

Operations Research and Logistics

Course

Food Logistics Management

Course code:	ORL-31806
Period:	5 - Afternoon
Credits:	6.00 ECTS
Contact Person:	Dr. Behzad Behdani Leeuwenborch building Room 6014 tel: 0317-484460 email: behzad.behdani@wur.nl
Lecturers/ Examiners:	Dr. Behzad Behdani Dr. Elsbeth Spelt
Language of Instruction:	English
Secretariat	Operations Research & Logistics Leeuwenborch building Room 6012 tel: 0317-485645 email: office.ori@wur.nl
Kick-off lecture:	Monday 14-03-2016 13.30 hrs C313 in the Forum
Examination date:	Friday 29-04-2016 13.30 - 16.30 C222 in the Forum
Re-examination:	Thursday 11-08-2016 08.30 – 11.30 C4030 in the Orion
Continuation courses:	ORL-30806 Operations Research and Logistics; Thesis ORL; Thesis FQD; Thesis HPC.

Profile of the course

The course Food Logistics Management (FLM) is about how organisations in the food supply chain fulfil market demand by getting the right product, in the right quantity and quality, at the right time and place, as *efficient* and *sustainable* as possible. A recent report by UK's Institution of Mechanical Engineers (IME) shows that realising efficient and sustainable food production is a challenging and urgent problem¹. According to the IME report, we produce about four billion metric tonnes of food per year. Yet, it is estimated that 30–50% (or 1.2–2 billion tonnes) of all food produced never reaches a human stomach. How can it be that organisations in food supply chains waste so many valuable resources and still be in business?

The goal of the course is to provide you a framework for understanding how complex food supply chains work. Thereby, this course provides you a basis for better logistic decision making in practical situations such as these:

1. You are a *product developer* working for a company producing fresh fruit juices. The company is considering to introduce *PurePulse*, a new way of producing fresh fruit juices with a longer shelf (21 days instead of one week). Your task is to find out what the benefits are of using a *PurePulse* installation compared to the current equipment. Do these benefits outweigh the cost of implementing this new way of processing?
2. You are a *supply chain manager* of a food processing company (like *FrieslandCampina*). Which of your products should be make-to-order and which should be make-to-stock? What should you consider in controlling stock levels of both components (e.g. raw milk) and finished goods (e.g. dairy-based beverages, infant & toddler nutrition, cheese, butter, cream)?
3. You are working for a producer, distributor, or wholesaler selling fresh food products having a total shelf life of X days. What percentage of the total shelf life can you promise to your customers?
4. You are a *food quality manager* in a company and you have problems getting on-time deliveries from your suppliers. Moreover, the quality of the raw materials delivered is low. How much impact does this have on your sales and operations? What are the best options for improving the situation?

These are all example situations that you may face in your future professional life and that determine how efficient and sustainable the performance of a food supply chain is. Because each food supply chain is unique, the range of logistic problems you may face is almost infinite. Therefore, this course focuses on explaining and analysing, both from a *logistic* and *food quality* perspective, *why* food supply chains behave as they do. Thereby, this course provides you the necessary tools and insights to deal effectively with almost any situation!

Learning outcomes

After the course you are expected to be able to:

1. demonstrate a detailed understanding of logistics and food quality management concepts in food supply chains;
2. model and analyse logistics systems that incorporate quality and perishability issues using quantitative modelling techniques such as simulation;
3. assess how specific characteristics of food supply chains (e.g. heterogeneous quality supply, perishability) interact with the effectiveness of logistics management decision making;
4. apply food logistics management theory in practical decision making.

¹ See: http://www.imeche.org/Libraries/Reports/Global_Food_Report.sflb.ashx



Learning materials and resources

- Hopp W. J. 2008. *Supply Chain Science*. Book available online as pdf or can be bought as hardcopy.
- Additional literature will be distributed via Blackboard.

Educational activities

The programme consists of a combination of four different work forms: lectures, tutorials, computer practicals, and self-study in which a variety of Food Logistics Management concepts are addressed. Generally, lectures take place on Mondays, Tuesdays, and Fridays, and computer practicals on Wednesdays and Thursdays. There are two tutorials, one in the first week and one in the sixth week of the course.

