Technology Valuation: An Introduction

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ABSTRACT

This chapter explains the basics of the various ways of estimating value of a new technology, focusing on the importance of agreeing on the value before finalizing a technology transfer deal. Indeed, value is simply the negotiated amount arrived at between two parties. Although there are many ways to place a value on a technology, most licensing deals focus on royalty amount, since it spreads the risk between the technology provider and the developer. The percentage assigned to royalty has to be negotiated. Several factors will affect royalty value: level of market demand, the improvement the technology can bring to the final product, whether or not other investments will be needed to develop the final product, and, most importantly, the predicted rate of uptake in the marketplace. Some understanding of these factors, or at least the procedures used to estimate them, will enhance one's ability to negotiate a deal that will both help bring the technology to market and nurture the relationship between the parties, thus facilitating any future technology transfer deals.

1. INTRODUCTION

What is *value* and what are *valuation techniques*? Value is what a willing buyer and a willing seller have agreed upon as the basis for the exchange of property or, in our case, intellectual property (IP) rights. The critical point is finding a particular value that is agreeable to both the buyer and the seller. The first task, and the most difficult one, is assigning realistic values (that the partners can agree on) to the various factors in the system. Simply put, valuation is the process of estimating a mutually agreed upon value for a product or an intellectual property that will enable its transfer from seller to buyer. People use many techniques to reach this value. A perfect valuation scenario would be one where both the buyer and seller walk away each thinking it got the best deal.

Although we may not realize it, we use valuation techniques every day. For example, an individual might not hesitate to pay US$6 for a hamburger, but would certainly *not* be willing to pay US$50 for the burger. This is because we perceive the value of a burger to be within a limited range. The benefits we derive from a burger are not expected to cost more than the money we are willing to spend; otherwise, one will eat elsewhere. From the buyer's point of view, the cost, benefit, and competing alternatives determine what we will pay, and, therefore, determine a value. That value will change depending on where we are, how hungry we are, and how far the nearest better alternative is. From the seller's point of view, the questions are: How much can I charge for the burger? What is the demand for my burgers? How many different alternatives are there? How is my product distinct and superior to the alternatives?

This chapter provides background knowledge on technology valuation that is particularly relevant to IP rights in agriculture. The chapter aims to heighten readers' awareness of the important

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issues and methods involved in technology valuation when negotiating the sale of rights to a new technology as well as in other circumstances.

2. VALUATION OF INTELLECTUAL PROPERTY

Much energy has been spent determining methods for valuing intellectual property, technology, or products. All available approaches require different amounts of data and serve different purposes (limitations are inherent regardless of the approach taken). A brief overview of the most common approaches to technology valuation is provided in this chapter. More detailed discussions are found elsewhere in the *Handbook*.[1]

The valuation of intellectual property tends to be very complex, since the task of valuation involves determining the present value against a future technology or product. Various methods have been developed that use greater or lesser amounts of economic theory. In the end, as the value will usually be a negotiated figure, what is most important is to find a method that both parties agree will produce a value they can accept.

The most common method of valuation is a process of *discounted cash flow*, which calculates the present value of future revenues. *Present value* reflects the price a purchaser of the intellectual property is willing to pay now, in order to receive anticipated cash from future sales of the product. Different variables and factors can be built into this, such as the risk of the technology not delivering promised returns, but obviously it is hard to accurately estimate the future cash flows from intellectual property or from an undeveloped, untested technology. The closer one comes to a final product, the more realistic will be the estimate of future cash flow. Waiting until near the end of product development to negotiate royalties can, however, give rise to serious problems in reaching a negotiated settlement.

Most valuation models rely on market data, which, at best, can provide only a range of probable values. For a revolutionary new product, direct market data is often unavailable and *proxies* (or existing products on the market) are used as substitutes. The complexity of valuation arises from the challenge of identifying useful, appropriate proxies. The more appropriate data one uses, the more accurate the valuation will be.

Furthermore, the individual and specific value of assets will vary widely. Understanding how these specific values are statistically distributed will greatly help estimating value, since including a probability of receiving a specified return aids decision making. Wherever an individual component has a range of possible values, knowing the statistical distribution over this range can make the overall valuation more accurate and also allow one to estimate the probability that this value will actually be achieved.

