OPM 761 – Research Seminar Production Management

Spring Term 2027

The goal of this seminar is to introduce the participants to conduct scientific research. Thereby, it prepares the students for the writing of their Master's thesis. The seminar is geared towards students intending to write their thesis at the Chair of Production Management.

Participants will explore one of the topics listed below. They will review and critically assess the corresponding scientific literature and present their findings in a written report (18 to 22 pages) as well as in an in-class presentation (15 - 20 min + 20 min discussion). Each participant is also expected to critically assess the presentations of the other students in the ensuing discussion.

Applications will be accepted from **November 9th, 2026** until **November 22nd, 2026**. Admission to the seminar will be confirmed by e-mail at latest on December 1st, 2026 and must be reconfirmed by the participant at the kick-off meeting.

The **Kick-off meeting** will be held on **December 4th, 2026** between 10:15 and 11:45 (CET). During this meeting, an introduction to scientific writing and presentations for term papers will be given.

A brief session on introduction to Overleaf and LaTeXwill also be offered. The time and date of this session will be decided in the Kick-off meeting among the interested students.

The **written reports** have to be submitted by Monday, **February 23rd, 2027** in the following formats:

- Two-fold hard copy version.
- Electronic version including a copy of the references cited in the report and auxiliary information (tables, data, programming code, etc.).

The **presentations** will be held as a blocked session during between **1st and 5th March 2027**. Attendance at all presentations is mandatory.

The final grade for the seminar is composed of the following components: Written report (50%) and presentation (50%).

There is a joint application process for all seminars offered by the chairs of the Area Operations Management. In the spring term 2027, this includes the following seminars:

- **OPM 701:** Research Seminar Supply Chain Management
  Chair of Logistics and Supply Chain Management, Prof. Dr. Moritz Fleischmann
  (Topics labeled with "L"),
- **OPM 760:** Project Seminar Operations Analytics,
  Chair of Production Management, Prof. Dr. Raik Stolletz
  (Topics labeled with "P"),
- **OPM 761:** Research Seminar Production Management,
  Chair of Production Management, Prof. Dr. Raik Stolletz
  (Topics labeled with "P"),

- **OPM 781:** Research Seminar Service Operations Management
  Chair of Service Operations Management, Prof. Dr. Cornelia Schön
  (Topics labeled with "S"),
- **OPM 791:** Research Seminar Procurement
  Endowed Chair of Procurement, Prof. Dr. Christoph Bode
  (Topics labeled with "B").

Detailed information on the seminar topics and the link to the online registration tool are available on the home pages of the respective chairs. In their applications, students can indicate up to five preferred topics from all seminars.

In addition, applicants for OPM 761 must send an email with (1) CV, (2) official B.Sc. and M.Sc. grades overviews, and (3) the list of courses in the Area Operations that you are currently enrolled in to opm761@uni-mannheim.de. For any further question concerning the seminar please also contact the chair via opm761@uni-mannheim.de.

P7 – Green Manufacturing: How to balance energy efficiency, production costs, and productivity?

Objectives: Manufacturing companies are under increasing pressure to reduce their environmental footprint, manage rising and volatile energy costs, and remain competitive in global markets. The transition towards green manufacturing and sustainable production therefore requires companies to consider how efficiently they use energy and other resources. These goals can conflict, e.g., a production schedule that maximizes output may incur higher electricity costs. Consequently, production scheduling is an important managerial decision to balance economic and environmental objectives. The Flexible Job-Shop Scheduling Problem (FJSP) captures this challenge by considering both the assignment of production operations to eligible machines and the sequencing of operations over time, while the extension to multiple objectives provides a framework to analyze which trade-offs are available to production managers.

The goal of this research seminar is to develop a structured understanding of how multi-objective FJSP approaches can support more sustainable and economically efficient manufacturing. The literature should be classified according to the objectives considered, and the evaluation criteria used. The findings should be used to derive managerial insights into how companies can evaluate competing production goals, when different solution approaches are appropriate, and what conditions must be met for these approaches to provide practical value.

Prerequisites: Knowledge of optimization models (e.g., OPM 561, 662)

Basic Paper: Shen et al. (2023); Dauzère-Péres et al. (2024)

> **Abstract**: This paper studies the problem of determining energy efficient schedules in a flexible job shop. The goal is to minimize the total energy cost, given a time-of-use pricing scheme, while ensuring that the schedule does not violate a maximum makespan. The problem is first formalized as a mixed integer program. Because it is already difficult to solve, the simpler problem with a fixed sequence of operations is then extensively studied. Some properties are derived for the specific problem with a fixed sequence. These properties show that the complexity of the problem depends on the structure of the energy pricing scheme. They are also used to propose two heuristic approaches. Relying on these heuristics, we further develop an iterative tabu search for the general problem. Extensive computational experiments are carried out to evaluate the solution methods and the potential gains on the total energy cost, depending on the flexibility associated to the maximum allowed makespan and on the time-of-use structures.

P8 – Operational decision making in remanufacturing under uncertainty

Objectives: Remanufacturing is an important part in the transition towards more resource-efficient and climate-conscious production systems. By restoring used products and components, companies can extend product lifetimes and reduce the need for virgin resources. Remanufacturing is characterized by uncertainty in the quantity and timing of product returns and differences in product condition. These characteristics complicate operational decision making, because insufficient capacity can lead to bottlenecks, while excessive capacity increases operating costs. Stochastic modelling approaches can help companies understand these uncertainties and evaluate operational decisions under realistic conditions.

