

# **INTELLECTUAL AND KNOWLEDGE CAPITAL FOR SUSTAINABLE DEVELOPMENT AT LOCAL, NATIONAL, REGIONAL, AND GLOBAL LEVELS**

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## **Summary**

Society is experimenting with what is now called “knowledge economy” or a “knowledge society,” based on the rapid development of intellectual and knowledge capital. Competing in the future will increasingly depend on mobilizing this capital at all levels: local, regional, national and global. In the modern innovation-driven world, learning and the command of intellectual and knowledge capital have become the key success factors of international competitiveness. Moreover, according to some authors, new technologies based on this intellectual and knowledge capital are the key to creating the more sophisticated products and businesses of the future, which will be able to improve the quality of the environment (particularly through dematerialization). In this context, a better understanding of the relations between the intellectual and knowledge capital and sustainable development at local, national, regional and global levels is crucial. In an innovation-driven economy, and a world characterized by the emergence of a mosaic of lifestyles with an intermixing of cultures, the generation of

new intellectual and knowledge capital has become vital to sustain economic, social, cultural and environmental development. It is necessary to insist on the challenge of building a learning society to produce and maintain a good quality of the intellectual and knowledge capital. A social partnership must be implemented around the production and the applications of intellectual and knowledge capital towards sustainable development. Foresights open up the possibility of answering such challenges in allowing negotiation of a new and more fruitful relationships or “social contract” between science and technology, on the one hand, and society on the other hand.

## **1. Introduction**

The modern world is fast-changing. Now, local, regional, national and global trends all influence the way people live, the way business is done, and the way the natural environment is exploited—in other words, the way in which sustainable development is implemented.

The last ten years of the twentieth century have witnessed dramatic political changes in Eastern Europe, rapid economic development in Asia, and the spread of market liberalization around the world. As a result, there is increasing global competition. In addition, the related forces of the explosion and convergence of computing, communications and media technologies, and of international deregulation, are reshaping the world economy in as fundamental manner as at any time in history.

The early years of the twenty-first century will be marked by continuing rapid advances in the technology base, and especially in technological applications. The two key technologies that will drive change are information and communication technologies (ICTs) and life science technologies. The information revolution, which started over fifty years ago with the invention of computing, has been steadily gathering momentum. In the past five years it has exploded into wide public attention and use, with the take-off of the Internet. The other main technological force to 2010 comes from the life sciences, which have in the past few years been rolling ahead at a startling rate. With the unraveling of the human gene there is scope for fundamental changes in human health care and food production, provided public concerns are met. It is clear that life sciences and ICTs are individually the generic technology pillars of the industrial economy at the start of the twenty-first century. Interesting and powerful technological opportunities will also come from the convergence of these two families of technologies (as in bioinformatics, DNA chips, prosthetics) and their integration with other technology groups, especially smart materials.

Meanwhile, complex technology systems such as energy, transport and clean technologies are becoming areas in which there is increased use of hybrid technology systems. For example, automobile manufacturing now requires state of the art capabilities in ICTs and materials, as well as knowing about design, engineering and manufacturing. To be or to remain competitive in complex technologies in the future, will require detailed know-how, if not mastery, of a range of enabling technologies that form the basis of these complex technological systems. In addition, the packaging of multiple technologies into high technology products requires interdisciplinary skills.

Such hybrid skills are expensive to acquire, and the decisions about how to build up such competencies (research and development programs, training and know-how enhancement) will be crucial for the coming years. The consequence is that innovation, new technologies, and the scientific research underpinning them are becoming more important. Science and technology are now strategic resources to be deployed as effectively as possible.

Society is experimenting what is now called “knowledge economy” or “knowledge society,” based on the rapid development of intellectual and knowledge capital. Competing in the future will be increasingly dependent on mobilizing this capital at all the levels: local, regional, national and global. In today’s innovation-driven world, learning and the command of intellectual and knowledge capital have become the key success factors of international competitiveness.

