Intellectual capital: a human capital perspective

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Abstract *In this article, intellectual capital is seen as complementary capacities of competence and commitment. Based on theoretically and empirically robust human capital theory, we define intellectual capital as individuals' complementary capacity to generate added value and thus create wealth. Resources are then perceived to be both tangible and intangible. This view is an extension of human capital theory to include the intangible capacities of people. Implications for future research are discussed.*

Introduction

Strengthening organizational resources constitute a central topic of the strategic management literature. Although there has been considerable progress in identifying the qualifications and capacities needed by business organizations in recent years, a satisfying analytical framework for studying intellectual capital is still lacking. Acknowledging the frameworks of Sveiby (1997, 1998), Kaplan and Norton (1992), and Edvinsson and Malone (1997), we conceive the competence dimension of intellectual capital in a similar vein as Ulrich (1998).

OECD (1999) defines intellectual capital as "the economic value of two categories of intangible assets of a company", that is, organizational and human capital. Organizational capital refers, for example, to proprietary software systems, distribution networks, and supply chains (Petty and Guthrie, 2000). Employing human capital theory, we here concentrate on and define the part of intellectual capital that is based on human resources. Human capital theory is well founded both theoretically and empirically, and can be generalized and adapted to constitute a solid platform for the analysis of intellectual capital.

Contextual background

Ulrich (1998) conceptualized intellectual capital as a multiplicative function of competence and commitment. Congruent with the arguments of Ulrich (1998), and Quinn *et al*. (1996), an examination of the characteristics and features of intellectual capital reveals that it represents a particular case as far as its different components are complementary. This brings about a new dimension in human capital analysis. Without constituting a revolution, this methodology can be used for capital items revealing a high degree of complementarity.

Several studies indicate that unique or scarce resources impact firm performance (Barney, 1991; Castrogiovanni, 1991; Grant, 1991; Mahoney, 1995; Nahapiet and Ghoshal, 1998; Pfeffer and Salancik, 1978; Tsai and Ghoshal, 1998). For instance, Barney (1991) suggests that organizations have a competitive advantage when their assets, capabilities or processes possess specific attributes. That is, when assets, capabilities or processes are rare, valuable, difficult to imitate, and have few substitutes, they represent a critical source for competitive advantage.

However, the bottom line of value creation processes is organizations' combined capacity to employ their, more or less unique, resources, their intangible and tangible assets. The development of the notion of intellectual capital within a human capital framework seems to be a fruitful theoretical refinement to this discussion.

The emergence of human capital theory and its micro-economic content

Economists have always focused on the productive effects of the quality of workers. William Petty (seventeenth century) was the first economist we know who emphasized labor quality differences and who identified what much later was labeled *human capital* when he argued for an inclusion of the "value of workers" in accounting for wealth for actuarial purposes. In the *Wealth of Nations*, Adam Smith (1776) wrote in length on the incidence of workers' and employees' knowledge and skills on the production process and the quality of output. He also argued that wages should be determined (among other things) by the efforts in time, energy and money spent by workers to gain the skills required for their working tasks. When analyzing the determination of wages, he explicitly stated that education and learning were to be considered as "investments" in human beings. He saw that the productivity of skilled workers is higher than that of unskilled ones and consequently argued for a justification of higher earnings of the former as a result of skilled workers' investments.

As for many other economic phenomena, Smith's view is impressively clear and advanced for his time. His intuition is the basis of the works of human capital theorists. But neither Smith himself, nor Alfred Marshall (1890, p. 469) who more than a century later stated: "The most valuable of all capital is that invested in human beings", ever used the term human capital.

Irving Fisher's capital theory came to constitute the founding base of modern human capital theory as it emerged in the second half of the twentieth century. "A *stock of wealth* existing at an *instant* of time is called *capital*. A *flow of services* through a *period* of time is called *income*" (Fisher, 1906, p. 52, his italics). His definition of income and capital was "all-inclusive", and Fisher thus cut through many controversies among capital theorist at that time on the nature of capital goods as to materiality, monetary aspects, durability or repeatability of use. He emphasized that all types of stocks would be capital when yielding services, and even explicitly included human beings.

