

Real options and demand uncertainties in supply chain management

/ ROCE Partners

Intermediate Report

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1. Overview of the literary review results

According to the research strategy presented in the project plan the literature review has been performed by now and the analysis and model developing part is under construction. The literature review was performed using the research questions as a guideline. The scope of the review is purposely larger than scope of the analysis and model developing part because we thought we needed more background information to support us in creating and developing a proper and practical model.

The first part of the literature review is quite general. It aims to answer the first research question considering the uncertainties in supply chain and the ways to manage them. The major uncertainties are presented in the table 1 and the various ways to manage different uncertainties are presented in the table 2.

Table 1: Sources of uncertainty and their effects.

Sources of uncertainty	The affected factors	Potential losses
Demand		
Lower than expected	Selling price Overstocking	Smaller sales revenues Stocking costs
Higher than expected	Shortages	Lost sales
Supply		
Amount delivered (too small)	Production quantity => shortages or delay	Lost sales or delay penalties
Price increase	Material costs	Higher costs => smaller profits
Delivery time (too long)	Production scheduling => shortages or delay	Lost sales or delay penalties
Quality of the delivery (too bad)	Production and distribution => shortages or delay	Lost sales or delay penalties
Operations		
Equipment failures (machines, vehicles)	Production and distribution	Lost sales or delay penalties
Product failures	Distribution	Lost sales and costs of waste

Table 2: Ways to manage uncertainties.

Ways to manage uncertainties	Advantages	Disadvantages
Forecasting demand and costs	Gives information of the future	Inaccuracy of forecasts
Safety Inventories	Assures sufficient amount of products to customers	Stocking costs
Extra production capacity	Assures sufficient amount of products to customers	Cost of idle capacity
Strategic long term partnership	Enables cooperation and some flexibility	Dependence on the supplier
Multiple suppliers	Independence of one supplier	Higher costs
Maintenance	Prevents disruptions	Maintenance costs
Inspections	Prevents disruptions and bad quality	Inspection costs
Geographical spread	Benefits from multiple markets and exchange rates	Complexity
Incentives	Encourages cooperation and results in efficiency	Complexity
Options and contracts	Creates flexibility in many ways	Complexity

The other part of the literature review is more specific. It concentrates on real options used in managing uncertainties in supply chains and the pricing of them. Different real options and typical industries where they are used are presented in the table 3

Table 3: Real options in different industries

Industry	Option characteristics
High-technology	Capacity reservation
Electronics	QF contracts
Wood products	Option to vary the order size
Computer automobile	Channel rebate
VCD rental	Revenue sharing
Publish	Return option
Fashion, catalogues	Backup agreement
Electricity	Futures and e.g. weather derivatives.
Semiconductor	Pay-to-delay capacity reservation
Capital-intensive goods	Forwards

Valuation of real options is usually made other way than valuation of options in financial markets. In the financial world the pricing is based on the assumption of complete and frictionless market. The assumption cannot be made in real option environment and often the data needed in pricing is not available. That's why different methods are used. Correlation pricing and lattice techniques are some examples of used methods.

2. Adjustments to the project plan

2.1. Framework for the case study analysis

The case data consists of information about demand forecasts and the realized demand for end-product components after the end-of-life point (EoL). EoL point is the time when manufacturing of the final product is stopped and a final order for the components is made. The components are ordered for product support and service firms that use them as spare parts for broken products.

The framework is chosen according to the content of the case data. The chosen framework will result in one major deviation from the setting presented in the project plan: due to the focus on components instead of end-products, the Make-to-Order point of view to the supply chain plays no role in our research.

In our research we will analyze two different real options and compare them with each other and to the situation without a real option:

1. Real option to reorder

The real option to reorder offers the producer an option to reorder more components from the supplier after the end-of-life order. The producer makes first the end-of-life order normally when the production of the final product is terminated. After one year from that the producer can use his real option to place a reorder for the components. The timing of the reorder is fixed beforehand but the reorder sizes can be changed. Still the reorder sizes must fulfil certain minimum level (e.g. reorder for only one spare part is not accepted).

The producer's objective is to have zero component inventory level after three years has passed from the end of the production. However, the inventory level should not reach zero any earlier because that causes stock-out costs. The inventory has no salvage value and therefore the amount of the components left in the inventory should be minimized.

This option provides the producer quantity flexibility and it also makes it possible to place a smaller end-of-life order at the beginning. This decreases the average inventory level and the costs relating to inventories. If the demand for the components is very different from the forecasts, then the real option offers a good possibility to react to the change.

2. The real option to delay

The real option to delay may have a great value under uncertainty in reducing the buyer's risk of having excess stock of components at final time. It resembles otherwise the situation where no option is used, but now the final decision point is not fixed. It may be delayed until the ultimate replenishment order point, which supplier has accepted in the supply contract. The major part of the risk of excess stock level at the final time is transferred to the supplier side. It is now supposed that the supplier has better access to reuse or recycle excess components and thus may take more cost-efficient actions with them. The buyer is asked to pay some premium in exchange for reducing its own risk. The option to delay is an interesting variation of the different real options, as it has ability to provide flexibility to the buyer side, but it doesn't require the supplier to source more capacity compared to the case where option to delay has not been agreed.

2.2. Schedule

The schedule and the people in charge for the different tasks (the second person reviews and comments on the first persons work) are as follows:

- 7.4. The no-options case analyzed with the data. The two options analyzed without the case data.
 - No option (Olli, Arto)
 - Real option to reorder (Julia, Olli)
 - Real option to delay (Arto, Julia)
- 11.4. First results from the options analysis with the case data
- 18.4. First version of the report ready
- 25.4. Final version of the report ready

2.3. Risks

Any new risk relating to the project has not been identified and therefore the risk matrix presented in the project plan is assumed to remain the same. Also probabilities of the risk events are expected to be approximately the same as previously.