This is why many developing countries, concerned about achieving sustainable industrialization and improving the quality of their citizens’ lives, are claiming that developments in science and technology play a central role in securing these—what is called for is a dramatic increase of their intellectual and knowledge capital.

It follows that a better understanding of the relations between the intellectual and knowledge capital and sustainable development at local, national, regional and global levels is crucial. This is the objective of this article. In Section 2 the importance of intellectual and knowledge capital for implementing sustainable development is explained, while in Section 3 the challenges and issues of this kind of capital vis-à-vis sustainable development policies are outlined.

## **2. The Importance of Intellectual and Knowledge Capital for Sustainable Development**

In an innovation-driven economy, and a world characterized by the emergence of a mosaic of lifestyles and intermixing of cultures, the generation of new intellectual and knowledge capital has become vital to sustain economic, social, cultural and environmental development. This applies equally to individuals, organizations, whole communities and regions, as well as worldwide.

In economic terms especially, intellectual and knowledge capital has become the primary resource and path to power, prestige and prosperity. Between 70 and 80% of economic growth is said to be due to new and better knowledge. Furthermore, the factor of three to four by which the stock-market value of most firms (companies) exceeds net fixed assets is largely ascribed to the value of intellectual and knowledge capital. This rises to seven for software companies and up to twenty for some US firms.

However, knowledge and intellectual capital are still fuzzy concepts. This is why it is proposed here first to highlight what they mean. Second, it is explained why, in getting key capital on which the development of the society is now based, the rules of the game have changed. Third, the strategies of firms are discussed in this context of “new economy,” and fourth, an analysis is made of why good management of this capital involves the implementation of national innovation systems.

## 2.1 Intellectual and Knowledge Capital: What is Being Spoken Of?

Intellectual and knowledge capital describes a state or potential for action and decision in a person, organization or group at different levels. Learning indicates some change in the state of this capital, often manifested by a change in understanding, decision or action. Highly developed intellectual and knowledge capital, as well as the learning process, characterize the superior intelligence and dominant position of the human species. As such, they are fundamental in determining continued development—not only in all spheres of civilization—society (community, group identity, relationships), the economy (the material world, services, work and production), and the realm of ideas and culture (sciences, arts, philosophy), but also between these human spheres and the ecological sphere, as well as in the regulation of the interaction between the ecological sphere and the three human spheres.

Investment in intellectual and knowledge capital confers both economic and noneconomic benefits on individuals, enterprises and societies. Economic benefits usually take the form of additional earnings, productivity or economic growth, while noneconomic benefits include greater social cohesion, lower crime, better health and quality of life, and maybe a better quality of the environment. A complement to this is social capital—the features of social organization such as trust, norms, networks, shared or mutual understanding of different cultural traditions and attitudes—which set the context in which intellectual and knowledge capital can be developed and exploited by facilitating coordinated actions. (Social capital, along with efficient and effective public administration, are parts of the “soft” intangible institutional capital on which growth and development depend, alongside the more familiar “hard” factors such as infrastructure and business investment.) A key question is how the mechanisms for the production, storage and transmission of intellectual and knowledge capital evolve and adapt to the currently emerging technical-economic paradigm. This latter is characterized by the increasing knowledge intensity of all facets of working and living. The speed with which it unfolds requires learning rates to increase dramatically. The capacity to “forget” in this situation is also very important insofar as the accumulated inertia of existing habits or practices may block the potential for new learning.

A distinction must be made between:

- the individual level, which orientates attention to the education and training of people;
- the organization level of cooperative and collective processes of intellectual and knowledge capital generation, management and learning within organizations and between organizations in networks; and
- the broader community or system level, which considers the overall coherence of individual and organizational knowledge and learning processes, plus the frameworks and incentives in place to further their development.

In order to bring the discussion down to concrete issues, a start is made with a segmentation which draws on the firm-level debate about intellectual and knowledge capital distinguishing between four types of intellectual and knowledge capital (see

Table 1), which for measurement purposes, are proxied by sets of nonmonitized indicators.