Theodore W. Schultz and Jacob Mincer, who independently and for different purposes (macro-economic for the former and micro-economic for the latter) elaborated human capital theory towards the end of the 1950s, both leaned on Fisher's capital theory. They considered human capital an independent capital category analogous to conventional capital with respect to economic and productive characteristics. Capital theory had over the years developed a fairly consistent theoretical framework containing a complete set of tools and concepts which were applied at human capital. This led to strong and convincing results and provided considerable explanatory power both for micro-economic and macro-economic phenomena[1].

Well served by the results and foundations of capital theory and driven by influential and skilful economists, human capital theory developed quickly in the 1960s. The research program added markedly to the understanding of human behavior both at individual and social levels. Among its primary research themes are assessments of returns from investment in different types of human capital. Human capital has been pivotal also in explanations of inter-individual earning differences as well as in analyses of causes of growth and development of regions and nations. Human capital theory has also been extensively used by and applied at other theories of economics and social sciences and has demonstrated impressive fecundity as a premise contributing to rendering other research programs more convincing and closer to realities (Bowman, 1980, p. 85). People's preferences and activity in and outside the labor market are found to have strong influence on their mental and physical capacities, and consequently, their productivity and usefulness as economic agents. The behavior of individuals and communities is therefore largely determined by the quantity (and quality) of human capital embodied in them.

Principles of human capital theory

Any constitution of a stock (material or immaterial) can be qualified as capital so long as it gives rise to income (Fisher, 1906). Based on this, human capital theorists consider human capital an analogy to conventional capital and use the neoclassical capital theory framework for analyses of human capital components. The accumulation of productive immaterial human capital embodied in human beings will increase the productivity of its owner, and in a well-functioning labor market, this will typically lead to increased earnings. Using a standard production function framework useful to analysis of productivity (e.g. Griliches, 1979; Weiss, 1986), we consider the individual worker's marginal product (MP) – assumed equal to wages – to be a function of three types of input. (L) is the quantity furnished of man-hours, (H) is an aggregate of human capital goods of various kinds and qualities, and (C) is a construct representing other capacities (with positive or negative incidence on his/her productivity) attributed to the worker such as motivation, physical and psychic endurance, and so forth. These attributes are the endowments of people, relying on their nature and nurture, and constitute what we define as the basis level of human capital, i.e. what people learn and how they behave

without any addition of human capital – e.g. as a result of compulsory schooling and a "normal" childhood. The constituents of (C) influence the effectiveness and productivity of (L) and (H). In exchange, most of the elements from (C) can be modified and improved through investments in human capital (H). The productive value of a worker's time is thus determined by the quantity and quality of human capital items $(h_1, h_2, \ldots, h_n)$ and capacity characteristics $c_1, c_2, \ldots, c_n)$ in a circular and mutual relationship, both with strong influence on L. This can be represented in the following manner:

$$MP = F[L; (H, C)], \text{ where } H = (h_1, h_2, \ldots, h_n) \text{ and } C = (c_1, c_2, \ldots, c_n) \quad (1)$$

Human capital theory affirms that people invest in themselves, through accumulation of different types of human capital goods like formal education and productive knowledge and information in order to constitute stocks of generally intangible human capital with the potential of increasing their owner's market and non-market productivity (e.g. Schultz, 1960). The incidence of human capital on earnings can be presented in its simplest form in equation (2). Net real earnings (E) to a human capital investor are equal to his/her basis earnings (B) plus the gross returns from his/her human capital investment (R) minus their costs (K):

$$E = B + R - K \quad (2)$$

Moreover, the rational investor will invest to the point where marginal returns equal marginal costs, i.e. where additional accumulations of human capital no longer lead to a net increase in subsequent earnings. Because costs and returns typically occur in different periods of time, the rational investor will apply a suitable discount rate which reflects his/her time preference and costs of capital and makes cash flows intertemporally comparable. This implies making a trade-off between the earnings of an entire professional career found by some individually adapted version of a "human capital earnings function" (Mincer, 1974), and the costs of investment in human capital. In addition, the importance of many non-monetary and non-market cost and return components lead the investor to assess these such that the calculus is undertaken in real terms. The marginal product of capital is assumed to decrease as the capital stock increases. This is one of the standard textbook conditions of a competitive equilibrium used in neoclassical economics[2]. The more capital, the less an additional unit of capital adds to output. The rational investor increases his/her investments to a point where marginal product of capital equals marginal cost. Faced with several investment alternatives, the individual investor typically selects the one yielding the highest returns, and by so doing, he/she contributes to raising the capital stock of this particular capital good, thus contributing to a diminution of its marginal product. This is an invisible hand mechanism at work in capitalistic systems, well known since Adam Smith. When there is capital mobility between regions, countries and sectors, returns from investment will tend to equalize for all types of capital (conventional, human

