

# Real options and demand uncertainties in supply chain management

/ ROCE Partners

## Project Plan

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## 1. Background

This project work is part of the course Mat-2.4177 Seminar on Case Studies in Operational Research. The work's client is ROCE Partners Oy, a consulting company specialized in supply chain management.

A company's supply chain faces many uncertainties that can cause severe deviations in operations from the planned. The most important is the uncertainty in the forecasts of demand. Other factors of uncertainty in a supply chain are, for example, price and currency risks, delivery disturbances, strikes and weather conditions.

A manufacturing company can, however, hedge from the risks caused by uncertainties, like excess inventories or running out of products, by different means. One way is to use real options. This means that the company can buy itself insurance for the uncertainty by, for example, buying additional capacity from an outside manufacturer, which the company can use if the demand exceeds the forecast. There are plenty of similar options and their control can be a major competitive advantage to a company. This project work's intention is to consider different means of controlling uncertainties. The emphasis, however, is on real options.

## 2. Objectives

The objectives set to this project are as follows:

1. Increase ROCE Partners' understanding of what kind of real option and contract models or other methods can be used to reduce the effect of uncertainties associated with supply chain management
2. Compare the functionality of different real option and contract models in scenarios regarding different factors of uncertainty
3. Apply appropriate models to a real case example of a make-to-order production system

### 2.1. Research questions and constraints

The main problem of this project work is to answer to the question of what kinds of uncertainties need to be considered in supply chain management, and how the effects of those can be reduced. To answer this and to reach the objectives, we have divided our research problem into research questions, which we tend to answer during this project. The research questions are:

1. What are the uncertainties that need to be considered in supply chain management?
  - 1.1. What parts of the supply chain do these factors of uncertainties affect?
  - 1.2. How can the risk caused by an uncertainty be reduced?
2. What kinds of real option and contract models are there, that are designed to reduce uncertainty?
  - 2.1. Which uncertainties can be reduced by which models?
  - 2.2. What are the underlying assumptions in each real option and contract model?
3. How can real options be priced?
4. What models are appropriate for the case example?
  - 4.1. How do the chosen models work in practice?

It is to be noticed that research questions 1.2 and 2 partly overlap. However, we want to handle them separately, as the former question considers real options as an alternative, whereas question 2 will take a deeper look at them and the different kinds of options.

The literature review will be a base for the analysis and case example, and thus we will limit the review according to the characteristics of the case. This implies that will mainly consider the supply side of the supply chain, i.e. contact to retailer and customer are excluded from the analysis. In addition, the financial option theory will only be briefly mentioned, as the analysis regards real options, which relate to non-financial assets.

### 3. Research strategy

The project work consists mainly of two different phases:

1. Literature review
2. Analysis

The literature review aims for answering research questions 1 and 2 including sub questions. Question 3 is to be answered mainly on the basis of the literature review, but in the analysis phase also by considering new pricing models. The emphasis of the analysis, however, is in applying the results of the review to the case example, which corresponds to answering question 4.

The literature review will be completed before any steps in the analysis phase are taken. The results of the review are then used in building the appropriate model in the analysis phase.

In the analysis phase, first a general model for a make-to-order process is created. The general model is then adjusted to and tested on the case data. The results of the tests will then be used to correct the general model, after which new tests can be executed. This iterative process will go on until the model works appropriately. In generating the model the aim is not to create a mathematically optimal model, but also the simplicity and manageability of it is to be considered. Too complex a model can result in noticeable internal costs in an organization.

### 4. Project schedule

The project implementation is going to be shared between group members according to project main entities, literature review and analysis. Two members will dedicate their research time first to conduct the review, and to write overall picture of uncertainties in supply chain networks. In addition they will consider the use of different real options.

Later on the other three members are going to identify and consider the most promising methods for modelling the real option pricing problem. The chosen methods are going to be analyzed and tested with real life data. As can be seen from the project schedule illustrated in figure 1, the literature review and different phases of model construction, testing and validation will consume the most of the time available for the project. The research report is gradually developed towards the final version.

