

Bachelorarbeitsthemen - BWL

FSS 2022

1. Cutoff service levels in operations management

The management of operations in warehousing, transportation and manufacturing is driven by service levels with respect to on-time delivery. In service level agreements, typically, so-called cutoff service levels (also known as Next Scheduled Deadline (NSD)) are widely used in industry and retail operations. For example, based on a cut-off time and a deadline, a certain target percentage of orders received until the cut-off time have to be processed until the deadline.

The objective of this thesis is to provide an overview of planning models that consider cutoff service levels used in logistics and manufacturing. The student is expected to describe the assumptions of respective evaluation models and optimization models from the literature.

Literature: Doerr and Gue (2013), Çeven and Gue (2015)

2. Virtual waiting in service operations

The concept of virtual waiting is used in amusement parks, call centers, and airports. After the registration at arrival, the customer can leave the queue and does not have to wait in line. The customer returns to the queue at a specified point in time. The advantage for the customers is that they can use their time more effectively.

The objective of the thesis is to give an overview over such virtual waiting options in service operations based on literature or business applications. Possible applications of this concept have to be described in detail. The specific assumptions and rules of the virtual waiting system should be described, compared with each other, and critically assessed.

Literature: De Lange et al. (2013)

3. Overview and applications of retrial queues

Queueing systems are used in various service systems, such as call centres, health care, emergency services, and repair facilities. In many of these service systems, customers leave the queue before being served (e.g. abandonment or balking) due to a lack of patience. However, impatient users may join the system at a later time point again (retrials). Moreover, assumed distributions and specific characteristics of the queueing

model depend on the specific applications. For example, time-dependent arrivals are observed in airport security lines.

The goal of the thesis is to conduct a literature review about retrial queues. Existing literature should be critically assessed and compared by describing different applications, specific characteristics, and resulting optimization models (objective, constraints, ...). Moreover, utilized problem sets for different applications should be reviewed and described.

Literature: Aguir et al. (2008)

4. Applications of queueing systems with impatient clients in service operations

Queueing systems are used in various service systems, such as call centres, health care, emergency services, and repair facilities. In many of these service systems, customers leave the queue before being served (e.g. abandonment or balking) due to a lack of patience. However, different business applications result in different assumptions on the queueing model, since some applications have specific characteristics that should be modeled (e.g. limited waiting room due to COVID-19 regulations).

The goal of the thesis is to conduct a literature review based on real world applications for such queueing systems. Existing literature should be critically assessed and compared with respect to characteristics of considered application areas.

Literature: Koole and Mandelbaum (2002)

5. Rethinking global supply chains

It is estimated that almost three quarters of globally operating organizations experience a supply chain disruption each year, i.e. an event that impacts the flow of goods, materials and/ or services, thereby limiting the ability of an organization to serve the end consumer. Last year, 75% of companies have had negative or strongly negative impacts on their businesses due to the COVID-19 pandemic. As global supply chains are subject to increasingly frequent and alarming severity of disruptions, there is a need to rethink the attributes that ensure and enhance the performance of global supply chains. In addition to already established attributes such as agility, adaptability and alignment, robustness and resilience are increasingly in the foreground.

The purpose of this topic is to focus on the attributes *robustness* and *resilience* that enable global supply chains to recover from current shocks, proactively mitigate future shocks and secure profitability. Based on the literature review provided by Cohen and Kouvelis (2021), delineation, comparison and critical appraisal of these two attributes as well as approaches to their quantitative assessment are also part of the thesis.

Literature: Cohen and Kouvelis (2021)

6. Capacity Planning under demand uncertainty

Manufacturer and supplier regularly have to make decisions based on uncertain and incomplete information. Future demand, delivery times and/or availability of raw materials and resources can be uncertain and thus make reliable planning difficult. Often long-term capacity decisions have to be made in the face of uncertain demand. In addition, potential correlation structures of demand can have a significant impact on resource allocations.

In this thesis, the linear optimization model proposed by Netessine et al. (2002), should be analyzed, implemented and critically evaluated on the basis of an own chosen example. Knowledge of a standard optimization solver such as Gurobi or Cplex is required to implement the model and perform sensitivity analyses.

Literature: Netessine et al. (2002)

7. The newsvendor problem for workforce planning

A classical and crucial building block of stochastic inventory theory is the newsvendor problem. In this problem, a newsvendor decides how much to stock of a perishable product, e.g. a newspaper, for a single selling period, facing random demand. If the actual demand exceeds inventory, the vendor suffers lost revenue, while in the contrary case, disposal or holding costs are incurred. Recently, this model has been used for workforce problems, where the vendor must decide on the assignment of personnel, when there is uncertainty about daily workload. Several variants and extensions of the basic newsvendor model exist addressing different aspects of workforce planning, e.g. workload heterogeneity, nurse staffing, absenteeism etc.

This topic is intended to provide a comprehensive and topical overview of the newsvendor problem for workforce planning based on the review provided by Qin et al. (2011). The different formulations and variants should be compared, analyzed and the respective advantages and disadvantages identified. Elaborating on research gaps is also an important part of the thesis.

Literature: Qin et al. (2011)

8. Lifeline infrastructures under disruptions

Disruptions within lifeline systems such as energy, healthcare or water supply can have far-reaching impact on societies. Lifeline systems are often considered as a network consisting of nodes and arcs, where nodes can represent components or actors, e.g. power plants or hospitals, and arcs can represent connections between node pairs for conveying service flows. In order to be better prepared for disruptions caused by natural disasters or unexpected accidents, it is of utmost importance to identify and strengthen the most critical nodes of the network. This can be done by an optimization problem that involves finding the set of nodes whose deletion maximally degrades network connectivity, i.e., causes maximum disruption.

