Service Operations Research Seminar HWS 2023 (OPM 781)

"Current Topics in Service Operations Management Research"

General Information:

1. The goal of this seminar is to introduce participants to conducting scientific research in the field of (service) operations management. It thereby prepares students for writing their M.Sc./Diploma Thesis primarily at the Chair of Service Operations Management, but OPM781 also qualifies you formally for writing a master thesis at any other chair in the Operations Area.

2. There are two types of offered topics – individual topics and team-based topics.

    a. **Individual topics:** Those topics are designed to be explored by a single student based on the fundamental literature provided. The topics are described below. Each participant with an individual topic will present his/her findings in a written report (about 20 pages) as well as in an in-class presentation (~20 min), followed by a discussion (~10 min).

    b. **Team-based topics:** Participants will work in teams of (usually) two on a real/realistic operations-related decision problem, based on a company case study. The objective of the thesis is to understand the company's problem and data, and recommend a solution based on a suitable methodological approach from the literature. Each team will present its findings in a written report (about 30-40 pages) as well as in an in-class presentation (~40 min), followed by a discussion (~20 min).

    Note: although prepared in group work, a team assignment is still an individual academic achievement of the team members. In general, all team members should be involved in all tasks and contribute to solving the assignment. If team members do not contribute equally, grades may differ, and you can specify who performed which task to what extent in joint statement of contribution (form available from the chair).

3. The **application procedure** for this seminar is combined with those for the seminars of the Chair of Logistics (OPM 701), the Chair of Production Management (OPM 761) and the Chair of Procurement (OPM 791). Students can apply for topics from all chairs by joining the ILIAS application group and completing the online form provided there. Topics labeled with "L" refer to the Chair of Logistics (OPM 701), topics labeled with "P" refer to the Chair of Production Management (OPM 761), topics labeled with "B"

refer to the Chair of Procurement (OPM 791) and topics **labeled with "S"** refer to the **Chair of Service Operations Management (OPM 781)**. To better match topic and student background, applicants for OPM 781 may in addition send a CV and official grades overview by post to the chair or by e-mail to soma@mail.uni-mannheim.de with subject "OPM 781 Seminar Application".[1]

4. The **application period** starts on **April 28th** and ends on **May 12th, 2023**.

5. The **assignment of topics** to students/teams will be preference-based. Team formation will be done by the chair, but if you have mutual preferences about who you want to be on the team with, we will try to match this.

6. **Admission** to the seminar is **binding** and will be confirmed by E-mail by **May 19th, 2023.**

7. A **kick-off meeting** for all participants will be held on **Tuesday, May 23rd,** at **10:15-11:45** in **SO318**. During this meeting, general guidelines for conducting scientific work will be discussed.

8. The latest **submission** date for the written report incl. appendices is **November 2nd**. For submission, please …
    a. **Upload your report** (Word- / Latex-document and PDF) via Task "Upload of final Thesis & Calculations/Software Output" in the OPM781 ILIAS group. If you have multiple files (e.g. a pdf and some Excel analysis), please upload all in a single zip file.
    b. **Submit a hard copy** at our secretary's office (Mon-Thu before noon) or at your thesis supervisor. Please make an appointment for submitting the hard copy.

9. Student **presentations** will be held by default in the **regular presentation** session on **November 15th (2023), in room SO 318**. A **fast-track presentation** session on **September 27th (2023)**, may be offered to students who desire to start with their master thesis early in HWS23 (with seminar thesis submission deadline on **September 13th,** 2023). Attendance is mandatory for all presentations on your own presentation date.

    Please **upload your final presentation slides** (ppt and PDF) on **Task "Upload of Final Presentation"** in the ILIAS group one day before the presentation, latest by 18:00 pm.

[1] Data protection: Please note that a breach of confidentiality and the unauthorized access by third parties cannot be excluded when transmitting an unencrypted email. Note on data protection: The submitted documents will be returned only if an envelope with sufficient postage is included. Otherwise they will be destroyed after the application process according to the requirements of the data protection law. Electronic applications will be deleted accordingly.

10. The final grade for the seminar is composed of the following components: Written report (60%), presentation (30%), contribution to discussion of your own topic and of potentially other topics presented on the same date (10%).

11. For questions concerning the seminar contact us by email at soma@mail.uni-mannheim.de

Seminar topics

Please note:

The amount of recommended literature does not indicate more or less workload. Your supervisor may have more recommendations for you.

