pereira Á, Spiteri J, Vence X (2021) Born or Grown: Enablers and Barriers to Circular Business in Europe. Sustainability 13(24):13670. https://doi.org/10.3390/su132413670

Corvellec H, Stowell FA, Johansson N (2021) Critiques of the circular economy, Journal of Industrial Ecology 26:421-432. https://doi.org/10.1111/jiec.13187

de Jesus A, Mendonça S (2018) Lost in Transition? Drivers and Barriers in the Eco-innovation Road to the Circular Economy. Ecological Economics 145:75–89. https://doi.org/10.1016/j.ecolecon.2017.08.001

de la Cuesta-Gonzàlez M, Morales-Garcia M (2021) Does finance as usual work for circular economy transition? A financiers and SMEs qualitative approach. Journal of Environmental Planning and Management 65(13):2468-2489. https://doi.org/10.1080/09640568.2021.1972798

Demirel P, Danisman GO (2019) Eco-innovation and firm growth in the circular economy: Evidence from European small- and medium-sized enterprises. Business Strategy and The Environment 28:1608–1618. https://doi.org/10.1002/bse.2336

EMF (2012) Towards the Circular Economy Vol. 1: an economic and business rationale for an accelerated transition. Ellen MacArthur Foundation, Cowes, Isle of Wight

EMF (2013) Towards the Circular Economy Vol. 2: opportunities for the consumer goods sector. Ellen MacArthur Foundation, Cowes, Isle of Wight

EMF (2014) Towards the Circular Economy Vol. 3: Accelerating the scale-up across global supply chains. Ellen MacArthur Foundation, Cowes, Isle of Wight

EMF (2020a) Strategic partnerships. https://www.ellenmacarthurfoundation.org/our-work/approach/business. Accessed 16 Nov 2020

EMF (2020b) Financing the circular economy: Capturing the opportunity. https://www.ellenmacarthurfoundation.org/assets/downloads/Financing-thecircular-economy.pdf. Accessed 15 Oct 2020

European Commission (2020) A circular economy action plan – for a cleaner and more competitive Europe. https://op.europa.eu/en/publication-detail/-/publication/45cc30f6-cd57-11eaadf7-01aa75ed71a1/language-en/format-PDF/source-170854112. Accessed 1 Nov 2020

European Commission, Directorate-General for Enterprise and Industry (2014) European competitiveness report 2014: helping firms grow, Publications Office. https://data.europa.eu/doi/10.2769/28020. Accessed 11 Jan 2022

Fallahi S, Mellquist AC, Mogren O, Listo Zec E, Algurén P, Hallquist L (2022) Financing solutions for circular business models: Exploring the role of business ecosystems and artificial intelligence. Business Strategy and the Environment 1– 16. https://doi.org/10.1002/bse.3297

FinanCE/CE100 (2016) Money makes the World Go Around. http://www.circle-economy.com/moneymakestheworldgoround. Accessed 16 Apr 2019

Fischer A, Pascucci S (2017) Institutional incentives in circular economy transition: The case of material use in the Dutch textile industry. Journal of Cleaner Production, 155(2):17-32. https://doi.org/10.1016/j.jclepro.2016.12.038.

Frishammar J, Parida V (2019) Circular business model transformation: A roadmap for incumbent firms. California Management Review, 61(2):5-29.

Geissdoerfer M, Savaget P, Bocken NMP, Hultink EJ (2017) The Circular Economy–A new sustainability paradigm?. Journal of cleaner production 143:757-768

Govindan K, Hasanagic M (2018) A systematic review on drivers, barriers, and practices towards circular economy: a supply chain perspective. International Journal of Production Research 56(2), 1-34. http://doi.org/10.1080/00207543.2017.1402141

Grafström J, Aasma S (2021) Breaking circular economy barriers. Journal of Cleaner Production 292, 126002, ISSN 0959-6526, https://doi.org/10.1016/j.jclepro.2021.126002

