Managing Risks to Increase the Value of Your Innovation Pipeline

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Summary

Innovation projects are inherently risky. For project teams, it's beneficial to be aware of the risks in their projects so that mitigation strategies can be developed that reduce the impact or likelihood of risk factors. Project plans can also be set up with embedded options that can increase their net present value. The present value of a project can be seen as a stochastic variable with a range of possible outcomes in different scenarios and the standard deviation of the project as a measure of risk. Following Modern Portfolio Theory, the maximum possible project values at each level of risk form a curve similar to the efficient frontier in financial portfolio management.

Introduction to project risk

All product development practitioners are aware of project risks. Risks refer to the possibility of something happening that affects the project in some way. Examples of project outcomes that the project team wants to avoid are delays in product shipping, customers returning defective product, or insufficient production capacity to meet unexpectedly high demand. All of these lead to lower profits than would be possible in the best scenario. There are also risk factors that have a positive effect, such as a competitor exiting the market.

Project risk may be defined as the probability of an uncertain event affecting the value of the project (1). Because companies value predictable future returns on investment, they are inherently risk averse. Managers will choose projects with low uncertainty over high risk projects if the net present value is equal.

The value of projects is often calculated as the net present value of future cash flows (NPV). However, this is an incomplete measure for projects that have intangible returns. Examples are those that build brand recognition or improve technical dominance over competitors. Also, loss avoidance must be taken into account for projects that protect a firm's market and maintain the current level of sales. The NPV needs to include intangibles and loss avoidance for project values to be comparable.

Product development projects are inherently risky. There are many types of risks – a list of different kinds of risk is in Table 1. Any of these risks has the potential to affect the value of the project as measured by the net present value (NPV) of its future revenues. Some are quite common, such as missed deadlines. Others are rare, such as black swan events like hurricanes and global pandemics. These unknown risks are very hard to predict.

There are risks that impact the project before and after product launch. Risks with project impact during development are pre-launch risks. These include the risk of project delays and technical development issues. Such risks affect the project NPV because the launch is delayed resulting in missed sales, the product performs above or below expectations leading to a different than anticipated performance in the market, or because market conditions change during a project delay.

After product launch the NPV may be changed by post-launch risks. Examples of these are changes in customer preferences, production issues after launch, and competitive and regulatory activity. If post-launch risks are realized, product sales or margins will be impacted. The project NPV should be adjusted for the probability of the reduced or increased sales in different scenarios.

If risks are recognized by the project team early in the project, their impact or likelihood of occurring may be reduced by taking risk mitigation actions. For example, a different product formulation could be chosen to reduce the risk of product stability problems during scaleup. Project teams benefit from brainstorming possible risks in an early phase of a project and determining if mitigating actions can be taken. It is helpful to study past projects and identify common risk factors and mitigation actions (2).

Table 1. Varieties of project risks

Type of risk	Example of risk	Impact on NPV	Probability of occurring
Executional	Project team misses deadlines	Medium	High
IP	Freedom to use cannot be obtained	High	Low-Medium
Market	Competitive product launched	Medium-High	Medium
Operational	Resources for project are not available	High	Low
Regulatory	Change in regulations	Medium	Medium
Systemic	Global pandemic affecting market demand	High	Low
Supply chain	Key ingredient cannot be supplied	High	Low
Talent	Key team member leaves the team	High	Low
Technical	Product cannot be scaled up	Medium-High	Low-Medium
Timing	Slow decision making	High	Low-Medium

How to measure risks

The level of risk of a project can be quantified in several different ways. A good way is to look at the outcomes of past projects with similar objectives. Examining past project revenues and comparing those to the business cases behind them will show the variation in revenues from the predicted revenues in the business case. Actual sales are often quite different from the predicted sales.

This is not surprising because it is impossible to predict the future accurately (3). The average variation in actual and forecasted sales of similar past projects can be used to estimate the risk of a current project. However, market conditions and the state of technology in an industry may change quickly, so past project performance may not be a good indicator of future results.

An common method to calculate project risk is to determine qualitatively the commercial and technical probability of success of a project (POS). In this case success is defined as a successful product launch. It does not mean that the forecasted sales are successfully realized. Therefore, this is an incomplete measure of risk.

