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**The challenges faced in the reverse logistics of automotive cores: lessons from co-creation with stakeholders.**

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**Abstract**

This paper presents the results of two co-creation sessions with stakeholders in the automotive aftermarket. The sessions were instigated as part of the EU project ReCiPSS to develop a new service to simplify the reverse logistics of automotive cores purposed for remanufacturing. Remanufacturing car parts is a longstanding practice within the automotive aftermarket. Over the last fifty years a mature, but also highly complex, market has developed. The reverse logistics of these cores substantially increases the complexity and costs of the remanufacturing process due to the fact that they are repeatedly shipped, handled, (re)identified and (re)assessed for quality and their remanufacturability by different actors within the supply chain. This is due to the fact that most cores are returned along the exact same route that the (remanufactured) replacement part took in the forward logistics, using a so called ‘surcharge’ or ‘deposit’ system. Core broker networks are used to fill in the gaps where not enough cores are coming in through the surcharge system. Together, this forms a complicated network. The current setup has benefits, e.g. with regards to customer relationships and higher return rates, but also provides the necessary challenges. To identify these benefits and challenges, as well as the needs of different stakeholders within the supply chain, a series of co-creation sessions were held with different actors. This paper presents the results of two sessions. This first was with a wholesaler, the second with several core brokers and a service provider. New insights were gained on the landscape of reverse logistics of automotive cores and the challenges different stakeholders are facing. These are presented in the paper in graphic overviews. Challenges include a lack of transparency and traceability leading to distrust, poor identification possibilities of cores, as well as threats from cheap infill and copies. With these results, new value propositions for the different stakeholders were developed. These were used to design and pilot an online platform together with a single service provider. The platform aims to benefit the different stakeholders while simultaneously reducing the complexity of the reverse logistics by identifying and evaluating cores only once before being directly shipped to their final destination. The paper concludes by highlighting the opportunities and challenges that the remanufacturing market is facing, based on the insights gathered from different stakeholders, and the implications for the future of the remanufacturing industry and policy.

**Keywords:** co-creation, automotive cores; reverse logistics; wholesalers; core brokers

**Introduction**

The circular economy hinges on the circular flows of products to close loops (Ellen MacArthur Foundation, 2013). Enabling the reserve logistics or ‘product recovery networks’ (Fleischmann et al., 2000) e.g. for remanufacturing, is therefore an essential process that is currently unfortunately still not commonplace in many product sectors. As an exception, the reverse logistics of car parts is a longstanding practice from which much can be learned. Remanufactured car parts play a small but crucial role in the automotive aftermarket: e.g. they provide affordable alternatives in the years that OEM’s are still required

to provide spare parts for cars that are no longer in production, resulting in strong increases in production costs of new spare parts. Over the last fifty years a mature, but also highly complex (Olugu et al., 2010; Sundin & Dunbäck, 2013), market has developed, yet it also faces significant challenges. To set up a remanufacturing process, companies need access to cores. A core is “a previously sold, worn or non-functional product or part, intended for the remanufacturing process. During reverse logistics, a core is protected, handled and identified for remanufacturing to avoid damage and to preserve its value. A core is not waste or scrap and is not intended to be reused before remanufacturing.” (CLEPA, 2016). The complexity and costs of the remanufacturing process are significant and are particularly influenced by the reverse logistics of these cores due to the fact that they are repeatedly shipped, handled, identified, assessed and stored for quality and their remanufacturability by different actors within the supply chain. As a consequence, some actors currently feel this process involves too much work (Huetter, 2020).

To reduce the complexity of these reverse logistic flows, a platform is being developed and trialed as part of the H2020 project ReCiPSS. To develop this platform in a manner that has added value for different stakeholders within the supply chain, they are being actively involved in the development. This is being done through the use of co-creation. The goal of the co-creation is to inspire and engage the project team and create empathy for the users of the platform. (Sleeswijk Visser et al., 2007). Several co-creation sessions with different stakeholders within the supply chain were planned to understand their needs and vantage points. This paper presents the results of two co-creation sessions and gives insight into the complexity of the reverse logistics of cores from the perspective of different stakeholders within the supply chain and the challenges they are facing. This complements Sundin and Dunbäck's (2013) study that focused on the challenges faced by remanufacturers. First, a backdrop on the return process of cores is given after which the co-creation approach applied in this study is explained. Consecutively, the results of the co-creation process are presented in the form of four overviews on the reverse logistics structures of a wholesaler and core brokers as well as the specific challenges these stakeholders are facing.

