

Chapter 7

Choosing Innovation Projects

SYNOPSIS OF CHAPTER

This chapter overviews the most commonly used qualitative, quantitative, and combination methods used to evaluate new product development projects. The chapter emphasizes that each method has its strengths and weaknesses, and that most firms will (or should) use a combination of methods in order to triangulate their information about a project's prospects.

The chapter begins by discussing the role of the development budget, including capital rationing, and differences in R&D spending across industries and across firms within industries. The chapter then reviews popular quantitative methods (e.g., NPV, IRR, Real Options methods) for project valuation, then turns to qualitative methods (e.g., screening questions, Qsort, balancing the company's R&D portfolio), and methods that are both quantitative and qualitative (e.g., conjoint analysis, data envelopment analysis).

LECTURE OUTLINE

I. Overview

- a. New product development is inherently risky and expensive, putting pressure on managers to make careful choices among projects.
- b. Firms use a **mix of formal, informal, quantitative and qualitative methods** when selecting and managing innovation projects and each of these methods has its own strengths and

weaknesses. Often the choices are driven by strategic implications rather than strictly financial analysis (this is a good point to have students discuss some of the strategic implications considered in Bug Labs' decision about which modules to develop).

II. The Development Budget

- a. Many firms use **capital rationing** (a fixed R&D budget and project rankings) to **choose** between valuable projects. Firms might establish this budget based on **industry benchmarks**, **historical performance benchmarks** and/or on a desired level of **R&D intensity**.
- b. Expenditures on R&D **vary widely between industries** and **between firms** in the same industry.

Show Figure 7.1

- i. For example, as shown in Figure 7.X **Intel's** R&D intensity is significantly higher than the industry average (20 percent versus 11 percent for semiconductors and electronic components), and **Pfizer's** R&D intensity is significantly less than the industry average (13 percent versus 16 percent for drugs). The table in Figure 7.2 highlights the impact of firm size on R&D budgets.

Show Figure 7.2

- b. **New ventures** often have to rely on **external financing**, family, friends, and/or personal debt because technology start-ups often have an **unproven technology**, an **unproven business concept** and/or an **unproven management team**. Three additional sources of financing are:
 - i. **Government grants and loans** from agencies such as the Small Business Administration in the U.S. or the Enterprise fund in the UK.
 - ii. **Angel investors** are similar to venture capitalists but without the limited partnership structure. Angel investors usually fund projects **under \$1 million**.

iii. **Independent or corporate venture capitalists** invest on **average \$10.5 million** in each project and usually specialize in one or a few industries in which they can leverage their expertise. Financing is usually accomplished through a complex **debt-equity hybrid contract**. Corporate venture capitalists are organized in one of two ways, via an **internal venturing group** or as a **dedicated external fund**. The pros and cons of each structure are summarized below:

1. **Internal venturing groups** are in a better position to **use the firm's expertise** and resources to help a new venture succeed. **Entrepreneurs** may be concerned about the larger firm **expropriating** the entrepreneur's proprietary technology under this structure.
2. **Entrepreneurs** are more likely to **trust a dedicated external fund** because it is less likely that these funds will have the expertise or desire to steal their ideas. On the downside, the ability of the entrepreneur to **leverage** any of the larger firm's **non-financial resources** is more **limited**.

III. Quantitative Methods for Choosing Projects

Discounted cash flow and **real option** analyses differ in that the real options approach facilitates the consideration of a project's strategic importance. Both of these approaches allow **rigorous mathematical** and statistical comparisons of projects. The **accuracy** of these methods is, however, **questionable** because the value of a new technology is difficult to know in advance and because these methods favor short-term low risk investments. For example, **Intel's** investment in **DRAM** technology enabled Intel to develop microprocessors, which turned out to be a very profitable business. From a NPV perspective this project is likely to have been considered a total loss.

i. **Discounted Cash Flow Methods** (NPV & IRR) rest on estimates of future returns, payback period, risk, and the time value of money. The **NPV** asks what the project is **worth today** and the **IRR** asks what **rate of return** does this project yield.

