International Journal of Intellectual Property Law, Economy and Management **1** (2005) 47–51

Outcome Management of Intellectual Assets

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Intellectual assets have become new business assets for the corporate management. Created through intellectual activities, they are separated from the asset holders (inventors, authors) and organizations (companies, departmental sections), after which they are utilized under a given rule to realize their potential values. The traditional bisection algorithm of physical and financial assets is rapidly losing ground to this revolutionary movement. The current diversified source for corporate growth and the ambiguity of the scope of core businesses have contributed to the raised expectations towards this new asset. Intellectual assets will fulfill their role as business assets if they produce mid — and long — term outcomes, promote corporate activities, and stabilize the company's territorial reign.

In this paper, I shall propose the theoretical models of intellectual assets from the viewpoint of outcome management, bearing their properties in mind. To begin with, I would like to answer the question of what an intellectual asset is. If one wishes to categorize this asset he/she may start by defining it from the core reaching out to the more ambiguous outer areas.[2] Here, the definition of an intellectual asset is a transferable asset separable from individuals and organizations, which will create derivative products when combined with other intangible or tangible assets. In many discussions and other papers the concept of the "intellectual roots of competitiveness" has been mentioned, in which intellectual assets are, in extremely difficult terms, defined as managerial capabilities, which can live up to their international reputation while maintaining and improving real profit under a fair business environment.[3] Dividing managerial capabilities is indeed a formidable task, but for the meantime, let's not include personal managerial skills in the above transferable assets.

Well then, what is the outcome of these intellectual assets? The outcome here is the change of style in corporate management that is induced by intellectual assets such as research papers. The ultimate purpose of an outcome is to realize the needs of an individual or an organization, like those categorized in Maslow's hierarchy of needs.[4] Such outcomes may be measured by standard monetary values, but it is still a difficult task to accomplish. The resulting shift in management style may change the office atmosphere, improve the management efficiency, fulfill the self-realization needs of the proprietor, and satisfy the stockholders. However, at the same time, this change in style may tip the equilibrium of employees and disturb the sleep of stakeholders. An outcome will always have positive and negative effects. Therefore, while the company determines the net impact, each department must calculate in detail the pros and cons of an outcome. The debate has just begun on what kind of indicator a company should employ for the valuation of outcomes.

1. Properties of Intellectual Assets

Intellectual assets are created by a constant retribution of inputs and outputs within a specific field of research. It normally has a three-faced boundary: statutory, technical, and economic boundary, which all play an important role in determining the asset value, like a land boundary would in a real-estate appraisal. By using intellectual assets with clear-cut boundaries, the various outcomes will partially or totally become the income of the relevant organizations.

Such Intellectual assets that follow this process have two characteristics; one is the value of owning the assets that is based on the "property rule," and the other is the value of licensing the assets under the "liability rule." The totals of each value should be theoretically the same, but due to the diversity of ownership and licensing, it is not so easy to calculate both values accurately. Furthermore, in licensing the intellectual

ISSN 1349-7723

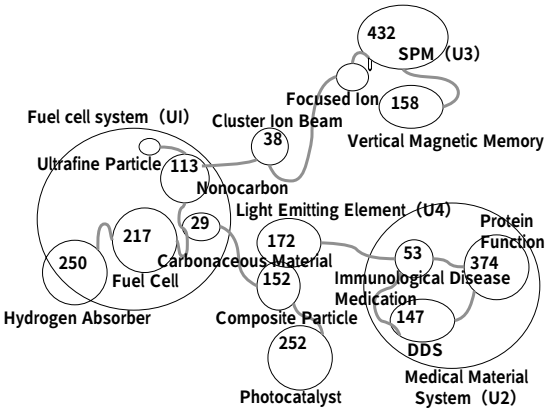

Figure 1. The Family Map for Patents in the Novel Nanotechnology Field (Figures represent the number of patents in 2003)

assets, there is the so-called "boundary problem," in which the boundary of an asset sequentially changes with time, international territory, and the field of implementation. The ownership of Intellectual assets, on the other hand, involves the "outcome problem," in which the multipliers (influences) of the outcome will vary with the changing statutes, technologies, and economic situations.