## Obtaining Cores

Within the automotive industry in Europe and North America, there are two predominant methods to obtain cores: through the surcharge system (or ‘exchange program’) and through core brokers (buy-back). The most common method is the surcharge system and it is used within the automotive aftermarket for spare parts. The automotive aftermarket is roughly split into two main channels, the OES (Original Equipment Suppliers) and IAM (Independent Aftermarket) and consists of many trade levels, some of which interlink the two channels. Within the surcharge system, when workshops/garages purchase a *remanufactured* spare part, they pay a surcharge (sometimes also called a deposit) on the part which gives them a ‘right-to-return’ the used part: When they remove the used part, i.e. ‘core’ from the car, they often place this core back in the same box the remanufactured part was delivered in (a back-in-box system). These cores are collected and sent along the same route back to the supplier they purchased the remanufactured car parts from. This trade level then checks the cores, reimburses the surcharge to the workshop/previous trade level, and sends the cores on to their own supplier(s). This process is then repeated all the way until the cores reach the remanufacturer(s) who then makes their own assessment of the cores and makes a balance of the surcharges that are owed, based on a number of assessment criteria, which differ per remanufacturer. Two types of assessment criteria are common: Technical criteria (e.g. is correct type of part returned or is there visible damage such as parts broken off or corrosion) and surcharge relevant criteria (e.g. did the customer actually buy a replacement part, and is it returned within the “core return window”). If a core is not returned within a pre-set time limit the right-to-return becomes void.)

If someone in this supply chain, e.g. the remanufacturer, makes a different assessment of the core and rejects it, it means that their customer, e.g. the wholesaler, will have to book a loss for the surcharge because they accepted the core and reimbursed their own customer, e.g. the workshop, which gives them a

financial risk. This surcharge system provides the majority of cores for OE remanufacturers. OE remanufacturers in certain cases also remanufacture the cores of other OEMs and, additionally, independent remanufacturers operate on the market which may give alternative routes that a core may follow. When a *new* spare part is bought instead of a remanufactured part, the core that comes out of the car is either lost or indirectly filters back into the system through core brokers.

Core brokers networks are used to fill in the gaps where not enough cores coming in through the surcharge system or to prepare for a (potential) future remanufacturing line. Here, remanufacturers buy cores from a network of core brokers who source their cores from a variety of suppliers such as workshops, scrapyards, wreckages, other core brokers, etc. Remanufacturers and core brokers regularly exchange lists of specific OE numbers with accompanying quality criteria that they are looking for or respectively have in stock.

To navigate the complexity of the aftermarket, the automotive demonstrators within the ReCiPSS project focuses on developing a new reverse logistics service and platform through a single service provider. This single service provider already handles the reverse logistics of cores for different parties within the supply chain and with the new platform aims to be able to simplify the reverse logistics of cores by directly shipping them to their final destination. A centralized clearinghouse will allocate the related value of the transaction to each trade level and enables the decoupling of the physical from the financial flows. Because the different trade levels are skipped, cores only need to be identified and evaluated once, thereby reducing overall (remanufacturing) costs.

In the development of the platform, it is essential to include stakeholders in the development process so that it fits their needs and has added value for the different actors. An advantageous approach with proven benefits is co-creation (Roos, 2015; van Dam et al., In press). Co-creation methods enable users and other relevant stakeholders to participate in the design process of new service and product offerings (Holmlid et al., 2015; Sanders & Stappers, 2008). Through co-creation, stakeholders' needs can be identified and translated into potential opportunities and barriers for the development of the reverse logistics platform and service. This following section will explain how it was applied within this study.

## **Method/approach**

Co-creation was initiated by an extensive preparation process. First, several workshops were held with the ReCiPSS and company project team to decide on a plan of action, narrow down in which areas it was most essential to receive input from stakeholders and which questions were most pressing. It was decided to first interview several actors within the supply chain and, based on the knowledge gathered through this method, narrow down which specific topics to address through co-creation. The interviews were conducted with 18 French and German spare parts dealers and core brokers and are reported on in Plaček et al. (in press). Based on the outcomes, co-creation sessions were planned with different stakeholders within the supply chain and this paper reports on the first two sessions which were held.