The POS calculation often depends on a sequence of qualitative evaluations of variables that are known to be related to the success of product launches. For example, a project may be rated on market competitiveness on a 3-point or 5-point scale, from not competitive to highly competitive. It may be rated on technical difficulty, from the product being based on known technology to being based on technology still to be developed. Another evaluation may be on product differentiation, from being a commodity to a patented, proprietary technology. Such evaluation criteria are specific to the industry in which a firm markets its products and are often specific to the company doing the evaluation. After rating a project on a list of criteria, an aggregate score can be calculated leading to an overall POS.

The POS is a useful measure to rank projects in the development stage according to how likely they are to proceed to product launch. However, it only reflects pre-launch risks, not post-launch risks. Therefore, the link to the potential revenues after product launch is weak. For that reason, the POS is not a useful measure to determine the risk of projects. A risk measure is needed that describes the probability of realizing the revenues and profits predicted in the business case of a project.

How likely are we to realize future profits?

The prediction of future sales and costs of projects depends on many assumptions. A certain market share may be assumed, or the reaction of competitors to the new product may be assumed to be slow or nonexistent. In regulated markets the time of product registration may be assumed to be the same as the time to register similar products. And it may be assumed that the project meets all its targets on time and there are no delays.

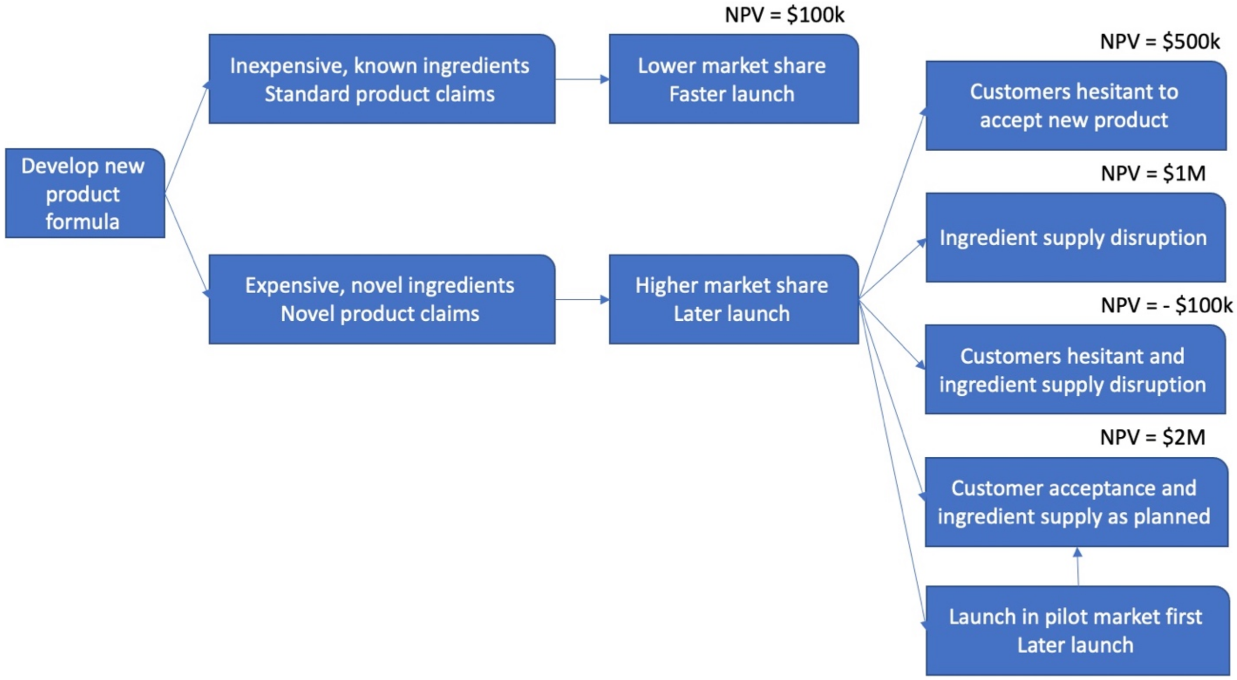

Figure 1. Scenario tree for an example project. Choosing new technology and claims delays the launch but opens up more market share. Using the option to launch in a pilot market first delays the launch more, but mitigates some risks.

In the real world many scenarios may happen. In some cases, the best case scenario comes true and the highest possible revenues and margins are achieved. In other scenarios, the NPV of the project may be smaller or even negative. At a minimum, firms should do a scenario analysis and calculate the NPV for best case, worst case, and one or more intermediate cases (Figure 1). An average NPV may then be determined by weighing the scenarios according to their likelihood of occurring. This involves still more assumptions on how probable each scenario is. The average NPV is at most an educated guess.

