PARIS CIRCULAR OPERATIONS WORKSHOP

30-31 JANUARY 2025

Book of Abstracts

with the Support of the partners of
the ESSEC Global Circular Economy Chair

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Welcome to the first Paris Circular Operations Workshop! *We are looking forward to the immense wealth of presentation and discussion topics!*

Felix Papier and Yann Bouchery
(Organizing Team)

# Practical Information

Event Venue

La Maison des Canaux

The conference will take place at **La Maison des Canaux**, a historic venue located along the Canal de l'Ourcq in Paris. Dedicated to innovation and sustainability, it provides a professional yet welcoming setting for the event. Its central location and modern facilities make it an ideal choice for conferences. This unique, eco-certified venue perfectly embodies the collaborative and sustainable spirit of our conference.

Venue Access
La Maison des Canaux is easily accessible by public transport:
- Metro: **Line 2, 5 or 7**, station **Stalingrad**.
- **Vélib'**: Bike-sharing stations are available nearby.
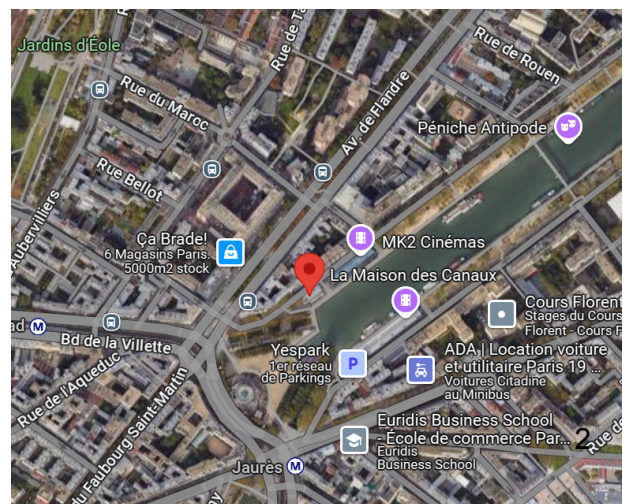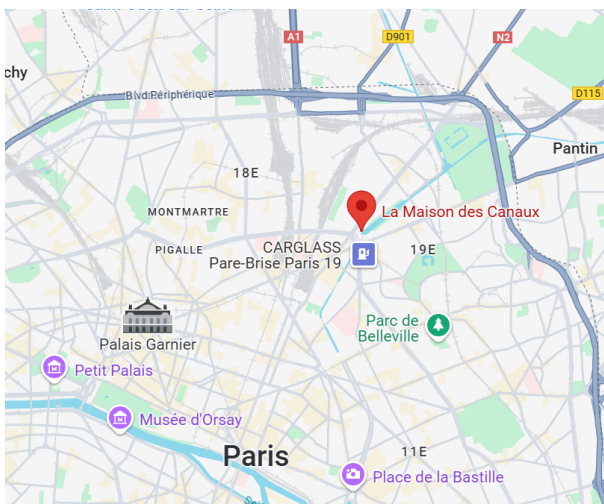
Restaurant (Thursday 30 January evening, 19h15/19h30)

Restaurant - La Marine Canal Saint Martin

URL*:*   *https://www.lamarinecanalsaintmartin.com/*
Address*:*   *55bis quai de Valmy, 75010 PARIS*

20 minute walking distance, or two stations on the metro line 5 (from 'Stalingrad' to 'République').

Company Visit (Friday 31 January)
Loewi is a French leader in electric bicycle refurbishment. We will meet the COO and visit the testing and refurbishment site in La Courneuve. The site is easily accessible via public transport.

Address of the site visit: 53 Av. du Général Leclerc, 93120 La Courneuve

We meet at 8:30 at La Maison des Canaux to travel together (by metro and tramway, approx. 30 minutes). You can also directly come to the site, and meet the group there at 9:15.

Contact information
In case of any questions or emergencies, do not hesitate to contact us at any time.

Workshop Organizers:
   - Felix Papier (papier@essec.edu)
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Program book last updated 27 January 2025

Workshop Agenda

<u>**Thursday, January 30**</u>

9h - 9h15 Welcome to Workshop   Felix Papier (ESSEC), Yann Bouchery (Kedge)

9h15 - 10h Keynote talk   Sandra Transchel (KLU)
"Transforming Packaging Systems: Is reusable packaging in B2C environments ready for scaling?"