## **German wholesaler co-creation session**

The first co-creation session was held with a medium sized wholesaler from Germany with an €100m turnover in their automotive car parts division. Their specific turnover for remanufactured car parts was roughly €2-3m. In preparation for the workshop, the CEO of the company was interviewed to gain a better understanding of the company. Consecutively, participants were asked to consider five questions beforehand concerning the strengths and challenges the company was facing, and their opinion on the current reverse logistic processes of cores. In the following week, six English-speaking employees from different departments and managerial levels participated in the session, including the sales manager, two store managers, an assistant purchasing manager, e-business manager and the son of the CEO. By bringing together different managerial levels, backgrounds, and experiences, the intent was to bring different perspectives into the dialogue and stimulate discussions. Four project members listened in on the session

as ‘flies on the wall’: they were present to learn from the participants’ experiences first-hand but did not participate in the actual session. The session lasted four hours and was split up into two parts with the lunch break in-between. The session was moderated by the first author and co-moderated by a German-speaking project partner to remedy language barriers.

The first half of the session focused on understanding the current logistics, working methods, processes, and other relevant topics surrounding automotive spare parts and cores including core management, trust and digitalization. This discussion was guided by a list of questions that flowed from the interviews and preparation workshops. Through this process underlying needs, frustrations, motivations, and (company) values became apparent. During the second half, participants were asked to build on this by designing a service that would fit with their needs and ways of working. Firstly, each participant was asked to identify the three most important topics from the previous discussion. Secondly, they were asked to name the first thing they would want to improve in the current reverse logistics process. Thirdly, they were paired up in teams of two to design a reverse logistics service or solution and present this to the other teams.

### **Core broker context-mapping session ReMaTec**

The second session focused on core brokers and their supply chain. The session was held during the ReMaTec show in Amsterdam to enable diverse core brokers from different countries to attend due to their presence at the show. This gave strong logistical and practical advantages for gathering a diverse group of partners around one table, but did limit the amount of time available for the workshop. The workshop therefore lasted 1½ hours. Five core brokers from England and Germany, a purchasing core broker (from a remanufacturer) and a (different) reverse logistics service provider participated in the workshop. Like with the wholesaler session, six project team members listened in on the session as ‘flies on the wall’. The session was moderated by the first author and third author to remedy language barriers. The session was guided by a list of questions that built on the interviews and first co-creation session and centered around reverse-logistics, working methods, core management, trust, transparency and challenges they faced with the intent to reveal underlying needs, frustrations, and motivations and ideas they had to improve the current situation. At the end of the session participants were requested to prioritize the ideas and topics that were discussed by identifying their top three topics.