This topic focuses on the challenges of securing lifeline networks by identifying their critical nodes. The critical node detection model proposed by Ventresca et al. (2018) as an integer optimization model, should be analyzed, implemented and critically evaluated on the basis of an own chosen example. Knowledge of a standard optimization solver such as Gurobi or Cplex is required to implement the model and perform sensitivity analyses.

Literature: Ventresca et al. (2018)

9. Literature review on queues with various service disciplines

In service operations, usually, customers in a queue are served in a first-come-first-serve (FCFS) order. However, in production systems, the sequence of the items being processed is less restricted and managers can chose sequencing methods that fit their

operation best.

Despite service rules such as shortest-processing-time-first (SPT) being capable of drastically reducing waiting times in many settings, there has been comparatively fewer studies focusing on analyzing them and most of the literature on queues considers FCFS as the default setting.

The objective of this project is reviewing the studies that analyze queues controlled with various service disciplines. One of the aims of the project is comparing the available studies in terms of their assumptions and the managerial insights they derive. The main service disciplines of interest are service-in-random-order (SIRO), last-come-first-serve (LCFS), shortest-processing-time-first (SPT) and longest-processing-time-first (LPT). However, other commonly used or newly developed service disciplines are in the scope of the project as well.

Literature: Mönch et al. (2012), Hyytiä et al. (2011)

10. Literature review on dynamic-stochastic production networks

Often in production systems, a part has to go through various machines for its production to complete. Also, depending on specifics of each part, it might need to visit different machines than other parts in the system. For these reasons, networks of queues can be a good mathematical device for modelling production systems with uncertainty.

Given that in practice, many of these systems involve time-dependent processes, e.g. due to production capacity being driven by the availability of workers which is not uniform during all hours of a day, there is a need for analysis of time-dependent queueing networks.

Given this background, the aim of this project is reviewing the literature about the analysis of time-dependent queueing networks, specially with a focus on identifying the specifics and assumptions of to the models related to each application and the managerial insights derived for them.

Literature: Van Brummelen et al. (2018), Kopats and Matalytski (2020)

11. Literature review on the application of machine learning in production control

The recent success of machine learning methods in various fields has motivated many studies that investigate the application of machine learning in operations management. More specifically, in the area of production control, there has been attempts at using the tools developed for standard machine learning problems for optimizing various aspects of production systems.

In this project, the main aim is preparing a comprehensive review of the literature on the application of machine learning in production control that categorizes the applications, places the solution methods in the already defined machine learning categories e.g. supervised/unsupervised, classification/regression and identifies the possible application areas that have not been explored.

Literature: Li and Olafsson (2005), Priore et al. (2001)

12. Literature overview on the dynamic and stochastic service systems in airport terminals

Various service industries face time-dependent arrivals. In addition, the total number of available servers and hence the total processing capacity can be also be time-dependent.

The goal of this thesis is to provide a comprehensive overview of the recent publications on the application of time-dependent queueing systems in service systems in airport terminals, such as check-in counters, security checks, departure lounges, and baggage claim facilities. The reviewed articles must be classified based on their assumptions, application area, performance evaluation measures, and assumptions on the optimization problem (if applicable), i.e., input data, decisions, objective functions, etc. The thesis must also provide an overview of the managerial insights mentioned in the reviewed research papers. A critical assessment of the literature and suggestions for future research concludes this thesis.

Literature: Schwarz et al. (2016); Rodríguez-Sanz et al. (2021)

13. **Literature overview on the application of time-dependent queueing in health care facilities and emergency departments**

Various service industries face time-dependent arrivals. In addition, the total number of available servers and hence the total processing capacity can be also be time-dependent.

The goal of this thesis is to provide a comprehensive overview of the recent publications on the application of time-dependent queueing systems in service systems in health-care facilities and emergency departments. The reviewed articles must be classified based on their assumptions, application area, performance evaluation measures, and assumptions on the optimization problem (if applicable), i.e., input data, decisions, objective functions, etc. The thesis must also provide an overview of the managerial insights mentioned in the reviewed research papers. A critical assessment of the literature and suggestions for future research concludes this thesis.

Literature: Schwarz et al. (2016); Andersen et al. (2019)

14. **Optimization Models for Personnel Scheduling with Split Shifts**

Shift Scheduling is an important task in various industries such as service, health care and logistics. In some businesses there are high demand peaks with a long idle time in between them e.g. in public transport the bus drivers' demand peaks correspond to the rush hours in the morning and the late afternoon. Also in assisted living facilities for people with disabilities the demand peaks follow a similar pattern. While the care assistants' demand peaks lie in the morning and evening, the demand for them is clearly lower during the day when the inhabitants are at work.

To deal with this time-dependent variability in demand, the personnel can be scheduled in split shifts. These are shifts interrupted by a long, unpaid break of several hours.

The goal of this thesis is to give an overview on the optimization models that can be related to personnel scheduling with split shifts / personnel scheduling with (long) break windows. The student is expected to classify the papers based on their underlying optimization problems, i.e. the assumptions, input data, decisions, objective(s) and constraints.

Literature: Aykin (1996)

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