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Topic S01: Sustainable Product Design through Remanufacturing

Remanufacturing is the process of restoring used products or components to their original condition or better. It involves disassembling the product, cleaning, and inspecting its components, replacing any worn or damaged parts, and reassembling the product to meet or exceed its original specifications. It is very difficult to carry out the process of remanufacturing if the product is not designed with the mindset of the end-of-life strategy. Therefore, the decision to include remanufacturing as part of product life cycle should be made as early as possible, as many barriers that occur during the remanufacturing process can be mitigated through proper product design at an early stage. This concept is known as design for remanufacturing (DfRem) in the literature.

As DfRem is very impactful on the remanufacturing process, it is of great interest to identify forces that incentivize DfRem whether it be legislation e.g. extended producer responsibility (EPR) or market forces e.g. the preferences of environmentally conscious customer segments.

The objectives of this thesis are to …

- introduce the remanufacturing and its key steps;
- review the literature of DfRem and identify the design features that are relevant to remanufacturing performance;
- provide open research gaps and future trends.

Basic Literature:

Abbey, J. D., Meloy, M. G., Guide Jr, V. D. R., & Atalay, S. (2015). Remanufactured products in closed-loop supply chains for consumer goods. Production and Operations Management, 24(3), 488-503.

Atasu, A., Guide Jr, V. D. R., & Van Wassenhove, L. N. (2010). So what if remanufacturing cannibalizes my new product sales?. California Management Review, 52(2), 56-76.

Gehin, A., Zwolinski, P., & Brissaud, D. (2008). A tool to implement sustainable end-of-life strategies in the product development phase. Journal of Cleaner Production, 16(5), 566-576.

Hatcher, G. D., Ijomah, W. L., & Windmill, J. F. (2013). Design for remanufacturing in China: a case study of electrical and electronic equipment. Journal of Remanufacturing, 3, 1-11.

Topic S02: Choice-Based Revenue Management: Estimation and Optimization

Discrete choice models are used to describe, explain, and predict a choice from a set of two or more discrete alternatives, such as choosing among several commute modes, buying a car among numerous models. They operate under the assumption that people, faced with a discrete set of options, choose the one with the maximal benefit. In business, researchers and practitioners use these models to examine consumer demand, predict competitive responses, and design pricing strategy and product lines.

Vulcano et al. (2010) study the practicality and effectiveness of discrete choice models in airline revenue management. Specifically, they assess to what extent discrete choice models can be estimated well using readily available airline data and measure the revenue improvement that choice-based revenue management could bring in a sample of test markets.

The objectives of this thesis are to:

- explain the problem addressed in Vulcano et al. (2010) and motivate the relevance;
- position Vulcano et al. (2010) in the corresponding stream of scientific literature;
- explain the model and methodology in Vulcano et al. (2010), including the theory, the estimation method, and the implementation;
- critically assess the contribution of Vulcano et al. (2010) to the theory and practice and discuss any gaps.

Basic Literature:

Vulcano, G., Van Ryzin, G., & Chaar, W. (2010). OM practice—choice-based revenue management: An empirical study of estimation and optimization. Manufacturing & Service Operations Management, 12(3), 371-392.

Topic S03: Choice-Based Dynamic Pricing for Vacation Rentals

Optimal product pricing is a major challenge for companies, as for most products customers demand is strongly dependent on the price. Former scholars developed choice models to capture demand dependent on product attributes (like color, price, size) to predict customer behavior. The multinominal logit model (MNL) is one of the most famous discrete choice model, as it has a good prediction in many fields combined with desirable mathematical properties.

Practitioners have to perform a variety of tasks to conduct current state-of-the-art methods. The paper of Wang et al. (2021) demonstrates how to get data, how to forecast market prices, design an optimization model and solved it with a non-linear optimization solver. The authors were able to improve the expected revenue between 3.5 % and 5.2 % for a major vacation rentals company.

The objectives of this thesis are to:

- explain the problem addressed in Wang et al. (2021) and motivate the relevance;
- position the paper from Wang et al. (2021) in the optimization stream of scientific literature;
- explain the models and methodologies in Wang et al. (2021) used. Pay special attention to the discrete choice model, nonlinear optimization model, and the implementation;
- critically assess the contribution of Wang et al. (2021) to theory and practice and discuss any gaps.