The following sections identify several valuation approaches and provide a short explanation of each. To illustrate this, each approach is explained with reference to a fictional, ongoing negotiation, between the University of Costa Rica and Mer Seeds SA de CV, over a commercial-use license for a root-rot-resistant gene isolated at the university. The gene has been transferred into a line of a root crop called mer, which Mer Seeds intends to cross with their elite breeding lines.

2.1 *Cost approach*

The cost approach is based on covering costs of developing a new product. Using this approach, the University of Costa Rica would seek to charge a one-time fee to cover all research and possible patenting costs for isolating the gene and producing the transgenic root-rot-resistant mer. While this approach is a highly relevant one for pricing an article produced for sale, the approach is rarely used to assign a value to a piece of intellectual property, because the cost to develop something is not usually related to the value of any intellectual property it contains. One version of the approach is to calculate anticipated future costs of developing similar technologies—in effect, using the proceeds from the sale of this technology to pay for developing the next one. This approach, however, is highly subjective and difficult to justify.

Still, knowing the cost of development of a particular technology is often useful and relevant when calculating the relative inputs of parties into a joint venture. If, instead of licensing a technology, an institution enters into a joint venture to develop a product, initial investments into the joint venture often control the share assigned to each party. A university or research institution may not have adequate financial resources to develop a product from a technology, but the institution could justifiably claim a share of a joint venture based on the investment in the project up to that point, as well as the product's potential value.

2.2 *Income approach*

A *pure income* approach is carried out by discounting future anticipated revenues (cash flows) several years into the future. In our scenario, this approach is used when the University of Costa Rica asks Mer Seeds SA de CV how much it would be willing to pay now for a certain return in the future (for example, US$10 million in 10 years time). The big drawback to this approach is that there may be no sales, market, or cost data from which to predict future revenues. Furthermore, the method relies heavily on allocation of risk: determining what the chances are of a disappointing return (or even of no return at all) and who should take this risk, the university or the company? Risk estimates are crucial for determining whether to invest in a new technology, but they are too often based on little more than gut feeling.

2.3 *Market approach*

The market approach requires finding a similar or comparable technology to the one being evaluated. In our scenario, the University of Costa Rica would look for other root-rot-resistant mer plants on the market and determine how much farmers are using and paying for the seed. So, the valuation would rely on finding sufficient data about similar transactions to arrive at an accurate estimate of the value of the new product. The inherent weakness of this approach is the difficulty of obtaining data for a truly novel product.

2.4 *Hybrid approaches*

The more common approach is to use a hybrid of income and market methods of valuation. This combines the benefits of market comparability and the business community's familiarity with the income approach. In our example, Mer SA de CV would use its experience with similar products to estimate what farmers would pay and how quickly the market for the seed would grow to produce the estimated income. This method is usually applicable where there is prior experience and sufficient information. Where products are being developed in-house (for example, in a large company that performs all or most of the research and development), calculating the net present value of a new product is based on this hybrid method. Decisions on funding products are made by estimating a certain minimum net present value.

2.5 *Royalty rate method*

Because royalties give the inventor a return on sales of the final product, royalties are often used to share the risk between the inventor and the developer. Parties often use a royalty rate that has been agreed upon in the past for similar technologies; that rate is then applied to anticipated revenue streams. Because of the risk-sharing nature of this method (if the product does not become a success, the royalty amount is low), this is a common approach to licensing technology. But the approach does not always result in a valuation of the technology itself. Indeed, royalty rates are often determined arbitrarily, with little or no relation to the added value the technology may give to the product. For example, in our scenario, if an initial collaborative research agreement between the University of Costa Rica and Mer Seeds limits the university to a maximum royalty of 5% of gross revenues, then, if the technology increases the value of Mer seed products by more than that, the university loses. Another problem with arbitrarily applying royalty rates, in this case, is that if Mer Seeds were to combine several traits in one variety, then the company might be unable to afford to pay 5% royalties to each technology provider if the combined added value was insufficient.