1. **Net Present Value (NPV)** compares the present value of cash inflows to the present value of cash outflows. In Figure 7.3, the present value of the future cash flows (given a discount rate of 6%) is \$3,465.11. So, if the initial cost of the project were less than \$3,465.11, the net present value of the project is positive.

Show Figure 7.3

If cash inflows are expected to be roughly equal from year to year for a very long period of time, the value of them can be calculated as an annuity. The present value of C dollars per period, for t periods, with discount rate r is given by the following formula:

$$\begin{aligned} \text{Annuity present value} &= C \quad \times \quad \frac{1 - \{1/(1+r)^t\}}{r} \\ \text{Perpetuity present value} &= C \quad \times \quad 1/r \end{aligned}$$

Managers also consider the ***discounted payback period***. In the above example, if the initial investment was \$2,000 it would be paid back between the end of year two (\$1,833.40) and the second month of year three (\$166.60).

Year	Cash Flow
1	\$ 934.40
2	\$1,833.40
3	\$2,673.02
4	\$3,465.11

2. **Internal Rate of Return (IRR)** identifies the **discount rate** that makes the net present value of the investment zero and is difficult to calculate when cash flows arrive in varying amounts per period because there can be multiple rates of return.

ii. **Real Options** thinking is most **useful** when there is **uncertainty** (and there usually is high uncertainty when technology trajectories are considered) and when a **firm's investment** in its own **learning**, development of new **capabilities** and the **creation of opportunities** are important factors in the decision making process. There is some **empirical evidence** that a real option approach results in **better investment decisions**.

1. **Real options** are **analogous** to **call options** on a stock. A call option gives the investor the right to buy the stock at a specified price (i.e. exercise price) in the future. Examples of this type of investment decision are shown in Figure 7.4.

R&D costs = Call option price

Costs to capitalize on R&D = Exercise price

Returns to R&D investment = Value of the stock purchased with the call
option

Show Figure 7.4

The value of a call option rises with the value of the stock, dollar for dollar (45° angle) once the option is “in the money” and is zero otherwise.

Show Figure 7.5

2. The **analogy can be stretched too far**, however. Technology investments often **do not conform** to the **same capital market assumptions** upon which the approach is based. For example,
- a. **Call options** are relatively **inexpensive** but **real options** can be very expensive because firms may have to make **large investments** in a technology before they can learn whether or not the real option is valuable.
 - b. **Call option value** is **independent** of the call holder's behavior but **real option value** is highly **dependent** on the resources (e.g. dollars, capabilities, complementary assets, strategies) a firm invests in developing a technology.

IV. Qualitative Methods for Choosing Projects

- a. Most firms will use both **quantitative and qualitative** evaluation approaches (ranging from informal discussions to highly structured decision processes) because many of the factors important to the decision are extremely difficult to quantify and attempts to quantify these factors can lead to misleading results.
- b. **Boeing's** development of the **Sonic Cruiser** is an example of a development project that may not be profitable but may at the same time be necessary when the importance of firm capabilities is considered.
- c. **Screening Questions** are organized into **categories** (see below) and are used by managers to structure technology project investment discussions. If managers want to **formalize** the process they can utilize a **scoring mechanism** (i.e. scaled responses to each question like

“Project fits closely with existing competencies” to “Project fits poorly with existing competencies”) that can then be weighted according to importance. Sample screening questions follow (a more extensive list can be found in the text):

1. **Role of Customer**—How big is the **market** of likely customers and what types of **marketing** will reach them best? How will the customer **value** the product **relative to substitutes**? How will the customer perceive the **ease-of-use** of the product (e.g. complements, training, etc.)? How will the product be **distributed**?
 2. **Role of Capabilities**—What **affect** will the new project have on current **core competencies** (e.g. leverage, obsolete). Will the firm be able to handle the possible **cash flow implications**? What **new competencies** will the firm have to develop and will these new competencies help the firm achieve its **strategic intent**?
 3. **Project Timing and Cost**—Does the firm have a choice with regard to **entry timing** (i.e. does the firm have the capabilities to be a first mover)? How **variable** are the **projected costs** and learning curve effects?
- d. **The Aggregate Project Planning Framework** focuses a firm’s attention on the **mix** of development projects (advanced R&D, breakthrough, platform, and derivative) in its R&D portfolio in order to determine whether the projects are **consistent** with the company’s **resources** and **strategic intent**. The framework also enables firms to determine whether its portfolio is **balanced** between projects with **short and long-term** payoff horizons. It is important to emphasize this balance to students: too much focus on short term projects can be

profitable in the immediate term but leave the company with no long-term prospects, and too much focus on the long-term can leave the firm strapped for cash in the short run. To create the map managers categorize their existing projects according to the **resources required** and the parts of the company's **product line** they support.