H&M (2019) H&M to trial clothing rentals for the first time. https://about.hm.com/news/general-news-2019/h-m-to-trial-clothing-rentals-for-the-first-time.html. Accessed 30 Nov 2022

Hartley K, Roosendaal J, Kirchherr J (2021) Barriers to the circular economy: The case of the Dutch technical and interior textiles industries. Journal of Industrial Ecology 26:477-490. https://doi.org/10.1111/jiec.13196

Henry M, Bauwens T, Hekkert M, Kirchherr J (2020) A typology of circular start-ups: An Analysis of 128 circular business models, Journal of Cleaner Production, Volume 245, 118528, ISSN 0959-6526, https://doi.org/10.1016/j.jclepro.2019.118528.

Hsieh H-F, Shannon SE (2005) Three Approaches to Qualitative Content Analysis. Qualitative Health Research 15(9):1277–1288. https://doi.org/10.1177/1049732305276687

IEMA (2018) IEMA Guide on Sustainable Finance, Lincoln: IEMA.

Ingka Group (2019) IKEA to test furniture leasing in 30 markets during 2020. https://www.ingka.com/news/ikea-to-test-furniture-leasing-in-30-markets-during-2020/. Accessed 30 Nov 2022

ING bank (2015) Rethinking finance in a circular economy – financial implications of circular business models. https://www.ing.nl/media/ING_EZB_Financing-the-Circular-Economy_tcm162- 84762.pdf. Accessed 16 Apr 2019.

Jabbour CJC, de Sousa Jabbour ABL, Sarkis J, Godinho Filho M (2019) Unlocking the circular economy through new business models based on large-scale data: an integrative framework and research agenda. Technological Forecasting and Social Change, 144:546-552

Kirchherr J, Piscicelli L, Bour R, Kostense-Smit E, Muller J, Huibrechtse-Truijens A, Hekkert M (2018) Barriers to the Circular Economy: Evidence From the European Union (EU), Ecological Economics 150:264–272, ISSN 0921-8009. https://doi.org/10.1016/j.ecolecon.2018.04.028

Kirchherr J, Reike D, Hekkert M (2017) Conceptualizing the circular economy: An analysis of 114 definitions. Resources, Conservation and Recycling 127:221-232. https://doi.org/10.1016/j.resconrec.2017.09.005

Kok L, Wurpel G, Ten Wolde A (2013) Unleashing the Power of the Circular Economy. Amsterdam. Report by IMSA Amsterdam for Circle Economy April 2. http://mvonederland.nl/system/files/media/unleashing_the_power_of_the_circular_economy-circle_economy.pdf

Linder M, Williander M (2017) Circular business model innovation: Inherent uncertainties. Business Strategy and The Environment 26:182–196. https://doi.org/10.1002/bse.1906

Lüdeke-Freund F, Gold S, Bocken NMP (2019) A review and typology of circular economy business model patterns. Journal of Industrial Ecology 23:36-61

Min Z, Sawang S, Kivits RA (2021) Proposing Circular Economy Ecosystem for Chinese SMEs: A Systematic Review. International Journal of Environmental Research and Public Health 18(5):2395. https://doi.org/10.3390/ijerph18052395

Mishra JL, Hopkinson PG, Tidridge G (2018) Value creation from circular economy-led closed loop supply chain: a case study of fast-moving consumer goods. Production, Planning & Control 29(6):509–521. https://doi.org/10.1080/09537287.2018.1449245

Ormazabal M, Prieto-Sandoval V, Puga-Leal R, Jaca C (2018) Circular Economy in Spanish SMEs: Challenges and Opportunities. Journal of Cleaner Production 185:157– 167. https://doi.org/10.1016/j.jclepro.2018.03.031

Osterwalder A, Pigneur Y (2010) Business Model Generation A handbook for Visionaries, Game Changers and Challengers. John Wiley & Sons, Inc., Hoboken

Osterwalder A, Pigneur Y, Tucci CL (2005) Clarifying business models: Origins, present, and future of the concept. Communications of the Association for Information Systems 15(1):1–25. https://doi.org/10.17705/1CAIS.01601

Pavoni S (2019) Sustainability: Will a Circular Economy Save the World? The Banker (FT publication), 169(1116):1–4.