3. THE PRODUCTION SYSTEM

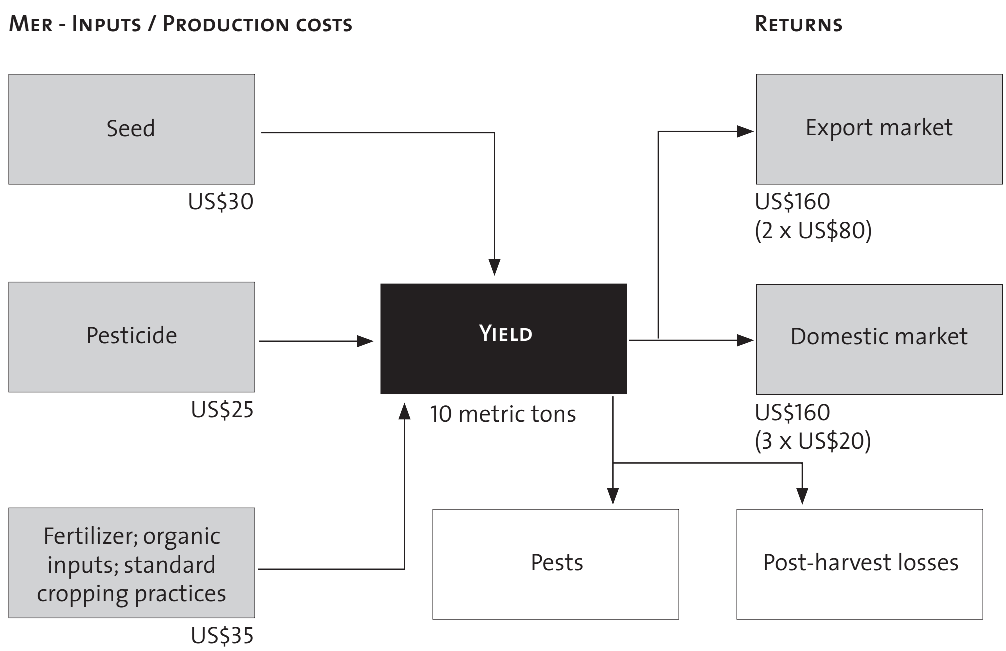
To accurately value a new technology, the existing production system must be understood in order to see where the new technology will be applied. While agricultural systems vary due to climate and local soil conditions, data do exist on input (costs) and output (benefits)—as in any field. Because of the complex interrelationships among agricultural markets, competition is hard to estimate, but data does exist upon which to base assumptions. As modern agricultural products rely more and more on biotechnology, a relatively new field, for which there is little information and substantial risk that there will be no product at all, valuation becomes more difficult. To illustrate the complexities of agricultural systems, we use an input/output or cost/benefit model based on the harvest of mer (see Figure 1).

The diagram depicts average returns per hectare of mer in Latin America. Input costs, such as for seed, fertilizer, and pesticide, have been derived by converting to U.S. dollars from the average costs in Latin America of those items. Similarly, yield in metric tons (MT) was calculated by taking conservative yield figures and deducting average post-harvest and pest losses to arrive at the final yield per hectare for the average mer farmer. Returns are divided between those from mer that is consumed domestically (Domestic) and those from mer that is exported (Export). On the basis of this model, production costs are US$90 and returns are US$220. A new product that reduces inputs (pesticides, in this case, of root-rot-resistant mer) can be calculated to increase returns by the amount that the pesticides cost.

4. VALUING IP RESOURCES

Sometimes, all of the IP resources of a company or institution need to be valued. Valuing these resources can provide a value for the whole company, including its intellectual property and physical resources, or it can reveal the input a company is investing in to developing a product, excluding

Figure 1: Hypothetical Cost/Income Model for Mer Production in Latin America



Note: The online version of the *Handbook* (www.ipHandbook.org) contains a downloadable Microsoft® Excel spreadsheet, which readers can use for modeling cost/income scenarios.

the technology that is being negotiated. In our hyphothetical example, Mer Seeds can point to the intellectual property that it already owns, for example, existing mer varieties, to show that the company is investing significant resources into developing the new product and also to show that the gene being obtained from the university will be worth only a portion of the total added value. Knowing such figures is relevant for joint venture negotiations.