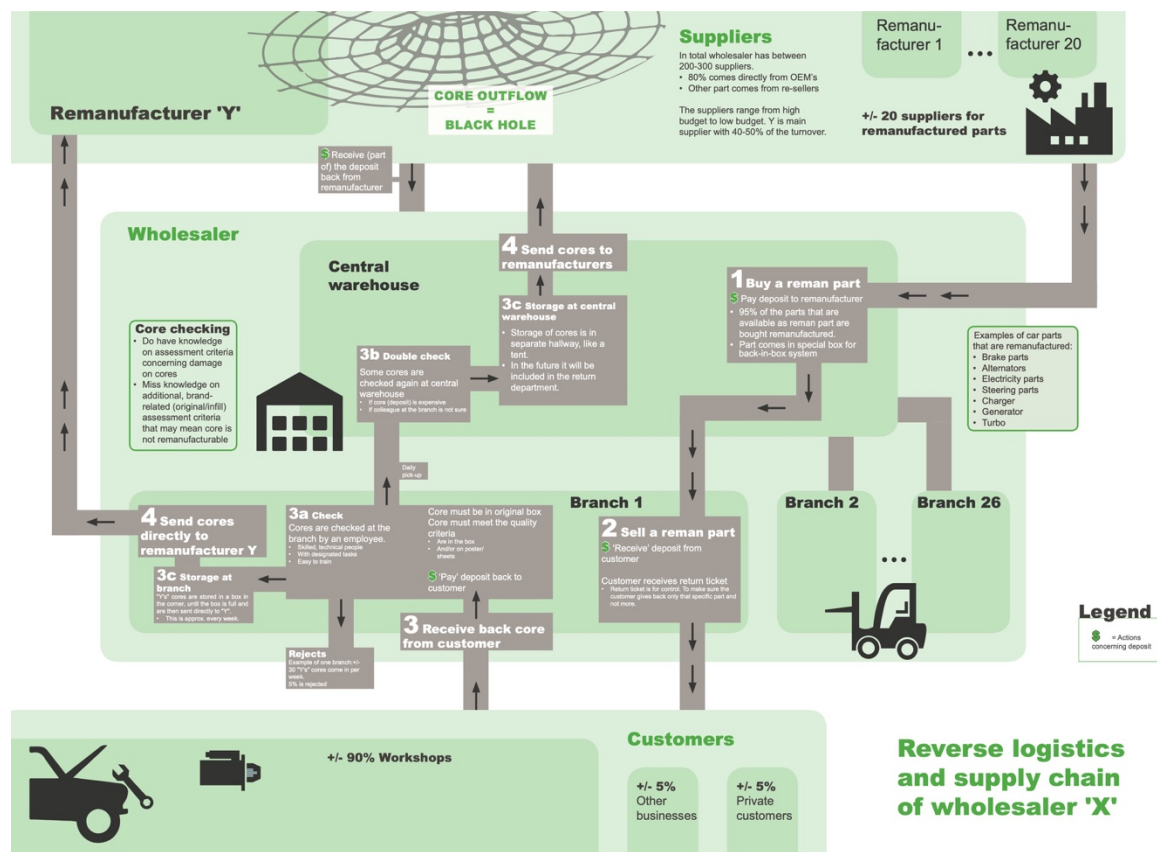
### **Data analysis**

In the weeks following the sessions, the sessions were transcribed verbatim and analyzed using thematic analysis. In several multiday workshops, the transcripts were cut into fragments according to individual topics and then grouped according to overarching themes. Transcripts from each theme were then re-read, if necessary regrouped, and key statements highlighted. Gradually, a subdivision became apparent between factual process/logistics-related topics and ‘soft’ issues. The process-related topics were then mapped in a (forward- and) reverse-logistics flow on one whiteboard for each stakeholder. The ‘soft’ issues were placed on a separate whiteboard for each stakeholder and required a further iterative process to map the relationships and causal effects of the different themes. Through this process, an overview took shape of the landscape within which the wholesalers and core brokers were operating and the main challenges they were facing therein. These four overviews were digitalized into interactive PDF’s with expandable text boxes to enable the inclusion of relevant quotes from participants. In this way, both the strong graphic visualizations as well as the richness of the underlying data could be preserved and presented to development team. In co-creation, it is critical to communicate the insights to those responsible for developing the concept further. They need to have a rich understanding of these insights to be able to develop ideas and incorporate the insights in the creative development process. Therefore, communication strategies that not only inform but also inspire idea generation, and promote empathy with users to achieve a rich understanding of their experiences, are preferred (Sleeswijk Visser, 2009).

## Findings

Figures 1-4 present the results from the co-creation process without quotes. Figures 1 and 2 visualize the (forward- and) reverse logistics of respectively the wholesaler and core brokers. They show for the wholesaler 'X' how remanufactured parts filter into their logistic flows and how cores are then gathered back from their customers, stored, and transported on to different remanufacturers. Remanufacturer 'Y' is the preferred supplier of wholesaler 'X' and therefore their cores are stored separately and, once a box is full, directly shipped to the remanufacturer from individual branches instead of first being sent back and stored at the central warehouse until it is dispatched to other remanufacturers. The reverse logistics overview of the core brokers is quite different because of the specific niche they fulfill in sourcing cores from different places. They exclusively deal with the reverse logistics of cores and as such remanufacturers are portrayed as their customers rather than their suppliers.

Figures 3 and 4 visualize the 'soft' issues and key challenges the wholesaler and core brokers respectively are facing within the landscape they are operating in. These challenges are specific to their business dealings surrounding cores and relate to e.g. business relationships, core management, but also to the specific role core brokers fulfill in the marketplace. Wholesaler 'X' had noticed that they were losing substantial amounts of money because not all deposits were being refunded. However, it was difficult to assess where the problem lay (e.g. who made a 'faulty' assessment) because there are currently little tracking measures in place for an individual core once it is removed from the car: The article nr on the box is no longer consistent with the core placed in the box, matrix codes or other identification on the cores are not always present or no longer readable, and placing stickers on the core itself is undesirable from a remanufacturing perspective and impractical due to grease. Having tried to analyze and optimize their internal processes, they assumed 'it's not us, so it must be them'. The core outflow from them to the remanufacturers was perceived as problematic because they felt they did not receive enough transparency and traceability, and if a core had been rejected, they had little means to verify the assessment and limited.