Basic Literature:

Wang Y. et al. (2021). Choice-Based Dynamic Pricing for Vacation Rentals. INFORMS Journal on Applied Analytics 51(6):450-462.

Topic S04: Designing the Service Experience – Activity Sequencing and Selection

Putting the customer experience at the heart of service design has become a governing principle of today's experience economy. Echoing this principle, the article by Li et al. (2022) addresses a service designer's problem of how to select and sequence activities in designing a service package. Empirical literature shows an ideal sequence often entails an interior peak; that is, the peak (i.e., highest-utility) activity is placed neither at the beginning nor the end of the package. Theoretic literature, by contrast, advocates placing the peak activity either at the beginning or at the end. The article in focus bridges this gap by developing a theory accounting for interior peaks and modeling the activity sequencing and selection problem as a nonlinear optimization problem. It also provides managerial implications for activity sequencing and selection.

The objectives of this thesis are to:

- explain the problem addressed by the paper and motivate its relevance;
- position the paper in the corresponding stream of scientific literature, and provide a literature review for it;
- explain model and methodology incl. the underlying theory and examples for practical implications;
- critically assess the paper's contribution to theory and practice, discuss its limitations, and provide a future outlook.

Basic Literature:

Li, Y., Dai, T., & Qi, X. (2022). A theory of interior peaks: Activity sequencing and selection for service design. Manufacturing & Service Operations Management, 24(2), 993-1001.

Topic S05: Real-World Analytics for Sustainable Product Design (Team Project)

Product design decisions are important decisions at the interface of marketing and operations that are very costly to implement and change and are determinant for market success. In order to systematically support decision-making in this area, a number of mathematical programming models for optimal product (line) design based on customer preference data from conjoint analyses have been developed in the last four decades. In these optimization models, a product is defined to be a set of attributes where each attribute can have different levels. The objective is to configure the products and prices such that profit is maximized given the products' costs and customers' willingness to pay.

In many industries today, product design increasingly requires integrating economic objectives with environmental thinking - driven by raising ecological concerns, regulatory pressures, and the potential to create a marketing edge through sustainable operations. 'Green' design is particularly challenging since it should not only embrace a product's key features from a consumer perspective but also all underlying supply chain processes that determine a product's 'greenness'.

For example, computer manufacturers have made various efforts aimed at reducing the environmental impact of products at all stages of their life cycles, from design to disposal. Firms need to decide if they design their products (and the underlying supply chain) for repair, remanufacturing, and/or recyclability, or if they invest into labels like Energy Star, certifying that the computer requires 25% - 40% less than conventional models by using the most efficient components and better managing energy use when idle.[2] Various empirical studies show that "green" product attributes increase consumer willingness-to-pay and may pay off the efforts on the supply chain side if higher prices can be charged.

The thesis' main task is to assume the role of a product development team who is in charge of designing a new product in a market where demand for more environmentally-friendly products is increasing (focus should be either on electronics or fashion). For assessing if the new product is not only environmentally but also economically viable, a conjoint analysis is to be performed. The conjoint data can then be used as input to a quantitative product design model that allows to derive recommendations, thus answer the following questions:

- Is there any additional willingness-to-pay of customers for the selected green attributes? What evidence does the empirical literature provide? What type of green attributes are most preferable from a consumer's and a designer's perspective?
- What are the implications for optimal product design?
- Optional: what are the implications for supply chain design? How does the cost structure change for producing the green product features and how can the additional cost be systematically incorporated into the product design decision?

As a base, the thesis should include providing a sound theoretical foundation by reviewing

1.) the current literature on empirical conjoint studies involving green features in the selected product category,

2.) a selected conjoint-based product design model that can suitably be applied in your own analysis.

[2] https://www.energystar.gov/products/computers, accessed on April 5th, 2023.

This thesis is a team-based project where participants will work in teams of two students.

Basic Literature:

Dobson, G., & Kalish, S. (1993). Heuristics for pricing and positioning a product-line using conjoint and cost data. Management Science, 39(2), 160-175.

Elie Ofek, Olivier Toubia (2015): Marketing Simulation: Using Conjoint Analysis for Business Decisions. Harvard Business School. (case study will be provided by the chair)

Orme, B. K. (2006). Getting started with conjoint analysis: strategies for product design and pricing research.