10h - 10h15 Coffee break

10h15 - 11h30 Session A: Circular Operations management

11h45 - 13h00 Lunch (on site)

13h15 - 14h Keynote talk   Jan Fransoo (Tilburg U)
"Circularity in Operations: Bridging Established Insights with Emerging Challenges"

14:00 - 15:15 Session B: Circular Supply Chains

15h15 - 15h45 Coffee break

15h45 - 16h30 Keynote talk   Moritz Fleischmann (Mannheim U)
"Allocation of recycling credits"

16h30 - 18h Session C: Circular Business Models

18h - 18h15 Closure

19h15 - 21h30 Dinner   *Restaurant - La Marine Canal Saint Martin*

<u>**Friday, January 31**</u>

 9h30 - 11h30 Visit of the LOEWI Remanufacturing site

Keynote Speakers

Sandra Transchel

Sandra Transchel is a faculty member in the Department of Supply Chain and Operations Management Kühne Logistics University, where she has been a professor since 2011. In 2008, she earned her PhD from the University of Mannheim, and previously graduated with a Diploma degree in Business Mathematics from the Otto-von-Guericke University in Magdeburg. Her research spans supply chain management, inventory control, revenue management, and production scheduling, with a focus on integrating supply and demand management. She is actively involved in projects addressing food waste reduction and local food production networks. Her work has appeared in *OR* and *EJOR*.

Jan C. Fransoo

Professor Jan C. Fransoo is a faculty member at the Tilburg School of Economics and Management, where he is Professor of Operations and Logistics Management. He has conducted research across a variety of domains within supply chain and operations management, with his work widely published in leading journals in operations research and transportation. He serves as Associate Editor of Decision Sciences and Senior Editor of POM. His current research focuses on retail operations in developing markets, urban logistics, and the interaction between human decision-makers and AI. He collaborates with organizations such as Unilever, UPS, World Bank, and the Inter-American Development Bank.

Moritz Fleischmann

Moritz Fleischmann is Professor and Chair of Logistics and SCM at the University of Mannheim, where he also serves as Vice President of Sustainability and Information Provision since 2023. He previously held academic positions at the Rotterdam School of Management and visiting roles at McGill University, Dartmouth, and INSEAD. He holds a Master's in Business Mathematics fro the University of Ulm and a PhD in Management from Erasmus University Rotterdam. His research focuses on inventory management, last-mile distribution, and sustainable supply chains, collaborating with companies like BASF, IBM, and Heineken. His work is published in journals such as OR and Transp. Science.

Technical Program

Session A: 10:15-11:30 - Circular Operations Management

- Toward a Framework for the Adoption of Digital Technologies in Circular Economy Operations
  M. F. Rodriguez Romo, V. Hargaden, N. Papakostas, P. Ghadimi (all UCD)

- Toward a generic simulation toolkit for reuse operations
  G. Lechner, A. Haas, S. R. Rinder, E. Steiner (all University of Graz)

- Data-Driven Failure Time Estimation in a Consumer Electronics Closed-Loop Supply Chain
  S. Lemmens (RSM), A. Calmon (Georgia Tech), S. Graves (MIT)

- Production planning and control for remanufacturing
  P. Van Loon (Chalmers), A. Ali (Chalmers), D. Guide (Penn State)

Session B: 14:00-15:15 - Circular Supply Chains

- A subsidized reverse supply chain in the Chinese electronics industry
  G. Berenguer (Universidad Carlos III de Madrid), Y. Zhang (Beijing Institute of Technology), Z. Zhang (Tsinghua University)

  Uncovering Waste: How Store Characteristics Impact Food Waste in Grocery Retail
  Konstantin Wink (TUM), Fabian Schäfer (TUM), Santiago Gallino (Wharton) and Alexander Hübner (TUM)

- Battling Food Loss and Empowering Growers with Ugly Veg: The Role of Whole-crop Contracts
  B. Hezarkhani (University Southampton), Y. Bouchery (Kedge), G. Demirel (Queen Mary University)

- Sharing experiences on developing and teaching a CLSC course for master SCM students
  S. Lemmens (RSM)

Session C: 16:30-18:00 - Circular Business Models

- Evaluating Right to Repair Policies
  M. Pourakbar (RSM Erasmus University), Z. Chen (School of Management, Shandong University), S. Alizamir (Darden School of Business, University of Viriginia)

- Incentivizing Supplier Repair Efforts for Circularity under Repair Heterogeneity
  W. Tu (University of Zurich), T. Tan (University of Zurich), N. Tahirov (Durham University), G. Mullaoglu (ASML)

- Repairing Fashion: What Drives Brands to Offer Out-of-Warranty Repair Services ?
  X. Dong (University of Manchester), J. Quariguasi Frota Neto (University of Manchester), A. Potter (University of Manchester), M. Reimann (University of Graz)

