

# Technology Valuation – A Milestone on the Path from Art to Science

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If you believe that your chief source of sustainable business success is the company's skill, knowledge, and information, you are likely in the forefront of the new economy – an economy fueled by intellectual assets, rather than hard assets. And if you are an executive of a technology-based business, you're probably fully aware that the source of your competitive advantage is your technology-based intellectual asset base. Collectively, these assets – including patents, trademarks, trade secrets, know-how, engineering drawings, and computer software – can be worth several times the book value of your tangible assets. Very likely, you realize that much of your technology-based asset pool is still untapped as a source of value-creation.

How do you manage your technology-based intangible assets (in addition to your capital and human resources) to maximize shareholder value? How do you measure technology assets?

One tool that has proven useful in measuring and managing technology-based intellectual assets is the TechFactor™ approach, which can be used for valuing technologies at any stage of development. Created by Arthur D. Little and put into extensive practice by The Dow Chemical Company, the TechFactor approach is emerging as a new standard among the array of intellectual asset valuation methodologies in current use. While valuation is not yet an exact science, the TechFactor method at least brings valuation to the next milestone on the path from art to science.

The TechFactor method incorporates some quantitative elements from other widely accepted valuation methods, such as cash flow and risk analysis. Those familiar elements of financial analysis are merged with and factored by a comprehensive and systematic qualitative assessment of the technology as judged by a combination of technical, commercial, and legal perspectives. The technology in question could be a group of patents (a folio), an individual patent, know-how, and/or trade secrets. The value of the intellectual property derived from the TechFactor method is intended to represent the fair market value, denned as the amount of money at which property would change hands between a willing seller and a willing buyer when neither is under compulsion and when both have reasonable knowledge of the relevant facts.

Technology valuation in general, and the TechFactor method in particular, is a tool that can help answer critical business questions arising throughout an organization. For example:

- „We're considering licensing some key technology. What's the fair market value?“
- „The business manager and the R&D manager don't agree on what our asking price should be for this technology. Who's right?“
- „What are our options for extracting value from our technology, and how can we judge which ones are most attractive?“
- „Can we realize value faster from our technology?“
- „Can we make better decisions, in less time, about exploiting our technology ourselves rather than licensing to others?“
- „Is this project worth pursuing?“

Specifically, the TechFactor approach, with its focus on issues relating to investment intensity and potential for return, helps define various paths toward and outcomes of technology investment. In so doing, it helps to define and direct R&D, define and direct commercial development, and identify, assess, and rank options for extracting value from technology.

Furthermore, the TechFactor method requires a breadth and depth of insight that is available only from a multifunctional team. Consequently, it becomes a vehicle for organizational learning and consensus building.

## The Premise of the TechFactor Method

The premise of the TechFactor method is that technology-based intellectual property has a calculable value, based on the economic impact of the competitive advantage that a company derives from its use. Three key assumptions underlie this premise:

- The contribution of practiced technologies to a corporation's competitive advantage can be *identified*
- The technological contributions can be *differentiated* from those attributed to other tangible and intangible assets
- The economic value of the technologies can be *quantified*

## Identifying Competitive and Economic Impact.

The economic impact of technology manifests itself in revenues and/or costs and can be quantified – with varying degrees of certainty – regardless of the stage of development of the technology. Obviously, the impact of a fully commercialized technology is more easily quantified than the impact of one that is at the concept stage, for which there is considerable uncertainty as to the extent and timing of that economic impact.

Of course, the impact of a given technology may be broad or narrow. Dow, for example, classifies its technologies as „key“ or „improvement.“ A key patent is defined as the technology required for entry into the business – that is, without the key technology, there would be no business. An improvement technology is one that advances an existing business in an incremental fashion. The value of a key technology is related to the total profits from the entire business it supports. If and when subsequent improvement technologies are added, the value of each of these improvement technologies is related to the incremental increase in profits it provides.