<b>Knowledge and Intellectual Capital</b>			
<b>Structural Capital</b>			<b>Human Capital</b>
<b>Organizational Capital</b>		<b>Customer Capital</b>	
<b>Innovation Capital</b>	<b>Process Capital</b>		
Patents, concepts, models	Computer and administrative systems, informal organization, internal network and culture	Brand names, trademarks, reputation/image	Individuals' skill, education, experience, values and social skills

Table 1. Categories of firm-level intellectual and knowledge capital

Such attempts at measuring intellectual and knowledge capital are guiding the type of investment patterns and strategies of firms in coming to terms with, as well as further advancing, the knowledge economy in which they operate. This demonstrates how intellectual and knowledge capital has swung to center stage as far as the asset and revenue-generating value of private firms is concerned. Its importance is reflected by the fact that the stock-market value of firms is on average three to four times the value of their physical assets. The argument is that an equally sophisticated understanding of intellectual and knowledge capital types and their importance must be developed in relation to individuals and systems or communities, and likewise be used to guide relevant public policies. What has been done is to identify analogies for the three main categories tracing downwards from the firm level to the level of the individual, and upwards to the higher system/community level, as shown in Table 2.

<b>Individual</b>	<b>↔Firm Level↔</b>	<b>System/Community</b>
Instrumental competencies and general knowledge	↔Human Capital↔ (Stock)	Technological know-how Knowledge infrastructure
Personal competencies	↔Organizational Capital↔ (Internal)	'Soft' technologies and social capital
Social competencies	↔Customer Capital↔ (External)	Ability to leverage benefits of system openness/internationalization

Table 2. Correspondences at individual and system level to categories of firm-level intellectual and knowledge capital

Based on these correspondences, Table 3 has been produced to demonstrate how different aspects of intellectual and knowledge capital can be brought together in a coherent scheme.

		<b>Intellectual and Knowledge Resources</b>		
		<b>Accumulated Intellectual Stock</b>	<b>Internal Organization and Processes</b>	<b>External Environment Interactions</b>
<b>Individual Level</b>	<b>Individuals</b>	Instrumental competencies (languages, science, literacy, numeracy, IT), general knowledge (economics, civics, literature)	Personal competencies (self-confidence, creativity, critical argumentation and analysis, psychological capital, intelligence)	Social competencies (language expression, teamwork, solidarity)
<b>Collective Levels</b>	<b>Organizations</b>	Human capital (skills, experience, values)	Innovation (patents, concepts) and process capital (informal organization, systems, internal networks and culture)	Customer capital (brand names, reputation, marketing prowess) Networking ability
	<b>Communities/ Systems</b>	Knowledge infrastructure Technological know-how and proficiency Industrialists and entrepreneurs	Institutional capital (efficient and effective public administration governance system) Social capital (trust, norms, networks) Cultural diversity	Ability to leverage benefits from system openness, foreign trade, Foreign Direct Investment (FDI) in-flows and circulation of human capital

Table 3. Categories of intellectual and knowledge capital for three different reference levels

For example, at the individual level, education and training systems impart variable mixtures of the three types of competencies (instrumental, personal and social) listed in the table, but mostly only consciously account for instrumental competencies and general knowledge—via standard examination and assessment techniques. The other types of competencies to-date have been unfortunately just random by-products of formal education systems, not measured or not considered worthwhile measuring, and therefore never consciously fostered.

Similarly, at the higher system level, intellectual and knowledge capital policies have been guided by considering primarily those factors which are readily measurable. Those at the regional, national or higher level, are concentrated in the categories of hard technology and knowledge infrastructure, hardware or artifacts, laboratories, universities and colleges, head-counts of researchers, qualification counts in the labor force, etc. These are what are captured in traditional science, technology and innovation indicators. But, as the table demonstrates, this is only part of the picture, and largely leaves out the soft/intangible factors which in many ways have become the most important. In fact, one way of reading the recent expanding trend in technology foresight and benchmarking-type policy exercises, is that these provide a means of getting some qualitative-cum-quantitative measure of the other categories listed in Table 3, in a way which the traditional indicators cannot.

