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Real Options in the Management of Innovation

Real Options Analysis applied to Tesla Motors

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Executive Summary

"The power of real options stems more from an appropriate mind-set than from the product of the model. The journey is more important than the destination." (Mauboussin, 1999)

As a basic principle, innovation is a strategic imperative and for most companies a survival condition. Permanent product and performance improvements support companies in growing and staying competitive. With successfully diffused innovative products to the market and customers, innovators are rewarded with a strong market share and profit (von Hippel, 1988). Innovation can also positively affect a company's intangible capital and profit. Hence, most companies have the incentive to innovate, although economic and business conditions can be volatile and outcomes from innovative activities uncertain. Based on this, companies need to consider the main reasons for the innovation development, which can be changes in the politico-legal framework consisting of deregulation, changes in the demand structure, intensified competition, and the technological progress (Stephan, 2004).

Furthermore, the innovation literature argues that innovation requires high expenditures before knowing about the degree of success of the resulting product or process. Innovations are tied to additional uncertainties coming from competitors, customers, suppliers, the legislation, and the company itself, which all influence the innovation process and management as well as the success of the innovating company (Rosenberg, 2004). Although innovators may know about these expenditures and uncertainties, they still seem to have the incentive to innovate. From their perspective, the chance to increase the market share and enhance profits via offering innovative products seems to outweigh the risks and expenses.

Taking these observations as a basis, this paper focuses on product innovations in the automobile industry to limit the offer of information regarding the variety of innovation types and the number of innovative industries. In particular, the focus lies on electric and hybrid vehicles, which today belong to the most interesting innovative products of the industry. Although the electric vehicle is not a new innovative product, it currently seems to change the entire industry and therewith the innovation process and management of each car manufacturer. Thus, an efficient innovation process with tailored investment decisions is required to develop, produce, and launch this innovative product successfully. The real

options analysis (ROA) seems to support the innovation process by enabling the management to involve managerial flexibility in the decision making. Traditionally, the discounted cash flow (DCF) is used to value investments in different business fields. This paper highlights that the DCF method does not completely reflect the actual project value, because it does not incorporate flexibility into the valuation. By considering the investments for an innovation project of the car manufacturer Tesla Motors, the ROA seems to be a sophisticated method for investment valuations in uncertain environments.

According to Mauboussin (1999) real options are analytically robust, although ROA solutions often contradict the net present value (NPV) rule. However, the real options approach requires a stronger understanding for business potentials, which can be achieved, if the management finds out which types of real options exist, how these options can be created, how and why option values change, and how to capture their value. There are three steps within the strategic decision making that help to answer these questions. The first step is an evaluation of the industry and product characteristics. The second step is an evaluation of possible strategic actions and the identification of specific real options that exist in most businesses. The third step is the results analysis that may lead to an increase or decrease of the company's value, which is assumed to be consistent with the innovation project value.

The real options used in this paper focus on investments for the innovation project of the Model X, which is the most recent innovative product of Tesla Motors. Two approaches are applied to value the investment decisions of Tesla Motors and to show that real options comply with the importance of managerial flexibility. The first approach is the binomial pricing model by Cox, Ross, and Rubinstein (1979). This seems to be a suitable valuation method for real options, because it allows for a discrete-time analysis and a definition of the optimal exercise boundary[1]. The second approach is the discrete-time analysis by Trigeorgis (2000), which is based on the financial option theory and values project investments in the innovation process as well with binomial decision trees for three selected real options. Sensitivity analyses for these real options are included in this chapter, too.

[1] The optimal exercise boundary is a function of time. For each discrete time value the exercise value is the last (in case of a put option) or the first (in case of call option) contact point with the payoff. This point informs whether it is optimal to exercise the option at this discrete point of time or not (van den Broek, 2007).

There are three questions to be answered in this paper: How does the ROA support the management in decision making? Which real option is the most appropriate for which step in the innovation process of the Model X? What critical issues arise from applying the ROA?

This paper is organized as follows. Chapter 1 provides an economic background about innovation, the types and classification of innovation, and patents. Chapter 2 refers to the innovation process and management as well as innovations in the automobile industry. Chapter 3 gives a profound insight in the ROA, the different types of real options, the value creation with strategic planning on capital budgeting from a management view, and drivers of uncertainty in the automobile industry. Chapter 4 provides the results of the real-life example applying the ROA to Tesla Motors' Model X innovation project by using the binomial pricing model for the project's gross value and the discrete-time analysis for valuing the real options.

Based on this, the option to defer recommends to wait until year nine before investing in the project. The option to expand has an optimal exercise date in year three such that a follow-up investment seems to be reasonable in this year as long as the customer demand justifies it. The same applies for the option to contract, which has also an exercise date in year three. It is possible that the management may decides between exercising the option to expand or the option to contract in year three, which depends on the particular market situation.

Subsequently, sensitivity analyses are implemented in order to support the management by verifying the decision on how much and when to exercise the particular real option. This analysis is based on increasing R&D investment costs by 1%, which leads to a negative sensitivity for the expanded NPV for all three real options. The option values have positive Vegas except for the option to contract, which shows a negative Vega. Furthermore, the risk-free rate increases by 1% such that the option to expand shows a negative sensitivity for the expanded NPV and a positive Rho for the option value. The option to defer and the option to contract show positive sensitivities for expanded NPV and Rhos. The volatility of the global automotive index is replaced with both the annual historical and implied volatility of Tesla Motors. This leads in both cases to positive sensitivities for the expanded NPV and Vega of the option to defer and the option to contract, but negative sensitivities for the expanded NPV and positive Vegas for the option to expand. For both cases the option to contract does not show an optimal exercise date.