**Differentiating Relative Contribution.** Commercial exploitation of technology requires both tangible and intangible assets other than the technology itself. The TechFactor is an expression of the extent to which the incremental cash flow derived from the practice of the technology is based on the technological asset itself. For example, for a cost-saving technology, the maximum TechFactor is 100 percent. For sales revenue-generating technologies, the maximum TechFactor is always less than 100 percent – an explicit acknowledgment that assets other than the technology itself contribute to its commercial exploitation.

We can determine qualitatively the extent to which a given technology is a factor in creating competitive advantage by identifying and considering all the attributes that affect its potential to create value. These can be grouped into „usefulness“ attributes and „competitive advantage“ attributes. These two groupings reflect „investment intensity“ issues and „potential for return“ issues, respectively.

For example, Dow had developed a novel technology, called Temporary Vapor Storage (TVS), that can reduce levels of operator exposure to chlorinated solvents used ubiquitously in the dry cleaning industry – as well as emissions of those solvents – below the levels of any other commercially available system. Use of this technology permits compliance with current Environmental Protection Agency (EPA) requirements. Dow assembled a multifunctional valuation team to assess the value of this technology in the context of licensing it to original equipment manufacturers (OEMs) supplying the dry cleaning industry.

When the Dow valuation team reviewed all the „usefulness“ attributes of TVS technology, it concluded that the overall effect on value creation was „high,“ i.e., every attribute was judged to have a positive effect on the value of the TVS technology. The usefulness of the technology was broad-based, given the fact that Dow’s own chlorinated solvents business was interested in exploiting the technology, as were several potential licensees. The capital required for implementation of the technology was low, not only for Dow, but for the OEMs and the individual dry cleaning establishments that would be the ultimate users. The lower the investment required to implement a technology, the more positive the effect on the value of the technology itself. Also, the time required for commercial implementation of the technology was short, less than six months. In other words, the payback on the technology could begin immediately. The useful economic life of the technology was judged to be more than five years, given the expected stability of EPA emissions/exposure requirements over that period. Also, Dow had already made other investments to acquire all necessary EPA approvals for TVS.

The valuation team assessed the „competitive advantage“ attributes as having an overall „medium“ effect on value creation. Several competitive advantage issues were thought to have a negative effect on the TVS technology value, specifically the availability of competitive alternative technologies, such as carbon absorption, and the expectation that competitors would respond to the threat of this new TVS technology by lowering prices. However, more than offsetting these negatives were the positive factors associated with TVS technology, such as strong differentiation from competing technologies, strong patents with broad and defensible claims, easily detectable infringement, long useful patent life, and no prior rights granted to anyone for use of the technology.

At this point, it is important to note that technology-based assets are not valued in the abstract. The valuation of technology is calculated within a business context – within the framework of a business enterprise, either real or hypothetical. Within this given business framework, each attribute has a positive, negative, or neutral effect on the potential value of the technology. Once all the attributes are classified, the net effect can be expressed qualitatively. In our TVS technology example, the valuation team considered the combined net effect of a „high“ rating for usefulness attributes and a „medium“ rating for competitive advantage issues and assigned a TechFactor of 55 percent to TVS technology, i.e., a TechFactor at the low end of the 50-75 percent range associated with a rating of „high.“ In this example, the Dow team weighted the usefulness attributes as more important to a prospective OEM licensee than the competitive advantage issues. In other words, the appeal of TVS to a licensee is driven more by the technology’s potential to enable the OEM and the dry cleaning retailer to comply with EPA requirements, and thus remain in business, than by the competitive advantage it would provide over another OEM supplier or other retail dry cleaning establishments.

Simply to develop a meaningful „master list“ of relevant utility and competitive advantage attributes requires multifunctional input: technical, commercial, financial, and/or legal. It’s the job of the multifunctional team to determine thoroughly and systematically whether each attribute, for the specific technology/market combination within the specific business framework selected, has the potential to create (or destroy) value.