In general, the boundary problem that is stated here is an issue faced when the Intellectual assets are compared in terms of the department-level business potential and its all-company profitability. For example, in using an intellectual asset, the vague boundary between private and public benefits will make it difficult to determine the business potential per se. And because a certain department's life expectancy of an intellectual asset is shorter than the time boundary defined in the ownership value, some intellectual assets will be labeled as bad assets.[5] As for the outcome problem, it often involves the questions of how to handle the risk of intellectual asset degradation induced by other emerging technologies, or how to determine the degree of contribution of each intellectual asset when combining forces to form new derivatives. Even in the early stages of a novel technology, e.g. nanotechnology, there are boundary and outcome problems to be seen. The boundary problem in this case would be the negative effects brought forth with the similar investments from different industries that are attempting to enter the patent family map that is defined by the technical boundary.[6] The outcome problem is how to measure the relative contributions of each intellectual asset when ripple effects or resonance phenomena are made through patent collaborations.

Taking the above into consideration, I will simplify the determining factors of the intellectual asset value (v). Where (K) is the intellectual asset's replacement cost, the intellectual asset value (v) is proportional to the multiple function of the specific outcome multiplier (a) and boundary multiplier (g), and is thereby defined as follows: $v = f(a, g) * K$. The shift in value for these multipliers will no doubt change the current discounted value and the opportunity cost within the intellectual asset's value-making process. If the company-owned n-type intellectual asset groups could be classified according to the multiplier level, and, on top of that, if an index for selecting the appropriate path for asset value-making could be proposed, the improvement of the strategic management for intellectual assets could be anticipated with more certainty.

2. Introduction to Outcome Management

2.1. Establishing Liaison Organizations for Intellectual Assets

In order to utilize intellectual assets as new business assets, the corporate management needs various human skills and organizational functions that are stratified in at least the following four categories: statutory skills, technical information, economic judgement, and strategic skills. The main problem is how to manage each of the above-factors, i.e., the so-called "governance issue." Especially, in light of the volatility of intellectual asset values, the strategic skills are the elements that play the major role. Therefore, there is a strong linkage between the problem of how to place the organizational functions and the task of making a viable system for intellectual asset valuation.

To this end, a liaison (collaboration) department is attached within the corporate structure, which does not necessarily have to follow the same intellectual asset valuation pattern of other departments, but will act as a tool to create common grounds for deliberating the value of the intellectual assets. Strategic skills underlying this movement will greatly influence the outcome distribution that covers the company's private and public benefits. As it was often quoted in the old days, free access to a scarce common resource will encourage the excessive private use of each department and may thereby destroy the public benefits of the whole company. There is also a possibility that the private usage of water upstream will decrease both private and public benefits downstream.[7] In line with this theory, the intellectual asset liaison department will provide information on the virtual third-party valuation to lead the

business judgement in the right direction. The relevant management style is called the outcome management of intellectual assets.

According to a survey conducted in 2003, 33% of the surveyed 700 companies employed a unified management/valuation system for their intellectual assets, and the average intellectual asset management cost was 0.14% of the total revenue.[8] The same figures, in a similar survey of 300 companies that was conducted five years earlier, in 1998, were 28% and 0.20%, respectively. In an income management, companies optimize their usage of internal resources, and, under a given risk environment, they seek maximum profitability. But in an outcome management, the basic idea for the companies is to systematically comprehend the outcome that is created by intellectual assets. In other words, they place more weight on the idea that intellectual assets have positive and negative effects both externally and internally, and they do not always return the income to the relevant departments. It is true that an adoption of a unified management/valuation system does not necessarily lead directly to outcome management, but its chances of changing the management style is quite high.

2.2. *Accounting System based on the Lifecy-cle of Intellectual Assets*[9]

As shown in the following diagram, the lifecycle of intellectual assets can be divided simply into ten periods. When measuring the value of an intellectual asset, the relevant periods would be: 1) Early-stage valuation (the initial stage where heavy prior investment can be seen and there is no cash flow); 2) Core stream valuation (the development stage where the various boundaries are modified and improved to accommodate the growing outcome); 3) After-seven valuation (the reviewing stage where the value of ownership changes); 4) Follow-up valuation (the observation stage where the total outcome value is determined). Another category would come from the management's viewpoint on human resources, which simplifies the award/compensation process of service inventions into the following phases: First assessment, Second assessment, and Third assessment & Supporting valuation. When looking at the financial planning process, we can divide the lifecycle into the budget allocation planing stage, the compensation allotment planing stage, and the follow-up planing stage. Furthermore, please note that the timing for the intellectual asset's abortion process is also shown in this diagram.