and other forms) over the entire economic system. The rational investor will consider all types of (real) returns. He or she will also estimate return prospects of all types of capital. In a reasonably well-informed economy, we expect all types of capital and capital markets to exhibit a tendency of evolving toward an equilibrium (i.e. where real rates of return from different investments are equal) account taken of risk premia, subjective discount rates connected to non-monetary returns, and other factors qualifying as different forms of capital and investment alternatives.

These mechanics have influence on human capital investors. A young investor will normally accumulate general human capital first, often formal education, both because that is a good starting point for learning special skills, and because a general basis of general human capital reduces the risk of unemployment and negative or low rates of return on investment (Nerdrum, 1999). Then the investor will search for more specialized investment prospects – like many kinds of on-the-job training – and accumulate specific intellectual and human capital.

Intellectual capital as a special case of human capital
Blaug (1976) classified human capital in six categories: formal schooling, on-the-job training, job search, information retrieval, migration, and improvement in health. This is based on types of human capital according to where and how it is accumulated, not which use in the labor market it has or how it affects the investor's productivity. The first weakness is due to purposes of theoretical generality, the latter is because investors are assumed to invest in the item that will yield the highest rate of return and that it therefore is "given" by economic mechanics.

In reality, intellectual capital is a result of either formal education or informal on-the-job training. It is therefore not "visible" in the traditional human capital categorization. In order to be able to analyze intellectual capital, we propose an addition of an intellectual capital dimension to the human capital construct, by allowing human capital to be qualified according to how it contributes to increased productivity in organizations.

Equation (3) is an extension of (1) that formulates the role of the components of intellectual capital on the productivity of the owner. HC and IC are subsets of H from (1) such that $[H = HC + IC]$. This idea is akin to Becker's (1964) distinction between general and specific human capital – the former increases productivity of the owner in general whereas the latter increases productivity of the owner only in one specific firm. The difference, and what we want to emphasize here, is that intellectual capital is constituted by sets of items which work jointly and in a complementary way, thereby increasing productivity of the owner in many firms and in many occupations.

$$MP = F[L; (HC, IC, C)], \text{ where } HC = (hc_1, hc_2, \ldots, hc_n),$$
$$IC = (ic_1, ic_2, \ldots, ic_n) \text{ and } C = (c_1, c_2, \ldots, c_n) \tag{3}$$

The productivity of a worker is hence defined by the amount of hours he/she works, combined with the person's stocks of human and intellectual capital and with the endowments of personal capacities and abilities.

Complementarity as a central characteristic of intellectual capital

An often neglected, but important economic characteristic of many types of human capital is that it is often unusually complementary. If one important capital item is insufficient or inadequate, for example, the ability to co-ordinate resources to meet the future demand for a certain product, the consequence is often that other abilities or capacities are prevented from expressing themselves and to have economic effects. Consequently, the return on investment of other intellectual capital items becomes very low, or even negative.

Complementarity in human capital theory is rarely explicitly considered. Nevertheless, for any capital good this is important because substitutable capital replaces other types of capital, whereas complementary capital uses other capital goods and needs them in order to be productive. The investment in substitutable capital therefore decreases the demand and investment for substitutable capital goods, and the investment in complementary capital increases the demand and investment for complementary capital goods. The degree to which capital goods are substitutable or complementary is therefore a determinant factor of the demand of other types of capital, and is consequently of much economic importance. The fact that the complementarity issue has not received much attention does not mean it is not important. We argue that one of the most important qualifications of intellectual capital is that it is unusually complementary (Quinn *et al.*, 1996; Ulrich, 1998). The previous lack of interest in this issue is presumably mainly due to the fact that human capital goods are mostly intangible and are difficult to represent and qualify. In empirical studies they are represented in proxies like "number of years in graduate studies", "time spent in certain jobs" and "possession of an educational diploma". The qualification of the relationships between such magnitudes and other capital goods is empirically complicated and varies among people and investment purposes.