Steiner, W. J., & Hruschka, H. (2002). A probabilistic one-step approach to the optimal product line design problem using conjoint and cost data. Review of Marketing Science Working Paper, 441.

https://sawtoothsoftware.com/

Topic S06: The Newsvendor Model – Review and Application to ReCellular's Closed-Loop Remanufacturing Decisions (Team Project)

ReCellular was a large cellphone remanufacturer and ranked among the top five firms in this domain in the United States. A substantial part of its business was focused on acquiring used cellphones, remanufacturing them, and selling them to other businesses. The demand for remanufactured cellphones was uncertain. Before the demand is realized, used cellphones were acquired; after it is realized, acquired used cellphones were remanufactured. Excess quantities of used cellphones were often salvaged at a loss. To deal with the risk of unsatisfied demand for remanufactured cellphones and excess inventory of used cellphones, ReCellular acquired used cellphones in different quality conditions: high-quality, medium-quality, low-quality. High-quality phones were phones that were lightly used and required very little remanufacturing effort but were expensive to acquire. Low-quality phones were phones that were extremely worn out and often had broken parts. Although such phones were very cheap to acquire, remanufacturing them would be expensive. For medium-quality phones, the acquisition cost and remanufacturing cost was in between the high- and low-quality ones. All used cellphones were remanufactured to the same specification, sold at the same price, and customers could not tell if the remanufactured cellphone was of high, medium, or low quality before remanufacturing. ReCellular needed to determine how many used cellphones in each quality grade to acquire to meet the uncertain demand, based on the trade-off between the acquisition cost and remanufacturing cost.

In fact, an extension of the traditional Newsvendor model could be used to make the above decision. The newsvendor model is a mathematical model with a wide range of applications, e.g., to determine optimal inventory levels in operations management or optimal booking levels in airline revenue management. The basic model is typically characterized by a perishable product with uncertain demand and a fixed price whose order size is to be determined. It assumes the situation faced by a newspaper vendor who must decide how many copies of the day's paper to stock in the face of uncertain demand and knowing that unsold copies will be worthless at the end of the day. The basic newsvendor model has been extended in many ways, e.g. by considering multiple inventory types or integrating pricing decisions.

The objective of the thesis is to understand ReCellular's situation, analyze the given data, model and implement the decision problem, as well as recommend and defend a solution, based on a suitable Newsvendor model extension. This should include providing a sound theoretical foundation by reviewing the basic Newsvendor problem, its mathematical structure and solution methods, selected extensions and applications.

This thesis is a team-based project where participants will work in teams of two students.

Basic Literature:

Guide, V. D. R., Neeraj, K., Newman, C., & Van Wassenhove, L. N. (2005). Cellular telephone reuse: The ReCellular Inc. case. In: Flapper S. D. P., van Nunen, J. A. E.E., & Van Wassenhove, L. N. (Ed.): Managing closed-loop supply chains, Springer, 151-156.

Mutha, A., Bansal, S., & Guide, V. D. R. (2016). Managing demand uncertainty through core acquisition in remanufacturing. Production and Operations Management, 25(8), 1449-1464.

Mutha, A., Bansal, S., & Guide Jr, V. D. R. (2021). ReCellular Inc: Managing demand uncertainty in closed-loop remanufacturing. INFORMS Transactions on Education. https://pubsonline.informs.org/doi/epdf/10.1287/ited.2021.0254cs

Qin, Y., Wang, R., Vakharia, A. J., Chen, Y., & Seref, M. M. (2011). The newsvendor problem:Review and directions for future research. European Journal of Operational Research, 213(2), 361-374.

Topic S07: The Newsvendor Model – Review and Application to the New Product Launch of Eastman's Tritan Specialty Plastic (Team Project)

Eastman Chemical Company is an American chemical company globally producing a broad range of advanced specialty materials, chemicals and fibers for everyday purposes. Founded in 1920 and based in Kingsport, Tennessee, the company now has more than 50 manufacturing sites worldwide with ~14,000 employees and sales revenue of approximately $10.5 billion in 2021. The development of Tritan, a new specialty plastics, was a major breakthrough for both Eastman and the broader chemical industry. However, the launch of the new product was quite challenging, and the Eastman specialty plastics team had to develop a convincing market introduction and production strategy before producing Tritan at full scale. First, Eastman had to commercialize a completely new material that only had been produced in the lab; second, the team had to develop a supply chain to manufacture a new component (monomer) and a new product (polymer) simultaneously; and finally, it had to analyze market entrance options given capacity constraints. Thus, the specialty plastics team faced several dilemmas: how should Eastman allocate its limited manufacturing capacity among the initial launch partners, and how aggressively should Eastman price Tritan, given that price would drive demand in the launch markets and in new markets?