The accounting system for intellectual assets should therefore be streamlined according to the aforementioned lifecycles. The value creating process of intellectual assets, starting way before the defining stages of patent claims and ending at the disposal of the assets, can be categorized into five accounting brackets: the creation process (CRP) account; the accumulation process (ACP) account; the allocation process (ALP) account; the circulation process (CIP) account; and the disposition process (DIP) account.[10] For example, in this value creating process of a core intellectual asset (code-numbered "x"), the R&D expenses assigned in the budget allocation planing stage or the investment subjected to cost-benefit evaluations will be posted in the CRP account. The fair compensation of service inventions for the same core intellectual asset (x) will be posted in the ACP account. Similarly, the internally utilized asset generating profits will be booked in the ALP account, the cross-licensed asset will be recorded in the CIP account, and, finally, the asset placed in the abortion process after an inventory clearance will be accounted for in the DIP account. It is necessary to establish a management accounting scheme based on these multi-staged values.

2.3. *Cluster Mapping of Intellectual Assets*

In the course of the above-lifecycle, the core intellectual asset (x) will establish a meaningful and technical linkage with other peripheral intellectual assets at each valuation phase. Here, we will call such peripheral assets "satellite intellectual assets (z)," and, when combined with the core asset (x), they will create a new similar product called the "cluster (C)." Each intellectual asset (x, z) will carry a quantum index (N), excerpt data (M), and an incidence indicator (s) derived from (M). Furthermore, where (e) is a statistical index denoting volatility, the quantum index (N) will consist of valuation (v; e), technical evaluation (t), and rights assessment (r). Putting these intellectual asset data in the form of a formula would result in the following:

$$C_i = C\{x, z_i\}$$
$$I = CRP, ACP, ALP, CIP, DIP$$
$$x_i = x\{N_i, M_i\} = x\{v_i; t_i, r_i, e_i, s_i, M_i\}\ x_i = x, z_i$$
$$v_i = f(a_i, g_i) * K_i$$

In future debates we must discuss how to use the information on intellectual asset clusters to establish optimal managerial indicators, which I believe is an issue closely related to the deployment of organizational functions. There are many ways to proceed in solving this problem; one is to rank the clusters using multipliers (a) and (g) to calculate the statistical threshold (or reference value). Another way is to use the maximum

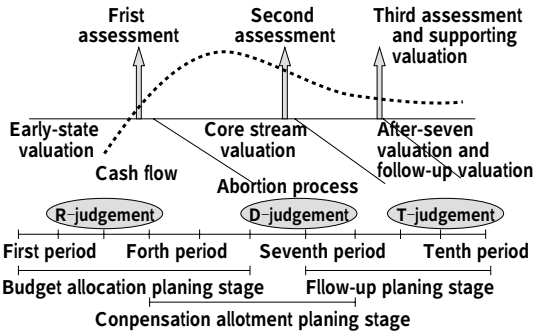

Figure 2. The Accounting System based on theIntellecual Asset Lifecycle

likelihood estimation method to determine the contribution degree of risk factors (t_i, r_i, e_i) towards the cluster's value volatility. It is also possible to chain together the clusters into a virtual cluster unit (U) to estimate the option price from the unit's volatility by applying the asset selection theory. What is important here is to make a total judgement by taking the various solutions into account, and not relying solely on one index.

3. Earning Multiplier for Intellectual Assets

Taking a look at the PBR index[11] of American companies we find that, during the thirty years from 1950 to 1980, the average market value of stocks was only about two times the book value of the net assets. However, after 1980, this ratio increased at an accelerated pace and exceeded the sevenfold mark. In general, it is the intangible assets (including intellectual assets) that mostly contributed in exceeding the twofold portion. Underlying this idea is the concept of the "earning multiplier" for intellectual assets. There are normally two ways to work out the value of a company: estimating the replacement cost for operation assets or determining the total market value of the stable stocks. The index that is obtained by dividing the market value by the replacement cost is called the "Tobin's q."

Where the earning multiplier of intellectual asset cluster (C_i) is (q_i),[12] and the risk factors (t_i, r_i) are constants, the relation between the outcome multiplier (a_i) and the boundary multiplier (g_i) is as follows:

$$(q_i) = f(a_i, g_i)$$

At a certain point of the intellectual asset lifecycle, the earning multiplier of the whole company can be determined by calculating the weighted average of the earning multiplier of each intellectual asset cluster in accordance with their valuation component ratio. This earning multiplier (q_i) will help the management make their decision when there is a change in the outcome or boundary multipliers that is induced by a purchase of an outside intellectual asset or an abortion of a bad intellectual asset.