One complication in these calculations is the need to value nonformal intellectual property: the know-how, experience, and expertise that reside in the company, and in its employees, and that may not be protected by patents and trademarks. Institutions that consider only the value of formal intellectual property stand to lose from overlooking this form of intellectual property.

4.1 *Excess earnings/residual value*

The excess earning/residual value approach places a valuation on an entire business, rather than a single technology. The approach is appropriate only if a company has just one major-platform technology and its business is based purely on products related to that technology. Using a period of five or more years immediately prior to the valuation date, a percentage return is assigned to the average annual value of tangible assets used in a business. This return is deducted from average earnings of the business for the same period, and the remainder, if any, is considered to be the amount of the average annual earnings from the intangible assets of the business. Since this method is based on past data, it is not necessarily useful for valuing a novel technology, but it may be used to value a company's existing technologies. which will allow for the determination of how much of an input one side is making in a negotiation. For example, Mer Seeds could use this method to value its existing germplasm in order to show that the varieties coming out of the transgenic project are just as much due to their germplasm as to the transgene. The main flaw in this model, however, is the assumption that excess earnings above and beyond the return on tangible assets are solely attributable to intangible assets. Such thinking can lead to an error in valuation because it assumes that the business is maximizing the exploitation of all of its intellectual property.

4.2 *Technology factor method*

The *technology factor method* is a modification of the income or excess earnings approaches that addresses the shortcomings of these approaches by directly measuring the contribution of the technology to the total revenue of the business. The technology factor method can be used on one technology at a time to eliminate the limitations of the excess earnings method, in which the whole set of intangibles are valued and lumped together. The technology factor method might be applicable to Mer SA de CV if it sold many more agricultural products than just mer seeds and if most of these products had a relatively low technology input (for example, if the company distributed many agricultural chemicals produced by large multinational corporations). In this case, an overall picture would not give the true worth of the value of the company's germplasm.

4.3 *Options pricing method*

The *options pricing method* estimates the value of the technology at the point it is considered to be successful and then calculates the probability of its preliminary successes along the path to commercialization. In the root-rot-resistant mer example, basic research has already been done, but there are still the possibilities that the technology will not work in the field, that farmers will not be prepared to buy it, or that a competitor will offer a better product (such as a very cheap fungicide). It is also possible that transgenic mer will not be approved for biosafety or food safety reasons. The probability of success at each step in the process is very hard to calculate, but with each step, the value of the technology effectively rises as the risk of failure diminishes. To use this model for early estimates of value, the technology must be well defined and the statistical analyses of historical data must be significant enough to allow the appraiser to assign probabilities to the technology as it proceeds from one step to the next. This method is applicable to start-up companies during their initial rounds of financing, and also for companies developing high-risk technologies, such as pharmaceuticals.