To answer those questions, Eastman sought for analytics-oriented decision support. In fact, an extension of the classical Newsvendor model could be used to help making those decisions in a more systematic way. The newsvendor model is a mathematical model with a wide range of applications, e.g., to determine optimal inventory levels in operations management or optimal booking levels in airline revenue management. The basic model is typically characterized by a perishable product with uncertain demand and a fixed price whose order size is to be determined. It assumes the situation faced by a newspaper vendor who must decide how many copies of the day's paper to stock in the face of uncertain demand and knowing that unsold copies will be worthless at the end of the day. The basic newsvendor model has been extended in many ways, e.g. by considering multiple products simultaneously or integrating pricing decisions.

The objective of the thesis is to understand Eastman's situation, analyze the given data, model and implement the decision problem, as well as recommend and defend a solution, based on a suitable Newsvendor model extension. This should include providing a sound theoretical foundation by reviewing the basic Newsvendor problem and its solution, selected extensions and applications.

This thesis is a team-based project where participants will work in teams of two students.

Basic Literature:

Eastman Tritan by Gal Raz, Tim Kraft and Allison Elias (Darden Business School, 2013), https://hbsp.harvard.edu/product/UV6748-PDF-ENG (case study will be provided by the chair)

Porteus, Evan L. "The newsvendor problem." In: Chhajed, D., & Lowe, T. J. (Eds.). Building intuition: insights from basic operations management models and principles (Vol. 115). Springer Science & Business Media, Boston, MA, 2008, Chapter 7

Qin, Y., Wang, R., Vakharia, A. J., Chen, Y., & Seref, M. M. (2011). The newsvendor problem: Review and directions for future research. European Journal of Operational Research, 213(2), 361-374.

Turken, N., Tan, Y., Vakharia, A. J., Wang, L., Wang, R., & Yenipazarli, A. (2012). The multi-product newsvendor problem: Review, extensions, and directions for future research. In: Choi, T.-M. (Ed.): Handbook of newsvendor problems – Models, Extensions and Applications, Springer, 3-39.

Topic S08: How to Design Responsive Service Processes – Introduction and Application to the Case Study of Singapore Changi Airport (Team Project)

In service settings, responsiveness or wait time is one of the key influencing factors on customer satisfaction and thus regularly in focus of research and management. Analyzing impact factors on waiting time or optimizing processes to reduce it are just some of the related topics that service operations management deals with. This discipline uses a broad range of methods like simulations or optimization models to find solutions in the best interest of customer and company. A case study that illustrates this very well is the one of Singapore Changi Airport.

The case takes the perspective of Hamidah Hassan, who works at SATS, a provider of gateway services at Changi Airport. SATS has a symbiotic relationship with Changi Airport Singapore and Singapore Airlines. Hamidah is in charge of the operations at the check-in counter. As passenger traffic at Changi Airport increases, the lengthening waiting lines threaten to impair customer perceptions of the airline and airport. In order to implement an efficient solution, she has to balance her cost of operations against the cost of waiting for passengers and the service level agreement with the airport authority.

The objectives of this thesis are to:

- Introduce waiting time management as part of service operations management and highlight its importance and complexity from a company perspective;
- Formulate a linear integer problem to solve the issue presented in the case study (ignoring any uncertainty);
- Implement the problem in Excel, solve it, and interpret the results;
- Perform a sensitivity analysis with regards to the key parameters given in the case study;
- Now considering uncertainty, perform the simulation analyses described in part B of the case study.

This thesis is a team-based project where participants will work in teams of two students.

Basic Literature:

Law, A. M. (2015). Simulation Modeling and Analysis. New York: McGraw Hill International, 5th edition.

Moosa, S., Sesdhadri, S., Rodrigues, B., & Chan, C. W. (2015). Singapore Changi Airport: Check-in to a world class experience. (To be provided by the chair)

Parlar, M., & Sharafali, M. (2008). Dynamic allocation of airline check-in counters: a queueing optimization approach. Management Science, 54(8), 1410-1424.

Terwiesch, C., & Cachon, G. (2011). Matching Supply with Demand: An Introduction to Operations Management. McGraw Hill, 3rd edition, Chapter 8 (Variability and Its Impact on Process Performance: Waiting Time Problems)