Here, I would like to limit this paper to the illustration of a few model cases, and leave the discussion of estimating the outcome and boundary multipliers for a future time. One model case example is an asset that incurs interest, in which the outcome multiplier would be the interest rate with risk (r), where $0 < r < 1$, and the boundary multiplier would be the term of the principal (t), where $1 < t$. The earning multiplier denoted as the simple compound interest function: $f(a, g) = [1 + r]^t$.

Similarly, when the company's material procurement sets off a production line outside the company, the outcome multiplier would be the ratio of direct expenses (A) that were put in material production, where $0 < A < 1$, and the boundary multiplier would be the scope of indirect ripple effects (n). In general, the boundary multiplier is infinite, and thereby estimated to spread out without constraint. So in this case, the earning multiplier would be the function of the outcome multiplier: $f(a, g) = [1 - A]^{-1}$.

What then is the model case for intellectual assets? In one example, in which the outcome multiplier is the ratio of R&D expenses (commonly personnel expenses (W), where $0 < W < 1$), and the boundary multiplier is the R&D period (n), the earning multiplier is: $f(a, g) = 1 + W + W^2 + W^3 + \cdots + W^n$. In another model, assuming the growing and declining curve in an intellectual asset lifecycle, we go on to define the lifecycle function by using the outcome multiplier (a) and the boundary multiplier (g), which would formulate the earning multiplier as: $f(a, g) = (1/2) * a * g$, $(\pi/2) * a * g$. This would be easy to comprehend if one is to imagine a growth curve similar to a triangular or elliptic curve. Furthermore, if one assumes a probability density function, where: p (g) is the pioneer appearance probability; q (g) is the follower appearance probability; s (a) is the growth rate for potential outcome; and (k) is the weighted ratio of the followers' demonstration effects, then the earning multiplier would be: $f(a, g) = (k * q(g) + (1 - k) * p(g)) * s(a)$.

As shown in the cases above, it is possible to introduce various earning multipliers. For intellectual assets, the proxy variables of the boundary multiplier are often the duration of use, the market share, or the technology penetration ratio. A definitive theoretical diagram of the outcome multiplier, on the other hand,

is not yet established. Sometimes it is substituted with a time factor as in the case of the boundary multiplier, but more often the scenarios are written with multipliers that are still unknown. In such scenarios, the probability model (N (μ,σ)) is adopted, and with the use of past cases (the performances measured in currency or quantitative units) the faire capturing of the outcome multiplier is preformed. And it goes without saying that if an excess premium (e.g., the use of 3σ standard deviation) is anticipated, it is theoretically assumed that additional risks and costs will be incurred.

The organization in most need of such indexes is the cross-sectional intellectual asset liaison department. Under the diversified intellectual asset valuations and the growing importance of the income and outcome management viewpoints, there is now a greater demand for personnel with abundant experience and knowledge in intellectual asset management. Simultaneously, there will also be needs for tools that will support the management of these assets. This is especially so because in outcome management the faire capturing of the earning multiplier and the strategic skills for its further convergence is indeed quite necessary.

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5 For intellectual assets starting research in 1990–99, the average R&D period was 2.6 tears, the leading time for Implementation was 0.9 years, and the profit pre-generating period was 3.2 years. Whereas, for intellectual assets corresponding for 1980–89, the respective periods were 3.4, 1.2, and 6.5 years. The above figures were compiled by the author, based on the lifecycle chart of intellectual assets listed by product and technology types in the "Assessment for the Effects of R&D Policy on Economic Growth," *Interim Report of the National Institute of Science and Technology Policy* (No. 64, 1999. 6).

6 This family map was modified by the author from the original in the *Inter-technology Analysis using the Data Mining Method* written by Tatsuo Nakamura (Mitsubishi Research Institute, lnc.).

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8 For details on the survey and research on this subject, please refer to "The Survey Report on the Patent Valuation System in the Patent Distribution Market" (March 2003) Chair: Kikuchi, Junichi, Patent Distribution Promotion Center, Japan Institute of Invention and Innovation.

9 Kikuchi, J., "Intellectual Intangible Assets and Their Valuation," *Japanese Scientific Monthly*, Vol. 56 No. 1 (Jan. 2003)

10 If the valuation is more diverse, considering the organizational structure, the process may be divided into more than five accounts.

11 PBR is the ratio used in the Dow Jones Index as the magnification of the book value of assets against the total market value of stocks. This is the contention frequently debated by Takaaki Nimura, CPA and Representative parther of Shin Nihon & Co.

12 Wildasin, David E., "The q theory of Investment with Many Capital Goods," *American Ecnomic Review* (1984).