It is theoretically possible for every attribute to have a positive effect on value. That circumstance leads to a high TechFactor. Conversely, it is theoretically possible for every attribute to have a negative effect on value, creating a low TechFactor. We have already presented the argument that, for sales revenue-generating technologies, the maximum TechFactor is less than 100 percent. How much less depends on the broad category in which the technology is to be exploited and the capital intensity of that category. For example, technology-based intellectual properties in the pharmaceutical and software industries, where the basis of competition is almost entirely technology-linked and the capital intensity comparatively low, can support much higher technology factors than the minerals or petroleum industry. In the chemicals and plastics industry, combined ratings of less than 30 percent from the attribute analysis and the TechFactor are considered low, while ratings above 50 percent are considered high. These correlations were determined empirically on the basis of a wide range of process, product, composition, and application technologies from the petrochemical, chemical, plastics, and specialty chemical industries.

**Quantifying the Value of Technology.** The economic value of a given technology, as determined by the TechFactor method, is the incremental cash flow derived from practicing the technology, multiplied by the associated TechFactor. Such a commingling of quantitative and qualitative factors is still unavoidable in valuing intellectual assets.

Concluding our TVS example, the Dow valuation team considered facts such as the number of existing dry cleaning machines and the number of new replacement machines per year; assumptions, such as zero growth for the industry overall; and projections, such as incremental cash flow of \$1,500 per machine and ultimate penetration of 1,000 new machines per year. Then it calculated the net present value of the incremental cash flow resulting from commercial exploitation of TVS technology at \$4.5 million. This incremental cash flow, multiplied by the TechFactor of 55 percent, results in a value of the TVS technology of \$2.5 million.

This valuation preceded actual TVS licensing negotiations. Understanding the factors that drive the value of TVS in the real-world business context chosen for the valuation prepared Dow’s negotiation team to negotiate the best price for the technology. And armed with a rational, supportable fair market value for TVS, the negotiators had the flexibility to consider various financial arrangements with prospective licensees which, in the end, would give Dow a fair return.

### **Putting Theory into Practice**

The TechFactor method has been proven helpful in a number of applications, including evaluation/valuation of technology for sale; in-licensing/out-licensing; minority equity position situations; internal business evaluation (scenario planning, opportunity evaluation, portfolio management, consensus building); mergers, acquisitions, divestitures; ventures; subsidiary royalty calculations; and litigation.

Dow has used the approach in several circumstances. In one, a research group developed a basic technology that spawned a number of products suitable for several applications and markets. Historically, Dow would have commercially exploited the technology itself to create a successful business – but not necessarily one that would leverage the full potential of the technology. Armed with the TechFactor method as a tool, however, the business team responsible for evaluating options for extracting value from the technology departed from this historic tradition. It developed various scenarios for commercializing the technology, with the team’s marketing representative guiding the discussion. The valuation exercise revealed that the business could nearly double its revenue through a combination of exploiting the technology within Dow plus a joint venture with an identified second party plus nonexclusive licenses to a defined, small group of third-party companies. The flexibility of the TechFactor method allowed the valuation of these „what if“ scenarios. Several days were necessary to fully assess each scenario and arrive at a defensible dollar value.

Another Dow research group was frustrated with its business management for not exploiting a technology that the group believed to be unique and exciting. To better sell this technology to management, the group dedicated two additional years of effort after the initial development work, to prove that the technology would work on a larger scale. They then wanted to value the technology to further prove their point. A multifunctional team was assembled, and the heated discussions that followed made it one of the most exciting appraisal exercises ever conducted at Dow. In the end, persuaded by the facts that were marshaled in response to the key issues of competitive advantage and utility, the representative from the research group accepted the team’s conclusion: the contribution of the technology to the business would be low. He also acknowledged that if they had gone through this evaluation two years earlier, it would have saved the research group two years of work – and eliminated the frustration between research and business management. Consensus-building is one benefit that results from use

of the TechFactor approach, no matter what the final value of the technology turns out to be.