- *Lectures*: Theory for understanding and analysing complex food supply chain systems is presented in lectures. Main goal is to support and stimulate you in acquiring knowledge, insight and understanding.
- *Supervised tutorial sessions*: Part of the course are three assignments. The first two assignments are based on a *simulation game*. In the simulation game, you will apply the knowledge gained in the lectures in a *virtual*, web-based, business environment. In the third assignment, you will analyse a business case on perishable food products in a retail setting using simulation modelling. The first tutorial introduces the simulation game and the second tutorial the simulation case.
- *Computer practical sessions*: In the practical sessions, you work in groups on three assignments. Basic knowledge on Microsoft Excel is required for the assignments and practical.
- *Self-study*: The total number of contact hours comprises only a part of the 6 credits. The other hours are planned for self-study of provided literature.

Assessment strategy (examination)

The final grade of this course consists of two parts:

- Average mark for the reports on all 3 assignments (30%).
- Written closed book exam (70%).

To pass the course, your final grade should be at least 5.5 AND a minimum grade of 5.5 for the written exam should be obtained.

Assignments: You will work on the assignments in a group of 4 students. The reports on the assignments are handed in via email on Thursday before 17.30hr in week 3 (assignment 1), 5 (assignment 2) and 6 (assignment 3). All group members will get the same grade. If no report is handed in on time, the whole group will get the grade 0 for that report.

$$\text{Final grade assignments} = \frac{\text{grade report 1} + \text{grade report 2} + \text{grade report 3}}{3}$$

Written closed book exam: The exam consists of open-ended questions. The use of a calculator is allowed. The exam is at the end of period 5 (Friday 29 April 2016, 13.30 - 16.30, in room C222 in the Forum). There will be two opportunities for a re-exam.

Important for re-examination: The contents of this course may be updated yearly, that means that the contents of the exam may also change yearly. The assessment of the assignments are only valid for the current academic year.



	Learning outcomes \ where assessed?	Assignment 1	Assignment 2	Assignment 3	Written exam
1	demonstrate a detailed understanding of logistics and food quality management concepts in food supply chains	X	X	X	X
2	model and analyse logistics systems that incorporate quality and sustainability issues using quantitative modelling techniques such as simulation			X	X
3	asses how specific characteristics of food supply chains (e.g. heterogeneous quality supply, perishability) interact with the effectiveness of logistics management strategies	X	X	X	X
4	apply food logistics management theory in practical decision making	X	X		X
	Contribution to final mark (%)	10	10	10	70

Outline and schedule of the course program

Week 1.

LECTURE Introduction to FLM (Behzad Behdani and Elsbeth Spelt)

This lecture starts with the set-up of the course. Next to that, we discuss the concept of as supply chain and the role of *strategy*, *controls* and *performance measurement* in managing a supply chain. Moreover, the concept of 'Quality Controlled Logistics' (QCL) will be discussed in this lecture. The concept of QCL hypothesizes that if product quality in each step of the food supply chain can be predicted in advance, goods flows can be controlled in a pro-active manner and better supply chain designs can be established resulting in higher product availability, consistent product quality, and reduced product losses.

Background reading:

- Chapter 0, 1, and 2.2 of Supply Chain Science, Hopp, 2008.
- Article on QCL provided on Blackboard.

LECTURE Food quality dynamic processes 1 (Elsbeth Spelt)

In order to meet the pre-determined food quality specifications, food quality dynamic processes need to be understood. Food quality dynamic processes can be viewed from four different angles: 1. food dynamics, 2. technological conditions, 3. human dynamics, and 4. administrative conditions. These four angles can be used for analysing each actor in the chain or for the whole supply chain in order to get a better understanding of factors influencing the pre-determined food quality specifications. This lecture introduces the main concepts of food quality, food safety, food quality perception and major deterioration processes affecting food quality and food quality perception. Furthermore, an initial analysis on food supply chains using the four angles will be made to derive factors influencing the pre-determined food quality specifications.

Literature to study:

- Chapter 2 of Food Quality Management, Luning and Marcelis, 2009.

LECTURE Inventory management and control 1, 2 (Behzad Behdani)

An important decision on the *tactical* level of logistics control is the type of *inventory policy* to use. An inventory policy provides answers to two fundamental questions: "how much should be ordered when an order is placed?" and "when should an order be placed?". In these two lecture, we discuss these two questions in detail for some of the most important inventory policies.