- Developing Circular Business Models in Ecosystems: A Case Study of the Dutch Microelectronics Industry
  M. Jiang, K. Dittrich, S. Lemmens (all Rotterdam School of Management, Erasmus University)

- Circular Economy Business Model for Electric Vehicle Battery
  N. Kumar Singh (FORE School of Management), N. Kumar Verma (IIM Bangalore), Milan Kumar (IIM Bangalore)

Abstracts

Session A - Circular Operations Management

Toward a Framework for the Adoption of Digital Technologies in Circular Economy Operations

M. F. Rodriguez Romo, V. Hargaden, N. Papakostas, P. Ghadimi (all UCD)

The aim of this research is to establish cross-sectoral operations commonalities and differences in adopting Circular Economy (CE) strategies through Digital Technologies (DT), such as those technologies which form part of Industry 4.0. The research is part of a wider EU Marie Curie Doctoral Network (iCircular3) programme whose overall objective is to contribute to the development of new guidelines and digital tools for the integration of circularity in industrial operations. A maturity framework is proposed which enables the readiness of operations to adopt digital technologies in support of firms' circular economy strategies. The framework was developed following a systematic literature review, which identified several gaps and research opportunities in existing maturity models. Through three in-depth case studies among industrial partners in the iCircular3 consortium, the framework was tested and refined. The final framework will support the EU Digital Product Passport readiness as well as informing the development of new ISO Circular Economy standards.

Toward a generic simulation toolkit for reuse operations

G. Lechner, A. Haas, S. R. Rinder, E. Steiner (all University of Graz)

Reuse operations, i.e., preparing used products for reuse, are complex. Typically, the quality of returned used products is unknown, as are the timing of their return and the quantity. Various reuse options (refurbishment, resale, spare parts scavenging, recycling) for multiple product types make decision-making challenging. Researchers identified meta-processes which are mostly present in reuse operations: acquisition of used products, grading to determine the quality of these, disposition decisions to designate a used product for a specific reuse option, and reuse activities. To support in-house reuse decision-making, we translate physical processes into simulation processes and compile a toolkit for reuse operations incorporating these functions. Created with Python's SimPy package, the resultant template processes simplify reuse-related simulation model generation. The adaptable approach allows customization of standard processes and decision-making procedures. We present two stylized proof-of-concept examples, inspired by the reuse of IT

equipment and white goods, to illustrate that the toolkit is well-suited for representing reuse operations across various industries.

Data-Driven Failure Time Estimation in a Consumer Electronics Closed-Loop Supply Chain
S. Lemmens (RSM), A. Calmon (Georgia Tech), S. Graves (MIT)

We examine and analyze a strategy for forecasting the demand for replacement devices in a large Wireless Service Provider (WSP) that is a Fortune 100 company. The Original Equipment Manufacturer (OEM) refurbishes returned devices that are offered as replacement devices by the WSP to its customers. Hence, the device refurbishment and replacement operations are a closed-loop supply chain. The proposed strategy leverages the observation that different devices fail according to a similar age-dependent failure distribution. Specifically, this strategy uses the empirical hazard rates from other devices to form a basis set of hazard rate distributions. We then use a regression to identify and fit the relevant hazard rates distributions from the basis to the observed failures of the new device. We use data from our industrial partner to analyze our proposed strategy and compare it with a parametric ARIMAX and a Random Forest machine learning model adapted to our setting. Our numerical analysis shows that our proposed forecasting strategy performs very well even (i) when the basis size is small, (ii) when producing forecasts early in the life cycle of the new device, and (iii) when the basis elements are randomly selected.

Production planning and control for remanufacturing
P. Van Loon (Chalmers), A. Ali (Chalmers), D. Guide (Penn State)

Remanufacturing has been advocated as a sustainable manufacturing approach capturing value from end-of- product. However, because used products are the basis for the operations, with a high degree of uncertainty in quality, quantity, and timing of the returns, production planning and control is complicated. Research highlights a gap in empirical knowledge regarding production planning and control (PP&C) for remanufacturing, with only a few studies available presenting data on how remanufacturers actually plan and control their remanufacturing production process. Through a survey, we document changes occurred in PP&C for remanufacturing since Guide's study in 2000, extending the scope to US and European remanufacturing plants. We map aspects such as product returns management, inventory management including balancing supply with demand, scheduling and capacity planning, materials management, the use and availability of information prior returns arrival and the use of digital technologies. We emphasize current challenges

experienced by industry and discuss the use of digital technologies to mitigate some of the uncertainty enhancing remanufacturing efficiency, an area for future research.