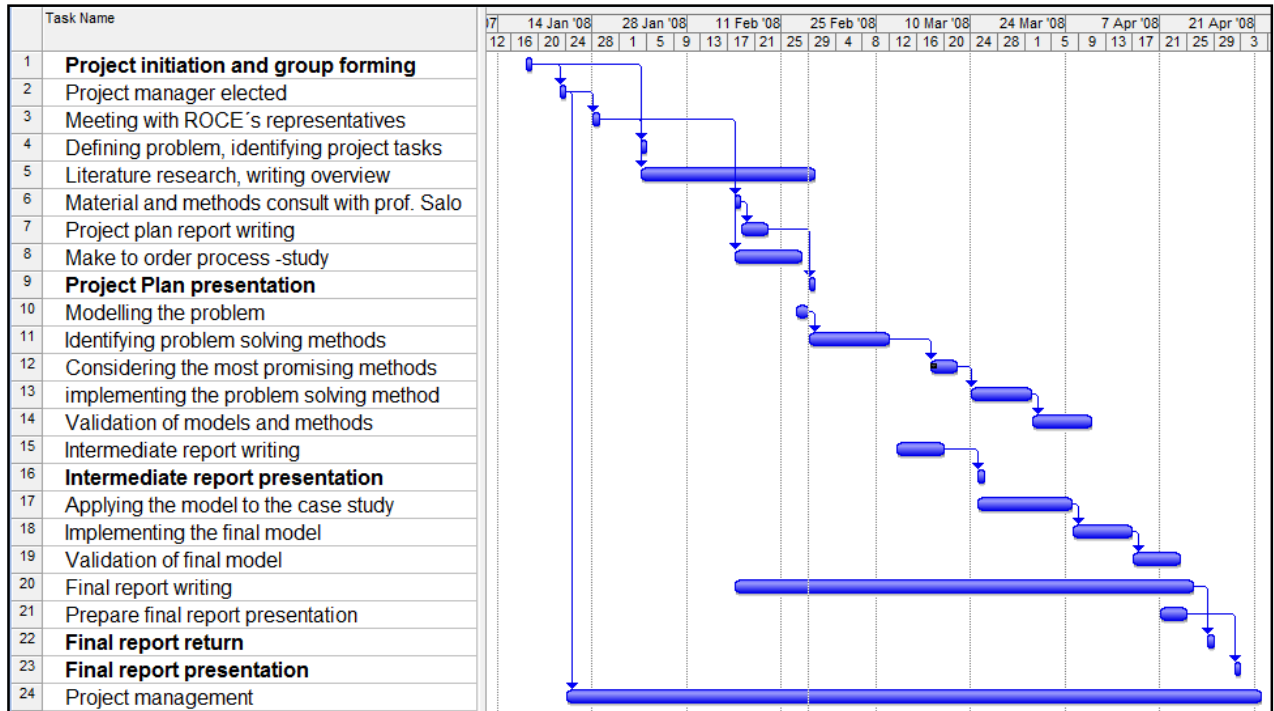


Figure 1. Project schedule

## 5. Resource availability

The project implementing team contains five members all with systems and operations research background. They are Julia Venesmaa (Project manager), Anni Hietaniemi, Olli Tiainen, Tommi Roine, and Arto Niinistö. The project manager is responsible for contacts with project initiator side, and overall progress of the project.

Project initiator side contains ROCE's Juha Martikainen, Anssi Käki, and Juuso Rantala as giving support and helping to define the research problem in relation to their company's specific needs. In addition they provide real life data for the case study.

Project supporting resources contains Helsinki University of Technology's Prof. Ahti Salo, specialized in systems sciences, and course assistant Jarno Leppänen. The project organization has been illustrated in figure 2.

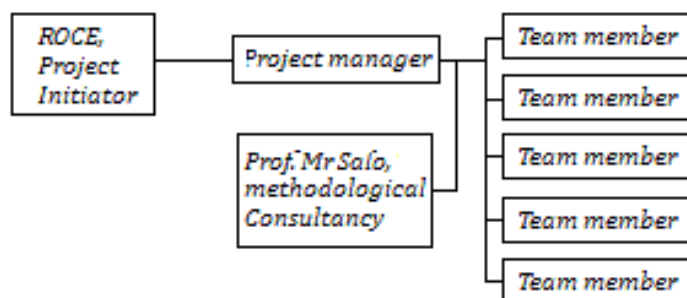


Figure 2. Project organization

The rough allocation of activities has been done at the beginning. Two project group members are conducting literature review, whereas other three are considering the modelling, and later on application of model to real life data. Smaller tasks are shared evenly to all project members. The summary of activities allocated to team member is shown in table 1.

Table 1. Main project activities allocated to different project members

Team Member	Responsibility Area
Julia Venesmaa	Project manager, research team(make-to-order research, Case Study)
Anni Hietaniemi	research team(Literature Research Overview)
Tommi Roine	research team(Literature Research Overview)
Olli Tiainen	research team(Case Study)
Arto Niinistö	research team(Case Study)

## 6. Risk assessment

Overall, the project is considered to contain low to moderate scale risks and not very serious risks at all. The risk identification-elimination matrix is shown in table 2. The project contains no direct financial risks. Instead, the most important risk is related to finding proper model for estimating demand and pricing real options in relation to demand. Projects initiators lack of dedication risk is considered to be negligible. Project members´ dedication and cooperation risk is considered to be low as most of members have known each other before and the project has been launched already successfully. Project schedule risk is important, but is considered to be relatively low as most of absences are known and scheduled in advance. Lack of sufficient analytical skills are considered to be low to moderate. The proper problem definition at beginning will save from much harm in the project implementation process.

Table 2. Risk identification-elimination matrix

Risk identifier	Probability of risk event	Expected loss	Elimination of risk
<i>Unrealistic targets</i>	<i>Moderate</i>	<i>Extra work, running out of time</i>	<i>Redefining the problem</i>
<i>Inadequate problem definition</i>	<i>Moderate</i>	<i>Extra work, may cause other risks to occur</i>	<i>Extra care at the beginning</i>
<i>Insufficient analytical skills</i>	<i>Low - moderate</i>	<i>Trivial or not useful results</i>	<i>Early methodological consultancy</i>
<i>Case data limitations</i>	<i>Low - moderate</i>	<i>No proper data available</i>	<i>Estimation of model parameter values</i>
<i>Poor interpersonal cooperation</i>	<i>Low</i>	<i>Slow progress in work</i>	<i>Supportive atmosphere</i>
<i>Running out of time</i>	<i>Low</i>	<i>Unfinished report</i>	<i>Early start</i>