**Figure 1:** overviews of the reverse logistics and supplychains of automotive cores for wholesaler 'X'

## Reverse logistics and supply chain of core brokers

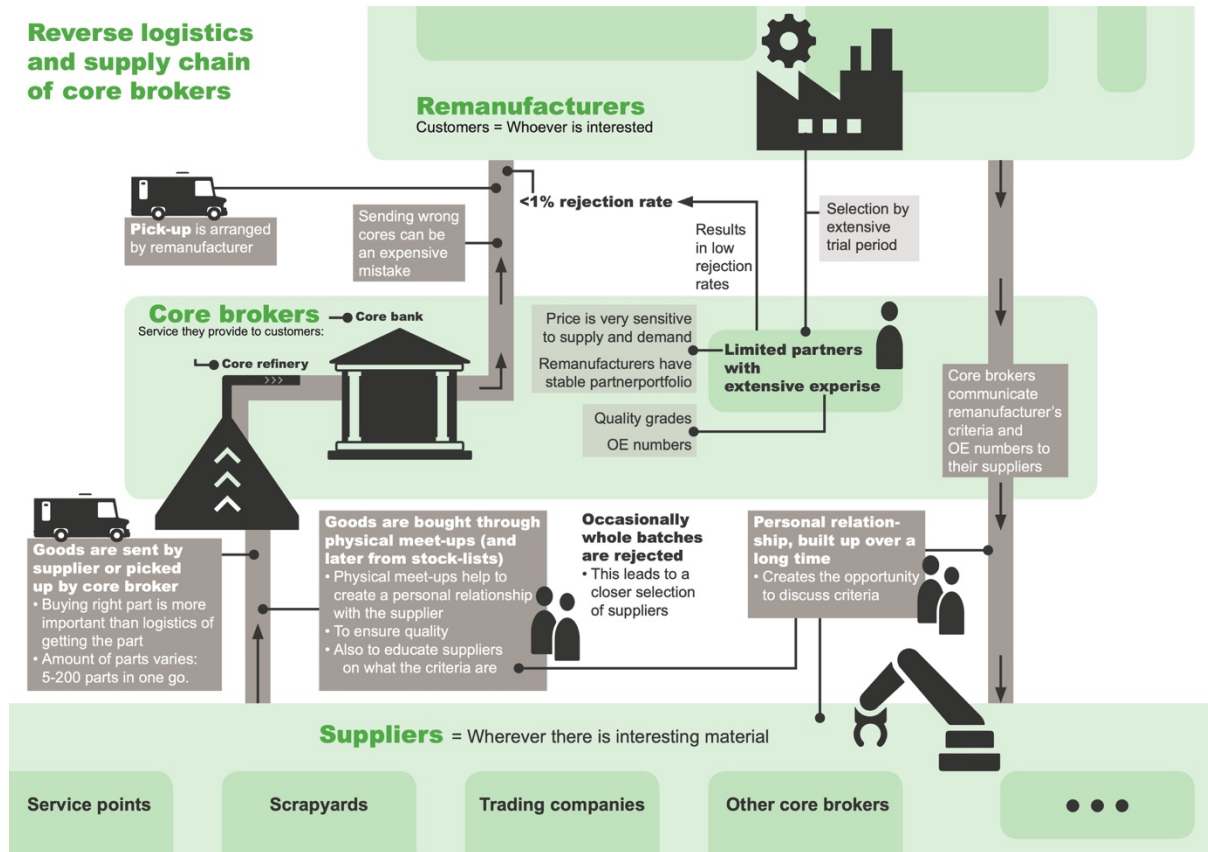


Figure 2: overviews of the reverse logistics and supplychains of automotive cores for core brokers