To see how the arguments in equation (3) work, we express it the following way:

$$MP = \beta_1 L + \beta_2 (L \cdot HC) + \beta_3 (L \cdot IC) + \beta_4 (L \cdot C) + \beta_5 (L \cdot HC \cdot IC \cdot C) \quad (4)$$

L interacts both with HC, with IC, and with C, and in addition all these elements interact with each other. Marginal productivity is a function of the arguments of equation (3), but multiplicativity between inputs gives rise to something more, an externality which appears with the simultaneous presence of different types of characteristics.

Complementarity is a central characteristic of intellectual capital because it is usually stronger than and distinct from other types of human capital, and consequently that it is more important to its owner. Used in organizations,

there is a threshold level required for all constituents of the intellectual capital. If one element fails to attain this level, this alone will be enough to prevent all the other constituents of intellectual capital to be productive (and many of general human capital and personal capacities as well). The investor's productivity is consequently lowered in and outside the labor market. Equation (5) states the complementarity relationships between intellectual capital items. The productivity of intellectual capital (MP_{IC}) is determined by a multiplicative relationship of the necessary intellectual capital:

$$MP_{IC} = \alpha_1 \mathrm{ic}_1 \cdot \alpha_2 \mathrm{ic}_2 \cdot, \ldots, \alpha_n \mathrm{ic}_n$$
$$\text{where } \mathrm{ic}_1 \geq \mathrm{ic}_1{}^*, \mathrm{ic}_2 \geq \mathrm{ic}_2{}^*, \ldots, \mathrm{ic}_n \geq \mathrm{ic}_n{}^* \tag{5}$$

Equation (5) indicates that the investor must possess every intellectual capital item in quantities and qualities surpassing certain thresholds (denoted by an asterisk). Each factor has a critical mass that it must attain in order to be productive and useful for the person, but also before it will contribute to the productivity of his/her other intellectual capital items. Complementarity is thus a totally essential qualification of different production factors for human productivity. Nerdrum (1999) discusses complementarity issues between different types of capital goods explaining both micro-economic and macro-economic phenomena. Nerdrum argues, based on Griliches' (1969) empirically based proposition that skilled and schooled labor is more complementary with capital than raw labor, that complementarity between different types of human capital could increase with the size and degree of "specialization" of the capital stock the more it is composed by intellectual capital. Hence, the more formal education possessed by an individual, the more valuable are additions of intellectual capital from on-the-job training, for example. The common effect of different types of human capital increases with stocks of each relevant capital item, and the returns on investment in one type seem to be higher the more important are the stocks of its complements. This is consistent with the general principles of neoclassical investment theory. Moreover, it supports the notion developed in the framework expressed in equation (5) where each capital item must surpass certain threshold values, in order to allow the whole set of capital components to be productive.

Implications for future research
This remains a sketchy and tentative theoretical framework. However, human capital theory is well founded both theoretically and empirically, and we believe it can be modified to constitute a solid platform for developing a conceptual assessment method of individuals' potential. We have argued that intellectual capital necessarily comprises a set of complementary capacities. Moreover, we have shown that economic theory possesses the theoretical arguments to justify the notion of intellectual capital. Because human capital theory traditionally does not account for the great potential embedded in the more unique characteristics dealt with here, we have extended the theory to

include the notion of intellectual capital, and as such, placed the theory within a broader framework of value creation. What remains, however, is to develop and validate objective operational measures and artifacts for the dimensions discussed.

Future research should attempt to assess the relationship of these assessment methods with organizational performance. Moreover, it appears to be worthwhile to investigate into the multiplicative effects and interdependencies of intellectual capital items as well as between intellectual capital and more general human capital.

Notes

1. Nerdrum (1999) gives an extensive overview of these achievements.
2. Unlike most conventional capital goods, the reason investment in human capital yields decreasing returns is not because marginal productivity of human capital decreases as human capital stock increases. Human capital investments yield decreasing returns because the value (determined by the labor market) of the investor's time is increasing due to rising foregone earnings. The increasingly costly time of a human capital investor is the most important input in the human capital investment process.

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