Yet another use of the TechFactor is in connection with litigation for infringement of patent rights. Here, „fair market value“ of the technology in question is not a sufficient measure of value, because damage from infringement could result in *total* loss of the business. Litigation, however, is an expensive proposition for a business. If it's possible to build high enough fences around a potentially important technology to make infringement impossible or costly, it's worth doing. The TechFactor process can help identify which, among a folio of early-stage technologies, is likely to be most valuable and therefore worthy of the extra effort to protect it. The approach can also, through the accompanying group discussions, surface ways in which the protective fences could be heightened.

### **Maximizing the Benefits**

Through practical applications of the TechFactor method, we have learned a number of lessons about how to maximize the benefits of technology valuation.

#### **Use a carefully chosen multifunctional team.**

The quality of any technology valuation – and particularly the TechFactor approach – depends highly on the quality of the assumptions and inputs incorporated into the process. So, the composition of the team and the expertise of its members critically affect the accuracy, credibility, and usefulness of the results. A team that is missing, say, knowledgeable and effective marketing representation could find itself unknowingly overvaluing a technology that may be a technical success but would fail to meet significant market needs in a differentiated, sustainable way.

**Expect disagreement among team members.** If there is no disagreement, worry! The comprehensive assessment of the value-creating attributes, which is at the core of the TechFactor method, requires that critical judgments be made about key technical and business issues, such as the size of capturable market, the potential for price premiums, and the extent to which the technology itself, as opposed to, for example, strictly commercial or service factors, contributes to competitive advantage.

Can you imagine a team consisting of representatives from R&D, sales, marketing, technical service, business management, manufacturing, financial analysis, and patent/legal politely agreeing on such hot-button, turf-related issues without lots of discussion, challenges, responses to challenges, and demands for more factfinding and less opinion-spouting? We can't, and that's the way it should be. For, in addition to a quantitative numerical result, one of the benefits of the TechFactor approach is the consensus-building and shared learning among functions. By the end of only one valuation exercise, each function will have increased its understanding of the perspectives and points-of-view of the others. This increased understanding leads to greater respect for and valuing of the unique contributions of the other functions in the collective effort to enhance the value of their business.

**Avoid overusing „neutral.“** Resist the temptation to declare an attribute neutral simply because information is missing. Consider it a red flag when no one on the team can answer a basic question. Don't settle for opinions when facts might be available. The greater the extent to which actual, rather than assumed or hypothetical, data is available, the more certain and supportable the assumptions and the more realistic and credible the calculated value of the technology will be. Find someone, inside or outside the organization, who can fill in any gaps in knowledge and judgment.

#### **Master the process before applying it to valuations of unfamiliar technologies and markets.**

Mastery of the underlying premise and of the mechanics of the valuation process can greatly reduce the time necessary to reach conclusions and increase confidence in the results. Dow has elected to provide its business managers and others interested in valuation with internal consultants who „know the drill.“ These internal consultants facilitate valuation team discussions and help ensure a high-quality output, even for unfamiliar or emerging technologies and markets, for which confirmable information may not be readily available.

**Push the envelope.** The real usefulness of the TechFactor method comes from „what if“ analyses designed to push both the technical and commercial envelopes generated by the standard „best-case, worst-case, most-likely“ analyses. The goal of such „what if“ games is to see the impact of various technical and business scenarios on value creation and, ultimately, to generate implementable, value-enhancing ideas for technology development and commercial exploitation.

### **The Results**

The TechFactor valuation method is an efficient technology valuation approach that leads to rational and supportable estimates of the actual or potential contribution of a specific technology within a defined business context. Used to its full extent, TechFactor discussions and analyses can lead to building and creating new products, new markets, and, in some instances, new businesses. Decisions related to internal business evaluation

and management can be made faster, with greater confidence that the options have been thoroughly explored and realistically ranked. Furthermore, this rational, codified approach to valuation can also be shared with potential business partners in negotiations. Collectively, these results can begin converting idle or underutilized technology-based intangibles into value-creating assets for the benefit of the organization's stakeholders.

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