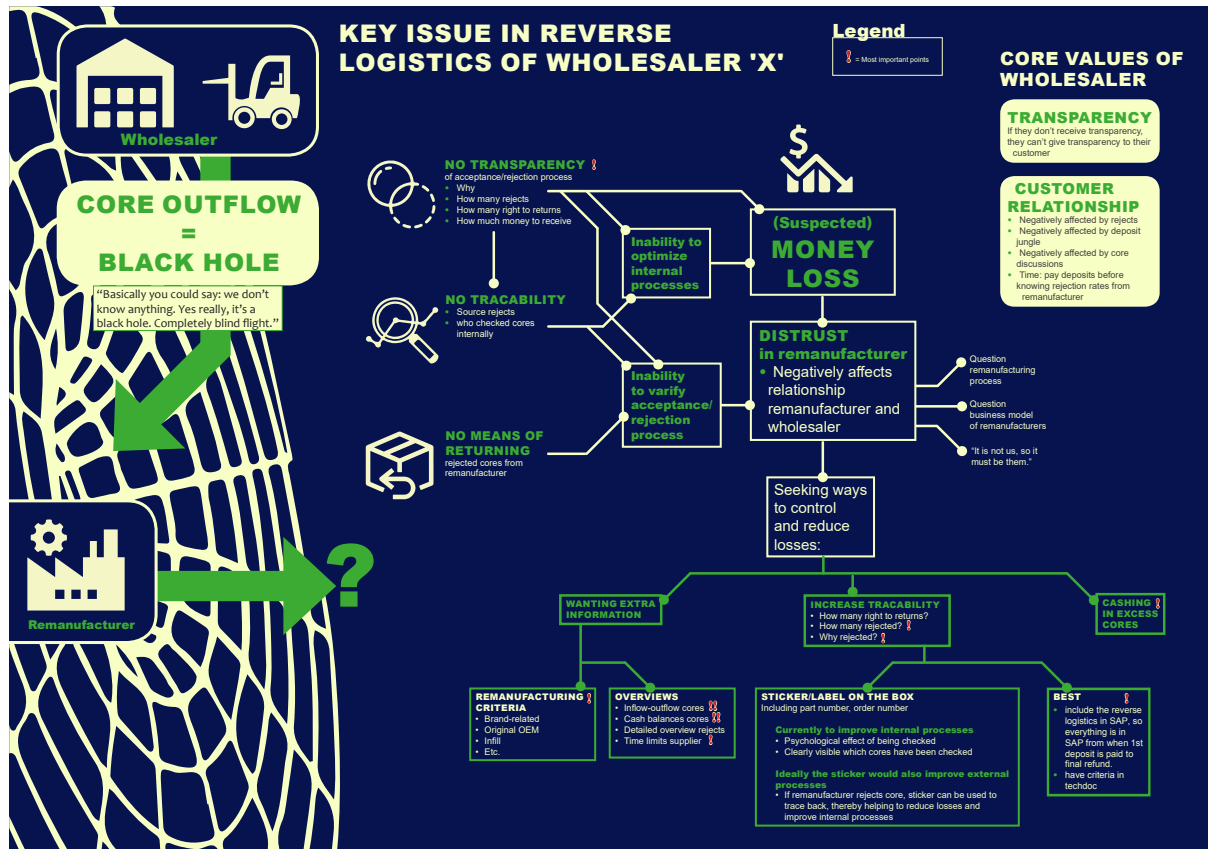
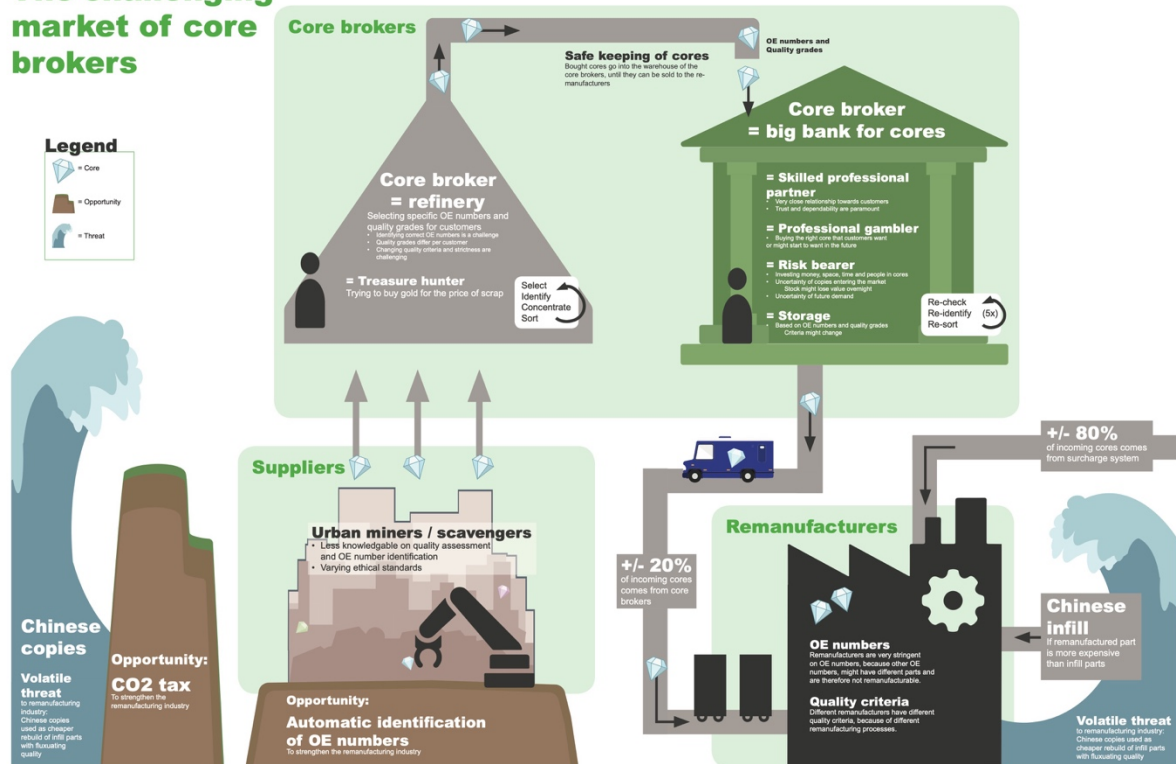