The goal of this research seminar is to provide a structured overview of stochastic models for operational decision making in remanufacturing systems. The literature should be classified according to the operational applications considered, the sources of uncertainty, and the performance measures evaluated. Moreover, the optimization problems should be classified with respect to the dimensions of the variability cube (Stolletz and Tan, 2024). Finally, the managerial implications, limitations of existing approaches, and opportunities for future research should be discussed.

Prerequisites: Knowledge of probability and stochastic models; basic knowledge of optimization is desirable.

Basic Paper: Hajipour et al. (2025); Rizova et al. (2020)

> **Abstract**: Product recovery is critical in reducing costs, enhancing profitability, and improving supply chain responsiveness to customer demands. Remanufacturing returned products, as part of the circular economy, is a central strategy in achieving these goals. This study presents a model that optimizes the remanufacturing process using in-house workstations and outsourcing to maximize supply chain profitability, reduce queue lengths, and ensure machine reliability. The remanufacturing system is modeled as an M/M/m/k queuing system, considering real-world supply chain constraints such as budget limitations, station capacity, and machine reliability. Supply chain optimization is achieved by maintaining efficiency while examining different remanufacturing policies and pricing strategies. The results show that expanding remanufacturing capacity enhances supply chain profitability, even with moderate increases in queue length. We provide valuable insights for supply chain managers aiming to optimize their remanufacturing processes and balance cost, efficiency, and reliability.

P9 – Balancing Human and Robotic Capacity in Operations Management

Objectives: Robotic systems are increasingly used to support human workers in production, logistics, and service operations. One application is order picking in fulfillment centers, where robots assist human workers in processing customer orders. While traditional manual operations primarily adjust their processing capacity through workforce staffing and shift scheduling, robot-assisted systems introduce additional decisions concerning the number and deployment of robots. Human workers and robots differ in their costs, availability, processing capabilities, and operational constraints. Moreover, in collaborative systems, the capacities of both resources are interdependent. For example, increasing the number of robots may provide limited benefits if human processing capacity becomes the bottleneck, while insufficient robotic capacity can leave workers idle. Determining an appropriate combination of human and robotic resources therefore presents an important capacity planning problem.

The goal of this research seminar is to provide a structured overview and comparison of capacity planning models for human workers, robots, and their combination in operations management. The existing literature should be reviewed with respect to the considered capacity decisions, objective functions, constraints, and modeling approaches. Particular attention should be paid to differences between workforce staffing and robotic capacity planning, as well as to how interactions between human and robotic resources are represented in integrated models. Finally, the managerial implications and limitations of the different approaches should be critically discussed, with particular attention to identifying research gaps in capacity planning for human workers, mobile robots, and their joint deployment.

Prerequisites: Knowledge of optimization models (e.g., OPM 561, 662); basic knowledge of stochastic models is desirable.

Basic Papers: Liu et al. (2026); Azadeh et al. (2025); Rijal et al. (2021)

> **Abstract**: Human–robot collaborative order picking (HRCOP) is becoming an important operating mode in modern warehouses, where autonomous mobile robots support human pickers in travel, transport, and coordination-intensive tasks. Yet the value of HRCOP depends not only on whether robot assistance is deployed, but also on how effectively robot support is aligned with human capability. We develop an analytical model to compare a purely manual picking system with an HRCOP system in which the firm jointly determines human capability investment and robot support. Our results indicate that collaboration does not always dominate manual picking. When improving human capability is relatively inexpensive, a manual system may remain competitive even in complex operating environments. We also show that the cost of human capability investment determines whether robots and human capability function as complements or substitutes.(...)

P10 – Balancing Speed and Costs in Service Systems

Objectives: Queueing systems are analyzed in a multitude of context: Call centers, traffic, airports, healthcare, restaurants, and customer services in general. One lever for the performance of such a system is the service rate, i.e., how many customers per time unit can be served. The service rate can be increased by, e.g., speeding up services, simplifying processes, and on the other hand reduced by additional up- and cross-selling, or by putting more diligence into the service. A higher service rate decreases congestion, and thus waiting. However, a higher service rate can come with other costs. E.g., in the so-called quality-speed trade-off literature it can also lower the value of the service provided to the customer. Depending on the business application, literature assumes different components in the objective function, such as waiting costs, revenues depending on the service rate, costs in the service rate, etc.

The goal of this seminar thesis is to provide a detailed overview, classification, and comparison of different objective functions in the literature on stochastic models with decisions on the service rate. The underlying motivation of the objective functions should be explained. Moreover, the optimization problems should be classified with respect to the dimensions of the variability cube (Stolletz and Tan, 2024). Relevant applications and managerial insights, as well as structural similarities and differences between the considered objective functions should be identified. A critical assessment of the literature concludes this thesis.

Prerequisites: Basic knowledge in stochastic modelling (e.g., OPM 561)

Basic Papers: Anand et al. (2011); Stolletz and Tan (2024)

> **Abstract**: In many services, the quality or value provided by the service increases with the time the service provider spends with the customer. However, longer service times also result in longer waits for customers. We term such services, in which the interaction between quality and speed is critical, as customer-intensive services. In a queueing framework, we parameterize the degree of customer intensity of the service. The service speed chosen by the service provider affects the quality of the service through its customer intensity. Customers queue for the service based on service quality, delay costs, and price. We study how a service provider facing such customers makes the optimal "quality–speed trade-off." Our results demonstrate that the customer intensity of the service is a critical driver of equilibrium price, service speed, demand, congestion in queues, and service provider revenues. Customer intensity leads to outcomes very different from those of traditional models of service rate competition. For instance, as the number of competing servers increases, the price increases, and the servers become slower.

References

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Azadeh, K., Roy, D., de Koster, R., and Khalilabadi, S. M. G. (2025). Zoning strategies for human–robot collaborative picking. *Decision Sciences*, 56(1):50–70.

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