Background reading:

- Chapter 7 of Supply Chain Science, Hopp, 2008.

TUTORIAL Simulation gaming (Behzad Behdani)

In the simulation game, your task is to run a company—called The Fresh Connection (TFC)—and to face the problems of coordinating your food supply chain. You will be running a company producing fresh juices and this company is in turmoil. You are part of a management team of four, responsible for achieving the highest profit possible. Each team member has a different role. You will run TFC in a game setting; there are five rounds you will play (see course schedule below). Except for the first practice round, each round requires extensive preparation and there is a set time for providing your game input. In this first tutorial, the simulation game is introduced and you will play as a group the first (practice) round of the game. At the end of the tutorial, assignment 1 is introduced.

Background reading:

- Introduction documents Company, Mission and Experience, provided on Blackboard.

Week 2.

LECTURE Transportation and distribution management for perishable products (Behzad Behdani)

In this lecture, we will discuss the transportation and distribution management issues, especially for food products logistics. These aspects are - in general - more challenging for food supply chains because of the limited shelf life of the products.

Background reading:

- Course material provided on Blackboard.

LECTURE Food quality dynamic processes 2 (Elsbeth Spelt)

In order to meet the pre-determined food quality specifications, food quality control needs to be understood. Food quality control considers two types of control measures, various control activities and control decisions minimizing typical sources of variations. The identification of control measures, activities and decisions can be used for analysing each actor in the chain or for the whole supply chain in order to get a better understanding of critical control points necessary to meet the pre-determined food quality specifications. This lecture introduces the main concepts of food quality control, sources of variation, kinds of control, and the identification of control measures, activities and decisions. Furthermore, the initial analysis on food supply chains is elaborated by incorporating critical quality control points to avoid 'out of spec' situations.

Literature to study:

- Chapter 5 of Food Quality Management, Luning and Marcelis, 2009.

PRACTICAL Simulation gaming

In two practical sessions, you will play the *second* round of the simulation game and work on assignment 1.

Week 3.

LECTURE Food quality dynamic processes 3 (Elsbeth Spelt)

In order to meet the pre-determined food quality specifications, food quality dynamic processes and food quality control need to be understood. Therefore, in this lecture you are going to analyse orange juice supply chains. Questions like: 'How do supply chains of orange juices look like?', 'Which critical quality and safety attributes need to be pre-determined in the product specifications?', 'Which influencing factors using the four dif-



ferent angles can be derived?', 'Which control activities need to be conducted?', 'Which quality control decisions are crucial and how should orange juice quality control systems be designed?' Each group presents their analysis for different orange juices using an interdisciplinary viewpoint of food quality and logistics. Furthermore, reflections will be made between the conducted analysis and the findings of the simulation game.

Literature to explore:

- Codex Alimentarius for fruit juices and nectars.
- Chapters 2 and 5 of Food Quality Management, Luning and Marcelis, 2009.
- Other literature of this course and previous courses.
- Literature provided by WUR library and other information sources.

PRACTICALS Simulation gaming

In these two practical sessions, you will play the *third* round of the simulation game and work on assignment 2.

LECTURE Feedback TFC & assignment 1 (Behzad Behdani)

In this lecture, a selected group of students will present their game results and answers to assignment 1. The presentations are followed by an interactive discussion on assignment 1 and the game results.

Week 4.

LECTURE Strategic decisions in logistics management (Behzad Behdani)

In this lecture, we discuss logistics management decisions on a *strategic* level. We will focus on main strategic decisions, such as the positioning of inventory in supply chain, inventory pooling, and dual sourcing.

Background reading:

- Chapter 8, 9.1, 9.2, and 9.3 of Supply Chain Science, Hopp.

LECTURE Collaboration and coordination in supply chains (Behzad Behdani)

In this lecture, we will discuss the issue of *supply chain collaboration* and related concepts such as, Vendor Managed Inventory (VMI) and channel coordination.

Background reading:

- Chapter 9 of Supply Chain Science, Hopp.

PRACTICALS Simulation gaming

In these two practical sessions, you will play the *fourth* round of the simulation game and work on assignment 2.

LECTURE Feedback TFC (Behzad Behdani)

In this feedback session students can ask questions about the game. We will also discuss topics that relate to the game.

Week 5.