Figure 3: landscapes of reverse logistics of automotive cores and the challenges faced by wholesaler 'X'



## The challenging market of core brokers



**Figure 4:** landscapes of reverse logistics of automotive cores and the challenges faced by core brokers

ability to let a different remanufacturer reassess the core due to the high costs of shipping a core back. This made it difficult for them to trust remanufacturers and their assessment, and resulted in a desire to find ways to control this process better to reduce losses. Key findings from this session are that trust, transparency, and traceability are crucial elements in the setup of reverse logistics services. Additionally, a system to track the reverse logistics of individual cores would be beneficial.

Core brokers, in contrast, work in a different arena. They can be seen as ‘refiners’ in the reverse logistics process: They source cores from ‘urban miners’ who collect or gather cores wherever they can find them. Core brokers separating wheat from chaff in the buying process and consecutively refine the assortment of cores by selecting preferred cores in different quality grades based on the diverse specifications different remanufacturers apply. These can change over time leading to (repeated) re-assessments and re-sorting. Next to that they also act as ‘core bank’: They are the risk bearer and a professional gambler because they need to anticipate which cores may start to be remanufactured in the future and take the financial risk in buying and storing these until demand from remanufacturers picks up. Core brokers in general had a positive relationship with remanufacturers due to close, selective, cooperations and shared history. Core brokers do face a couple of significant challenges. During the session it was said that, despite the increased attention for remanufacturing; ‘I think most core dealers would say, it has been the hardest right now as it has ever been in thirty years’ due to the inflow of cheaper Chinese copies and infill, which undermines the very existence of automotive remanufacturing. A key finding from the session is the opportunity they saw in a CO<sub>2</sub> tax because this gave the ability to create a more level playing field between remanufactured parts and new parts. Additionally, easier identification could simplify the work of core brokers.

## Conclusions

Reverse logistics will become increasingly important as the circular economy scales up. Product sectors with no previous experience in this area will need to learn from the experiences and challenges of other sectors, such as the automotive industry, to be able to set up a cost-efficient and effective network. This



paper has shown that working together with stakeholders to set up or improve reverse logistics can provide meaningful insights that are critical to its successful execution. Further research should include other stakeholders in the supply chain, to be able to present a complete picture of the different needs and interests that are present and develop a reverse logistics service that is cost effective, efficient, and has value for all. The insights provided in this paper also have implication for the broader circular economy field, policy and product design. For example, increasing the ability to identify and trace cores needs to be considered during the design stage of those parts, far before remanufacturing processes are in place. Furthermore, policy needs to be geared towards creating an equal playing field for remanufacturing activities to sustain and nurture this valuable approach, e.g. by not only taking economic costs into account but also including environmental costs, removing national taxes on used parts, not taxing circular activities double (such as both forward and reverse logistics), and reconsidering tax structures which are disadvantageous to labour-intensive remanufacturing activities. Only then can remanufacturing, and the necessary accompanying reverse logistics, become truly relevant.

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