Session B - Circular Supply Chains

A subsidized reverse supply chain in the Chinese electronics industry
G. Berenguer (Universidad Carlos III de Madrid), Y. Zhang (Beijing Institute of Technology), Z. Zhang (Tsinghua University)

We study a special environmental producer responsibility policy for the Chinese electronics industry. The policy is based on awarding a per unit subsidy to qualified returned electronic products and ensuring a minimum producer collection volume while allowing larger collection volumes. Based on a real application from a company that produces LCD TVs, our paper studies the optimal design of the product's reverse supply chain when there is flexibility in settling the inspection locations of the returned products and flexibility in the volume of returned products collected. The problem is modeled as a nonlinear mixed-integer program and an efficient outer approximation-based solution approach is proposed. We show how the government can stimulate the collection amount of returned products by increasing the unit subsidy, and we also find that the company's marginal benefit from improving the subsidy increases in a superlinear fashion. Furthermore, the highest collection volumes may not occur at the highest quality level of returned products for capacitated remanufactured. The company can also be incentivized to increase the collection of returned products by permitting flexible testing locations. We also observe how the optimal testing locations vary for different levels of unit subsidy and different ratios of qualified and non-qualified returned products.

Uncovering Waste: How Store Characteristics Impact Food Waste in Grocery Retail

Konstantin Wink (TUM), Fabian Schäfer (TUM), Santiago Gallino (Wharton) and Alexander Hübner (TUM)

Food waste is a significant sustainability challenge for retailers, leading to higher carbon emissions and increased costs, yet empirical evidence on its root causes remains limited. Although the influence of internal and socio-economic factors in brick-and-mortar retail, such as store physical characteristics, basket sizes, or competitive intensity, is well-documented, the effect of various store attributes on food waste remains largely unexplored. Thus, our research uses proprietary transaction data and socio-economic data from a European grocery chain to investigate the relationship between store-specific attributes and in-store waste levels. The data covers 315 retail stores in urban and non-urban areas. By applying the Double Machine Learning algorithm XGBoost for causal inference, our findings indicate that store-specific attributes, operations, and organization substantially and significantly impact food waste levels. We estimate the potential for reducing food waste through counterfactual analysis up to 5.2 %. Our study fills a gap in the literature on food waste in retail by providing empirical evidence on the store attributes that lead to higher waste levels beyond the existing body of literature that mainly focuses on other store performance metrics like sales or profit. Furthermore, this study creates awareness and offers novel managerial insights for practitioners considering food waste when optimizing store organization and operations, thus driving more sustainable practices in the retail sector.

Battling Food Loss and Empowering Growers with Ugly Veg: The Role of Whole-crop Contracts

B. Hezarkhani (University Southampton), Y. Bouchery (Kedge Business School), G. Demirel (Queen Mary University)

Cultivation of fruit and vegetable yields produce that does not conform to the aesthetic requirements of the retail sector. The so-called 'ugly veg' is a major contributor to global food loss. We examine the capability of agri-food supply chains, in particular by adopting 'whole-crop' contracts, to incorporate ugly veg, reducing food loss and empowering growers who are often the weaker players. We model agri-food supply chains with dual produce types under spot and whole-crop contracts, and obtain the subgame perfect equilibria, and the associated food loss volumes. With spot contracts, the retailer or the grower may prefer not offering the ugly veg to avoid cannibalization of the 'normal produce'. However, whole-crop contracts always bring the ugly veg to the market and enable the grower to profit under lower wholesale prices, thereby giving more leverage to the grower. Nevertheless, supply chain members might still find spot contracts more profitable. Whole-crop contracts could reduce food loss by largely incorporating the ugly

veg in fruit and veg supply chains. Our work helps the agri-food supply chain managers make better, and less wasteful, decisions and potentially take advantage of whole-crop contracts. The adoption of whole-crop contracts by agri-food supply chains, however, might require supportive policies to diminish incentive misalignment.

Sharing experiences on developing and teaching a CLSC course for master SCM students
S. Lemmens (RSM)

Session C - Circular Business Models

Evaluating Right to Repair Policies

M. Pourakbar (RSM Erasmus University), Z. Chen (School of Management, Shandong University), S. Alizamir (Darden School of Business, University of Viriginia)

The Right-to-Repair (RTR) movement has led to various governmental initiatives, including repair bonuses and mandates requiring manufacturers to provide repair resources to consumers, as well as combinations of both approaches. This study evaluates the effectiveness and impact of these policies, contributing to the RTR literature by explicitly modeling government decision-making and incorporating manufacturers' control over product repairability. We employ a two-period game-theoretic model to optimize government policy and anticipate manufacturer responses, treating consumers, manufacturers, and the government as key players. We identify conditions under which each policy maximizes social welfare and examine its effects on manufacturers' profitability, consumer surplus, and environmental impact. Our findings reveal that policy effectiveness is shaped by consumer behavior, market dynamics, and product characteristics, underscoring the importance of regulations tailored to these factors and cautioning against blanket policies that may have unintended consequences.