LECTURE The value of information in food logistics (Behzad Behdani)

In this lecture, the importance of data gathering, monitoring and information sharing in managing logistics processes in a food supply chain will be discussed.

Background reading:

- Course material provided on Blackboard.

LECTURE Introduction to simulation (Behzad Behdani)

In this lecture, we discuss the key stages of any simulation study:



1. Conceptual modelling.
2. Build computer simulation model.
3. Perform experiments with the simulation model.
4. Implementation.

Background reading:

- Course material provided on Blackboard.

PRACTICALS Simulation gaming

In this practical, you will work on the *fifth* (final) round of the simulation game and also assignment 2.

LECTURE Feedback TFC & assignment 2 (Behzad Behdani)

In this lecture, a selected group of students will present their game results and answers to assignment 2. The presentations are followed by an interactive discussion on assignment 2 and the game results.

Week 6.

TUTORIAL Simulation case (Behzad Behdani)

In this tutorial, we discuss how simulation can be used to model and evaluate the logistics performance of food supply chains. In the second hour of the tutorial, the simulation business case is introduced and you will start working as a group on assignment 3.

Background reading:

- Course material provided on Blackboard.

LECTURE Case discussion (Behzad Behdani)

In this lecture, we will discuss your progress in assignment 3 and you will have the opportunity to ask question related to the simulation case.

PRACTICALS Simulation case

In this practical you will work on simulation case and assignment 3

LECTURE Feedback assignment 3 & questions final exam (Behzad Behdani)

In this lecture, a selected group of students will present their answers to assignment 3. The presentations are followed by an interactive discussion on assignment 3. Finally, you will have the opportunity to ask questions related to the final exam.



Lecture rooms : C313, C318, C321, PC662, PC707 & PC612 Building 102, Forum

Lecturers: Behzad Behdani (BB), Elsbeth Spelt (ES)

Note: Activities written in *italics* = no class meeting

2016	Monday 13.30 - 15.15 C313	Tuesday 13.30 - 15.15 C318	Wednesday 13.30 - 17.15	Thursday 13.30 - 17.15 PC662, PC707	Friday 13.30 - 15.15 C321
Week 1 (14-18 March)	LECTURE (BB+ES) Introduction to FLM	LECTURE (ES) Food quality dynamic processes 1	LECTURE (BB) - C313 Inventory management and control 1	TUTORIAL (BB) Simulation gaming	LECTURE (BB) Inventory management and control 2
Week 2 (21-25 March)	LECTURE (BB) Transportation & distribution management for perishable products	LECTURE (ES) Food quality dynamic processes 2	PRACTICAL - PC662, PC707 <i>Simulation gaming</i>	PRACTICAL <i>Simulation gaming</i> 17.15hr Deadline round 2	Good Friday
Week 3 (28 March-1 April)	Easter	LECTURE (ES) 13.30 – 17.15 Food quality dynamic processes 3	PRACTICAL - PC662, PC707 <i>Simulation gaming</i>	PRACTICAL <i>Simulation gaming</i> 17.15hr Deadline round 3 17.30hr Deadline report 1	LECTURE (BB) Student presentations Feedback TFC & assignment 1
Week 4 (4-8 April)	LECTURE (BB) Strategic decisions in food logistics management	LECTURE (BB) Coordination and collaboration in supply chains	PRACTICAL - PC662, PC707 <i>Simulation gaming</i>	PRACTICAL <i>Simulation gaming</i> 17.15hr Deadline round 4	LECTURE (BB) Feedback TFC
Week 5 (11-15 April)	LECTURE (BB) The value of information in food logistics	LECTURE (BB) Introduction to simulation	PRACTICAL - PC662, PC707 <i>Simulation gaming</i>	PRACTICAL <i>Simulation gaming</i> 17.15hr Deadline round 5 17.15hr Deadline report 2	LECTURE (BB) Student presentations Feedback TFC & assignment 2
Week 6 (18-22 April)	TUTORIAL (BB) - PC612 13.30 – 17.15 Simulation in FSC Simulation case	LECTURE (BB) Case discussion and question hour	PRACTICAL <i>Simulation case</i>	PRACTICAL <i>Simulation case</i> 17.30hr Deadline report 3	LECTURE (BB) 13.30 – 17.15 Student presentations Feedback assignment 3 Final exam questions