The “embedded” idea is based on the fact that individuals are the building blocks of social collectivities (be these firms, families or any other organization). These in turn are the building blocks of higher-level organizational structures (networks, locality/region based systems), and so on up through national, supranational to global level systems, with each successive level embedded within the previous one. It can be argued that the types of intellectual and knowledge capital which are relevant for the different successive levels can be quite different: the intellectual and knowledge capital which exists, or is required, at one level is not just a simple sum over that of the constituents at the lower level. However, the compatibility between the intellectual and knowledge capital processes at different levels is absolutely vital to the overall coherence of the topmost system level in question. Another key aspect which the embedded constituency representation underlines, is that the different levels must demonstrate similar degrees and speeds of adaptability and propensity to change, so that continuous evolution maintains coherence. The primary goal of policy action should be to develop the learning abilities of the system.

This particular view strongly marks the approach followed here and the type of messages and implications deduced. For instance, the view that formal education and training systems are less and less capable of providing individuals with the intellectual and knowledge capital that the labor market requires, is an example of such an undesirable incompatibility, and is, it is argued, a product of the above-represented mismatch.

The implicit suggestion is that traditional policy spheres somehow need to be reconfigured in order to have more organic links, cooperation and *de facto* coordination between them. The need to sustain interdependencies between constantly changing realms of the labor market, basic education, private living sphere, and the global

economy, has become so critical that anything short of this is unproductive. A precise mapping of the “policy realm versus constituency” correspondences and gaps might be a basis on which to develop a coherent family of intellectual and knowledge capital-oriented policies.

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### Biographical Sketch

**Sylvie Faucheux** is currently Professor in Economic Science at the University of Versailles-St Quentin-en-Yvelines (UVSQ) in Paris, France, and Director of the research institute C3ED (Centre d'Economie et d'Éthique pour l'Environnement et le Développement) based at the UVSQ. Since 1992, in addition to teaching, research supervision and other duties as a university professor, Faucheux has been responsible for the leadership and management of contract research at C3ED in the fields of sustainability, ecological economics, environmental policy and scenarios. She has published a large number of scientific papers in French and English, and is associated with several collective publishing ventures. These include: the role of coeditor for the *International Journal of Sustainable Development* which was established in 1998 and publishes a lot of ecological economics contributions; cooperation in the establishment of the *International Library of Ecological Economics* (a new monograph series published by Edward Elgar); and a new series in ecological economics based in Switzerland, to be published in French with translation agreements for English and German. Recently, she has especially concentrated on problems of governance, risks and technological change, and systems of “vigilance-foresight,” with stakeholder-based approaches to the analysis of transitions towards sustainability in European countries. She has worked with several Ministries of the French state, with firms and with the European Commission on these topics, including recently climate policy, nuclear reactor waste management, and futures studies for technological innovation and the environment. As a member of the ISEE Board, Sylvie Faucheux brings a long experience in leadership, organization and resource management for ecological economics activities on an international and multilanguage level. In 1994, she led the organization of a major international conference in Paris on models for sustainable development (participation of 400), and in 1996 she played a central role in organizing the inaugural conference of the European Society for Ecological Economics (ESEE), the European branch of ISEE. She was elected the ESEE's first President in 1996, until stepping down from this position at the end of 1999. Under her leadership, the C3ED research institute has acted as host for the ESEE Secretariat since 1996, and has provided the support needed to establish a regular

ESEE Newsletter, to maintain the membership list, and other activities. Sylvie Faucheux has also led initiatives to establish partnerships with universities, ministries and industry in the Middle East and parts of Africa (especially French-speaking North and West Africa), in this way broadening the base of ecological economics networking. She is a member of the European Consultative Forum on the Environment and Sustainable Development as well as reporter of the Climate Change Working Group of the former forum.

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