Incentivizing Supplier Repair Efforts for Circularity under Repair Heterogeneity

W. Tu (University of Zurich), T. Tan (University of Zurich), N. Tahirov (Durham University), G. Mullaoglu (ASML)

Motivated by a collaboration with a leading firm in the semiconductor industry, this study examines the reverse supply chain for high-value optical components. The buyer, responsible for assembling and maintaining modular machines sold under service contracts, faces high spare parts turnover due to responsive maintenance obligations that require immediate on-site replacement of faulty modules. This practice leads to the accumulation of reusable, high-value failed components at off-site repair facilities. Due to limited in-house repair capabilities, the buyer seeks to engage suppliers to repair these components, offering the potential to enhance circularity and cost efficiency by increasing the reuse of components for maintenance services. However, suppliers often prioritize producing and selling new components over repairs, creating misaligned incentives. This study explores the contract design to align supplier incentives with the buyer's reuse rate target, aiming to reduce maintenance costs and improve sustainability through repair and reuse. We model this interaction as a Stackelberg game, where the buyer compensates the supplier for repairs based on a pre-defined incentive structure, and the supplier adjusts repair proportions in response. We analyze various incentive structures to enhance supply chain performance,

finding that well-structured incentives can achieve both cost-efficiency and sustainability goals.

Repairing Fashion: What Drives Brands to Offer Out-of-Warranty Repair Services ?

X. Dong (University of Manchester), J. Quariguasi Frota Neto (University of Manchester), A. Potter (University of Manchester), M. Reimann (University of Graz)

Out-of-warranty repair services, as a key component of circular operations, are gaining prominence due to their significant market potential and sustainability benefits. Despite their importance, little is known about the drivers behind these services. This study addresses this gap by examining four groups of potential antecedents: product characteristics, product portfolio, environmental orientation, and market forces. Based on a novel dataset on the repair policies of US-based fashion brands, we find that out-of-warranty repair offerings are primarily driven by product-related factors rather than environmental ones. The significant influencing factors include product clockspeed, product price, and stock keeping units. This exploration of the drivers of out-of-warranty repair services not only establishes a grounded theoretical framework for future research but also provides practical insights for managers making repair service decisions.

Developing Circular Business Models in Ecosystems: A Case Study of the Dutch Microelectronics Industry

M. Jiang, K. Dittrich, S. Lemmens (all Rotterdam School of Management, Erasmus University)

The challenges of resource scarcity, environmental pollution, and rising emissions have heightened the urgency for sustainable development, yet technological innovations in circularity often lack implementable Circular Business Models (CBMs). The circular economy relies on collaboration across the value chain, requiring stakeholders to co-create value through ecosystem-level CBMs. Despite recent efforts to drive ecosystems toward circularity through sustainability and system-wide collaboration, past research has largely focused on theoretical CBMs for individual products, companies, or industries, neglecting the interconnected dynamics of stakeholders at the ecosystem level. Our research addresses this gap by exploring how to develop effective CBMs through ecosystem collaboration. Using the Dutch microelectronics industry as a case study, we examine existing CBMs and the drivers and barriers to achieving a circular ecosystem. We identify four CBM evolution trajectoriesâ€"Born-to-be Circular, Circular Incumbent, Merging Business Model, and Joint Business Modelâ€"based on ecosystem involvement and collaboration. The findings highlight drivers such as regulatory mandates and innovation opportunities, alongside barriers like high costs and supply chain complexity. This study offers industries a framework for

ecosystem-level CBM development, equipping operational managers and policymakers with tools to overcome barriers and foster sustainable value creation across industries.

Circular Economy Business Model for Electric Vehicle Battery

N. Kumar Singh (FORE School of Management), N. Kumar Verma (IIM Bangalore), M. Kumar (IIM Bangalore)

We investigate the closed-loop supply chain design and business model challenges faced by an electric vehicle firm engaged in battery as a Service (BaaS), leasing batteries to customers. Firms increasingly emphasize the need to repurpose electric vehicle (EV) batteries after their initial use in EVs. Closed loop supply chains (CLSC) for EV batteries are inherently unique; thereby, circular economy solutions that have proven successful in other industries may not achieve the same effectiveness in this domain. This study finds the optimal CLSC business model for the firm involved in battery repurposing and recycling business.

List of participants

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