- i. **Advanced R&D** projects are necessary to the development of **cutting edge strategic technologies** (e.g. Honda's work on hydrogen fuel cells). If firm's portfolio consists entirely of advanced R&D projects the firm may not be able to sustain itself in the short term (i.e. no short term cash flows). There may be **no obvious immediate commercial application**.
- ii. **Breakthrough** projects incorporate **revolutionary new product and process design technologies into a new product** -- that is they are oriented around a **specific commercial application** (e.g. Honda's development of Insight).
- iii. **Platform** projects generate **fundamental improvements** in the cost, quality, and performance of a technology versus prior generations and are designed to serve a core group of customers (e.g. Hunter's "Care Free humidifier and Toyota's Camry).
- iv. **Derivative** projects involve **incremental** changes in products and/or processes (e.g. Camry LE, Camry SE, etc. are based on the Camry platform but target different customer segments). If a firm's portfolio includes only derivative projects then it may have good short-term returns but also may not be able to compete when the market moves to a new technology.

Show Figure 7.6

1. For example, **pharmaceutical** firms can suddenly find a **devastating gap** in its project portfolio because they have become increasingly reliant on a new

blockbuster drugs and because projects typically have high failure rates, long development cycles, and rely on patent protection that will expire.

- e. **Q-Sort** is used to **rank** projects on a variety of dimensions. Individuals are given a **stack of cards** (on each card is a development project) they put in order according to their assessment of how well each project performs on the criteria presented (e.g. technical feasibility, market impact, fit with strategic intent). These rankings are then used to structure a debate about the projects.

V. Combining Quantitative and Qualitative Information

- a. **Conjoint** and **data envelopment** analyses **combine** quantitative and qualitative project assessments by **translating qualitative** assessments **into quantitative** measures so that projects evaluated in different ways can be fairly compared.
 - i. **Conjoint Analysis** is a family of techniques (e.g. Discrete Choice, Modeling, Hierarchical Choice, Tradeoff Matrices, Pairwise Comparisons) enabling the relative importance of product attributes to be derived statistically. The text uses the selection of **camera attributes** as an example of how multiple regression can be used to identify the weights implicitly assigned by customers to individual criteria. In the theory in action section **Marriott's** experience in developing the **Courtyard** concept is investigated.
 1. Marriott used conjoint analysis to determine which features customers would want most in a moderately priced hotel (the segment of the industry with continued high growth). Marriott first ran **focus groups** to identify customer segments and the hotel attributes they valued. Then in an exercise similar to a **Q sort** hotel customers were given a fictional \$35 with which to

build their own hotel and a set of cards representing the major hotel attributes. The tradeoffs customers made in the process of building their hotel enabled managers to develop “hotel profiles” that participants were then asked to rate. The managers could then use regression to assess how different levels of service within a specific attribute influenced customer ratings of the hotel overall.

Show Figure 7.7

- ii. **Data Envelopment Analysis (DEA)** facilitates the comparison of projects using **multiple criteria** and **different** kinds of **measurement units** (e.g. dollars, rankings, Likert measures from a survey). DEA uses **linear programming** to create a hypothetical “**efficiency frontier**” that represents the best performance on each measure. Each project is then assigned an **efficiency value** based on the projects distance from the efficiency frontier.

- 1. For example, the Advanced Technologies Group of **Bell Laboratories** chose to evaluate projects in terms of three measures: discounted cash flows, the investment required, and desirability from the perspective of intellectual property and product market benefits. For the latter two measures, projects were given a score of 1, 1.5, or 2.25 based on the group’s model for intellectual property and product market benefits.

Show Figure 7.8