In theory, infinitely many scenarios are possible. One might think of the NPV of a project as depicted in Figure 2 below. The horizontal axis is the project NPV and the vertical axis the probability that the NPV will be achieved. For a low-risk, incremental project, the width of the distribution is small and there is only a very small chance that the value of the project will be negative and the firm loses money. For a higher risk, more disruptive project, the distribution is wider and there is a higher chance of losing money. Normally, a more risky project would have a higher NPV.

These curves are depicted here as normal distributions with a mean NPV and a standard deviation σ. The standard deviation is a measure of how risky the project is (4). With a high σ, the distribution is wide and it becomes more likely that the actual value of the project deviates from the NPV. For practical projects, the distribution changes during the project as more information is gained and risks become more or less likely. Therefore, each project NPV distribution is a snapshot in time of the continuously changing distribution.

How could the NPV distributions be calculated in practice? One could analyze many scenarios and assess how likely they are, then determine the distribution. This is only doable for large projects with a high NPV, where the project team is well resourced. Another way is to assume a value of σ based on a determination of how risky a project is. One could analyze past projects and determine the actual value compared to the predicted NPV. A new project can be assigned a certain σ based on how similar it is to past projects. First, one has to make sure the NPV of a project reflects the managerial flexibility in making project decisions, by adding the value of embedded options.

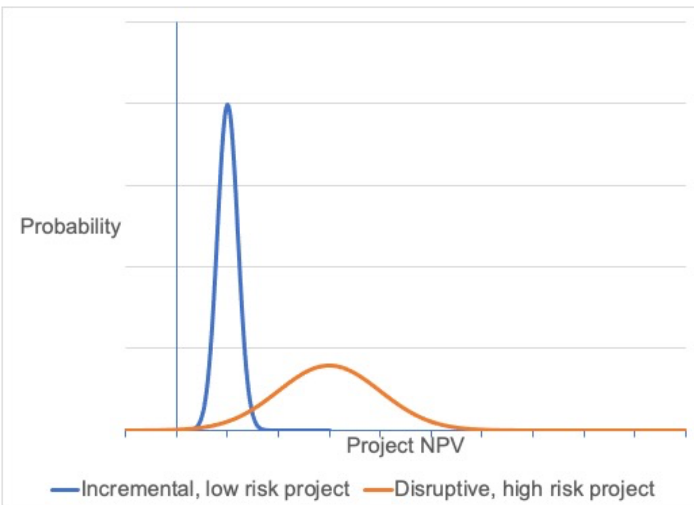

Figure 2. Probability distribution of NPV for low risk and high risk projects

Real options are embedded in projects

Decisions in projects can be represented by real options. Real options are the rights to buy or sell assets without the obligation to exercise that right (5). For example, a test product launch may be made with the full launch in all relevant markets only executed if the test gives good results. The cost of the test is similar to the cost of buying an option on the full project. The value of such options can be calculated using option valuation techniques such as the binomial options pricing model and the Black-Scholes formula.

Other examples of real options in innovation projects are the choices to delay or accelerate a product launch, the option to make add-on investments such as line extensions, the possibility to increase the scale of a launch by investing in additional production capacity, or the option to switch the use of a piece of capital equipment to another project. The value of such options is higher if the benefits are more uncertain, because the range of potential benefits of the option is higher in that case, but its downside is capped at its cost (5). Considering option value can bring the NPV of a project from negative to positive. However, options pricing can be complex (6,7).

Aim for the efficient frontier

With an expected value for the NPV of a project (the mean <NPV> of its distribution) and its risk (modeled by the standard deviation σ), a risk/reward ratio σ/<NPV> can be calculated. The risk/reward ratio determines how attractive a project is for investment. A project with lower risk σ and higher reward <NPV> will be more attractive to pursue compared to a project with higher risk and lower <NPV>. Its returns are higher and relatively less uncertain than for projects with lower <NPV> and higher risk.

Projects of different sizes can be compared by plotting the mean NPV vs. the associated risk σ. Figure 3 shows an example of such a plot for a diverse set of projects. For each level of risk, a maximum <NPV> can be achieved. All projects with a lower <NPV> and the same risk are less attractive. Why take risk when it doesn't offer a reward? With taking more risk, the maximum reward <NPV> is higher as well.