Preston F (2012) A Global Redesign? Shaping the Circular Economy. Energy, Environment and Resource Governance. Chatham House, London

Reim W, Sjödin D, Parida V (2021) Circular business model implementation: A capability development case study from the manufacturing industry. Business Strategy and the Environment 30(6):2745–2757. https://doi.org/10.1002/bse.2891REIMET AL.2757.

Rizos V, Behrens A, Van der Gaast W, Hofman E, Ioannou A, Kafyeke T, Flamos A, Rinaldi R, Papadelis S, Hirschnitz-Garbers M, Topi C (2016) Implementation of circular business models by small and medium-sized enterprises (SMEs): Barriers and enablers. Sustainability 8(11):1212. https://doi.org/10.3390/su8111212

Rogers E (1962) Diffusion of Innovations. Free Press of Glencoe, New York

Salvioni DM, Bosetti L, Fornasari T (2022) Implementing and Monitoring Circular Business Models: An Analysis of Italian SMEs. Sustainability 14(1):270. https://doi.org/10.3390/su14010270

Seles, B. M. R. P., Mascarenhas, J., Lopes de Sousa Jabbour, A. B., & Trevisan, A. H. (2022). Smoothing the circular economy transition: The role of resources and capabilities enablers. Business Strategy and the Environment, 31(4), 1814– 1837. https://doi.org/10.1002/bse.2985

Tonelli M, Cristoni N (2018) Strategic Management and the Circular Economy. Routledge, New York. https://doi.org/10.4324/9781315102641.

Toxopeus H, Achterberg E, Polzin F (2021) How can firms access bank finance for circular business model innovation? Business Strategy and the Environment 30(6):2773–2795. https://doi.org/10.1002/bse.2893

Tukker A (2004) Eight types of product – Service system: Eight ways to sustainability? Experiences from suspronet. Business Strategy and the Environment 13:246–260.

Tura N, Hanski J, Ahola T, Ståhle M, Piiparinen S, Valkokari P (2019) Unlocking circular business: A framework of barriers and drivers. Journal of Cleaner Production 212:90–98. https://doi.org/10.1016/j.jclepro.2018.11.202

Uhrenholt NJ, Kristensen HJ, Rincón CM, Jensen FS, Waehrens VB (2022) Circular economy: Factors affecting the financial performance of product take-back systems. Journal of Cleaner Production 335:130319, ISSN 0959-6526, https://doi.org/10.1016/j.jclepro.2021.130319.

United Nations Environment Programme Finance Initiative (2020) Financing Circularity: Demystifying Finance for Circular Economies. https://www.unepfi.org/publications/general-publications/financing-circularity/. Accessed 20 Oct 2020

Vermunt DA, Negro SO, Verweij PA, Kuppens DV, Hekkert MP (2019) Exploring barriers to implementing different circular business models. Journal of Cleaner Production 222:891–902, ISSN 0959-6526. https://doi.org/10.1016/j.jclepro.2019.03.052

Wasserbaur R, Sakao T, Milios L (2022) Interactions of governmental policies and business models for a circular economy: A systematic literature review. Journal of Cleaner Production 337:130329. https://doi.org/10.1016/j.jclepro.2021.130329

World Economic Forum (2022) The Global Risks Report 2022: 17th Edition. https://www.weforum.org/reports/global-risks-report-2022. Accessed 30 Nov 2022

Whalen K (2020) Circular Business Models that Extend Product Value: Going Beyond Recycling to Create New Circular Business Opportunities. International Institute for Industrial Environmental Economics, Lund University.

This is a research paper based on accumulated knowledge from several years of research and customer interaction at the unit Sustainable Business at RISE

RISE – Research Institutes of Sweden
ri.se / info@ri.se / 010-516 50 00
Box 857, 501 15 BORÅS

Grants Office/Informationscenter
RISE Rapport: 2023:151
ISBN: 978-91-89896-42-0