Economic evaluation of a new product

UOP, headquartered in Illinois, USA, is one of the major international suppliers and licensors of process technology, catalysts to the petroleum refining, petrochemical and gas processing industries. The company offers a wide variety of catalysts covering all the downstream sectors. In hydrocracking, UOP products are designed to respond to increased market demand for the processing heavier feeds, increased throughput and yields, lower hydrogen consumption and improved product quality. Approximately 2,600 employees work at the company's headquarters in Illinois and subsidiaries in the USA, and Canada, as well as manufacturing facilities in, Houston, China, Malaysia, Brazil, etc. The annual turnover in 2017 amounted to 860 million US Dollars.

Over the past decade, UOP's sale of process technology and catalysts for oil refineries has increased sharply due to a strategic focus on the development of catalysts for the production of fuel with ultra-low sulfur content (ULSD –Ultra-Low Sulphur Diesel) and a global trend toward environmental legislation that tightens requirements for allowable sulfur content. UOP has developed and delivered catalysts for oil refineries around the world. Catalysts, called "UR series", are used for cleaning oil and for the production of refined products. More than 2,000 different products can be produced from crude oil.

To refine products that meet environmental regulations, products such as gasoline and diesel must first be cleansed of contaminants such as sulfur compounds and nitrogen. This is done by mixing the products with hydrogen and then directing them through the vessels containing the UR catalysts. The catalysts induce the various compounds in the oil to react with the hydrogen to produce the desired product. After several years of research work, UOP was able to develop a new catalyst, UR-new, which is even more efficient than the previous catalyst, UR. During the part of the refining process where the catalyst is employed, a semi-processed product, LCO (Light Cycle Oil), is recovered. LCO is important in the production of ULSD. By using the UR-new, the amount of recovered LCO increased from 25% to 29.2% of the amount of oil flowing into the catalyst. This added value in the production of LCO is set to be 60 USD per barrel.

The basis of the following calculations is a refinery that processes 30,000 barrels of oil a day and produces 365 days a year. For a refinery of this size, 110 tons of catalyst must be used. After 2.5 years, the catalyst must be replaced. Before UOP can attempt to sell the UR-new to refiners, they must first establish a selling price. A common method is to use a specific margin for the variable manufacturing costs. In a research-intensive company such as UOP, this method is not suitable, because the variable manufacturing costs are relatively small in comparison to the considerable development costs. To determine the selling price based on the development costs is also not economically rational, as already incurred costs (sunk cost) should never influence future decisions. A sense of what will be an upper limit for the selling price can be obtained from an assessment of the product's usefulness to the customer: EVC (Economic Value for the Customer)

Part I: Deterministic Study

1- If the refinery has previously used UR Catalyst, what is the absolute highest additional cost for UR-new the refinery should be expected to accept?

2- The development of UR-new has taken 3 years and the development cost is calculated to be 3.5 million USD per year. The price of UR-new has now been established, and on that basis, sales of UR-new in the next 5 years will be: Year 1: 400 tons, Year 2: 700 tons, Year 3: 2,400 tons, Year 4: 3,800 tons and Year 5: 4,200 tons. For the next 5 years, the marketing costs for UR-new are planned to be 200,000 USD per year. Assume that the gross margin on UR -new at the established selling price is 30,000 USD per ton. Further, assume that UOP uses an interest rate of 20% per annum. One problem in assessing profitability in developing a new technology (here UR-new) that replaces an existing technology (here UR), is that the assessment should be based on assumptions about what would have happened if the new technology had not been developed. What is the payback period for the development of UR-new, if it is assumed that it would not have been possible to sell UR in years 1-5?

3- When marketing UR-new, it is likely that UOP will acquire new customers who previously used competing products. In this case, UR-new will contribute to increased sales of catalysts. However, when UR-new replaces UR, it is expected that existing customers will switch over from UR to UR -new, with reference to Question 1. In this case, the contribution of UR -new will only be an additional gross profit with respect to UR. Assuming that the UR -new does not contribute to increased sales, but merely replaces a similar sale of UR that could be achieved over the five years, what should the additional gross profit on UR -new be for the project payback to be 3 years?

Part II: Sensitivity Analysis

4- The development of UR-new has taken 3 years and the development cost is calculated to be 3.5 million USD per year. The price of UR-new has now been established, and on that basis, sales of UR-new in the next 5 years will be: Year 1: 400 tons, Year 2: 700 tons, Year 3: 2,400 tons, Year 4: 3,800 tons and Year 5: 4,200 tons. For the next 5 years, the marketing costs for UR-new are planned to be 200,000 USD per year. Assume that the gross margin on UR -new at the established selling price is 30,000 USD per ton. Further, assume that UOP uses an interest rate of 20% per annum. Calculate the future value of the project (Hint: 3 years for UR-new development and 5 years of sales of UR-new).

5- Preform sensitivity analysis of a measure of merit (net future worth in question 4) to variation, over a range of ±100% of some selected input cash flow parameters and graph the results. This analysis is intended to tackle the impact of errors in estimating various values of the input parameters. The UOP company has decided to conduct the sensitivity analysis with the aim of providing the higher management with information concerning the risk behavior on investment economic effectiveness due to possible uncertainty for some critical input cash flow parameters. The selected parameters for the analysis are:

   a) Discount rate: some reports anticipate projected increase on lending interest rate in the near future
   b) Marketing costs for UR-new
   c) Expected life of the project
   d) UR -new selling price
   e) Plot the one-at-a-time where x = percent deviation from most likely value and y= Future worth (dollar)