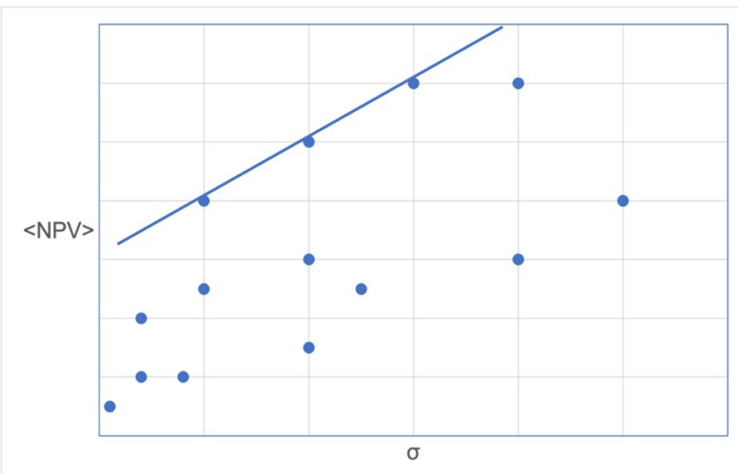

Figure 3. Example of the mean NPV and risk σ for a range of projects. The solid line indicates the highest return available for a given level of risk – the "efficient frontier" following Modern Portfolio Theory (8).

The curve limiting the maximum return that can be achieved for a given risk level is known in investment portfolio analysis as the efficient frontier. There are no portfolios of assets that can be assembled with a return higher than at the efficient frontier for a given risk level. This analysis is similar to that done in Modern Portfolio Theory (MPT), a theory formulated in 1952 by Nobel prize winner Harry Markowitz. Markowitz showed that portfolios of financial assets with returns that are not correlated will provide a return with a lower risk level. It is advantageous to construct portfolios with uncorrelated assets, such as stocks and bonds.

Product development projects have expected returns and risks similar to financial assets, but they are not publicly traded, and project portfolios are not as flexible. A firm cannot invest arbitrary amounts in one project, but it can invest more in one project class than another. For example, a company could focus its investments on certain markets or brands. Therefore, it should be possible to build a portfolio of product development projects that has an optimum risk/reward ratio. This could be done by investing in product development for different brands, customer segments, product forms, manufacturing sites, geographies, etc. Portfolio diversification is a good strategy in product development as it is in financial assets.

A diversified portfolio of projects is still risky

I described how a portfolio of assets with uncorrelated returns is optimal on the efficient frontier. However, the returns of new product development projects within a firm are almost always correlated (9). This is because the products launch in the same or related markets, were developed by the same or a similar team, and were exposed to the same company-wide risks. How could one determine the risk of a firm's portfolio of projects in terms of its risk σ, if the individual project risks are correlated?

The standard deviation of a project portfolio is the square root of its variance σ^2, which is equal to the weighted average of the variances of the component projects, if the projects are uncorrelated. For correlated projects, the covariance of the returns for different projects must be included for each combination of projects. These covariances are generally not known. However, the covariance for projects A and B is equal to the product of their standard deviations $\sigma_A\sigma_B$ times a correlation coefficient r_{AB}. A correlation of +1 indicated a perfect correlation, 0 is no correlation, and -1 is a perfect opposite correlation. In general the correlation coefficient of product development projects is between 0 and 1. With an assumption for the correlation coefficients, the overall portfolio risk $\sigma_{portfolio}$ can be calculated (8).

Firms can set a target for the overall portfolio risk that matches their risk tolerance. If a firm is very risk averse, $\sigma_{portfolio}/ <NPV>_{portfolio}$ should be small. If it wishes to take more risk, more risky projects and more correlated projects can be undertaken. A higher portfolio risk should be matched with a higher expected NPV.

Conclusion

Project and portfolio risks can have a major impact on the returns on investment in innovation. Project risks can arise from many sources and it is vital for the project team to be aware of the largest risks. The team can mitigate the impact of project risks on the future value of a project by developing actions to take when a risk is realized. The project plan can also include embedded options to reduce risk and increase project value.

Treating the net present value of a project as a stochastic variable allows expression of the project risk as the standard deviation of the NPV distribution. This suggests a straightforward method of ranking proposed projects by their risk-reward ratio. Projects with higher value at the same risk level or lower risk at the same value should be funded preferentially for an optimum return on investment in innovation.

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