4.4 *Technology risk/rewards method*

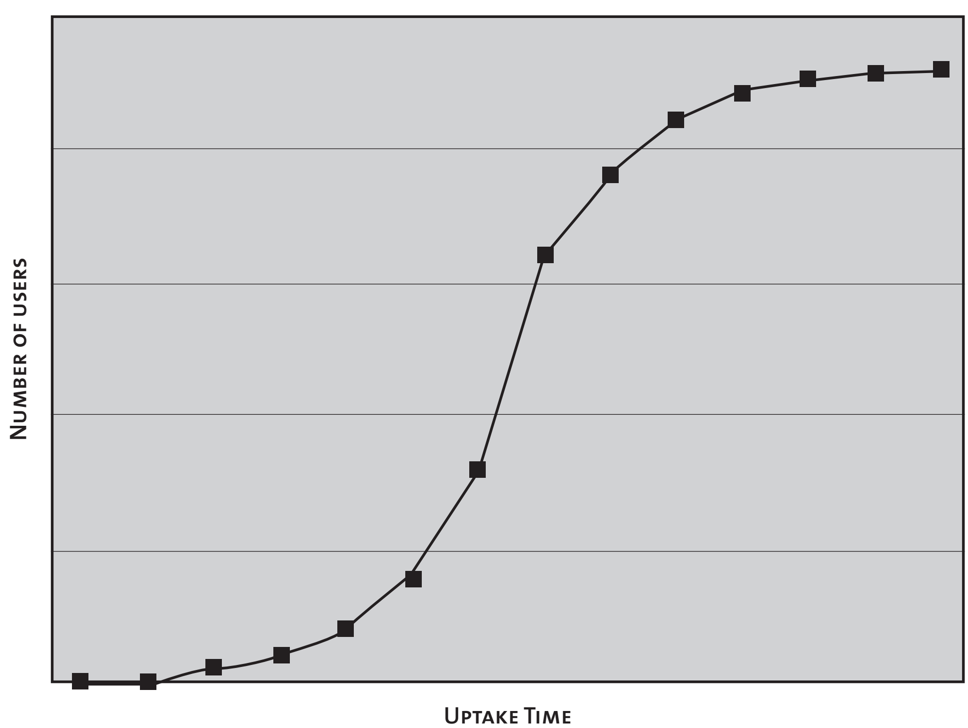
The *technology risk/rewards method* uses the value of roughly comparable technology-based businesses as a proxy for the value of patents, and then subtracts from this number the amount of cash needed to further develop the technology to a commercial stage. Thus, Mer SA de CV would first calculate the value the company could gain from the technology and then look at the investment needed to bring the technology to market. Using this number, the company would decide whether to commercialize the product and whether paying the University of Costa Rica could be afforded. One drawback of this method is the assumption that the value of technology-based companies reflects only the value of the technology, which ignores many other factors.

5. ADOPTION

One very important factor in determining the market value of a product is how much of the product is sold or used and at what rate demand for the product develops and increases. A product's success depends not just on the number of people who try it once, but on the number of repeat users. This is referred to as the *adoption process*, in which a product goes from being new in the marketplace to being an established product (or, in some cases, obsolete).

Figure 2 is a generalized adoption curve for a hypothetical new technology or product. Importantly, the rate at which a product is taken up has a great effect on the revenue that goes to the developer of the product. In this case, as often happens, initial uptake is low, and adoption grows slowly as people become aware of the product, try it out, and use it. Early adopters show the product's potential value, and gradually other consumers begin to use it. As more users see the benefits, the product spreads throughout the market. When the new product approaches full market penetration, the rate of uptake slows—there are always people who are either very late

Figure 2: Generalized Adoption Curve For a New Product



in adopting or will never adopt the product. At some point other competing products may enter the market and reduce market share, or newer technologies may arise that replace the product completely. The actual curve, therefore, will be more complex than Figure 2 suggests.

In reality, farmers are likely to be wary of initially investing heavily in an agricultural product, such as a new seed variety. Some will try it out on part of their land and, if they feel it is worth the investment, they might then plant more of the seed. Other farmers may see this and decide to try out the seed themselves. Once a certain amount of the seed is being grown, the adoption rate will increase. However, there will almost always be some farmers who will either delay adoption or not adopt at all, because they prefer traditional methods, are unwilling to change, or perhaps because their land is of such poor quality that the increased yield does not cover the increased price.

Calculating the value of a product by making sales projections (the income approach) must, therefore, consider not just the total area of land on which a seed could be used, but also include a realistic sense of the rate at which the coverage area will expand to reach the total. Meanwhile, as other products will also likely become available, the original product will be unlikely to retain its area indefinitely.

6. CONCLUDING REMARKS

As the discussions above indicate, no universal method for technology valuation exists. In fact, different methods will often be used within one organization. The method chosen depends on the kind of technology in question and whether one is a technology buyer or a technology seller. In the end, however, what most matters is the accuracy of the estimations and assumptions about whether a product will be a success and how much people will pay for it. Estimating the size of the potential market and the adoption rate for the product are both important in this process.

Negotiating is a big part of arriving at a value for your technology, but remember that developing intellectual property into commercial products through in-licensing and out-licensing is not a zero-sum game. Both buyer and seller are looking to get something good out of the deal. And these are the much-sought win-win deals. ■

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1 See, also in this *Handbook*, chapter 9.3 by R Razgaitis.