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### Intellectual Productivity

designing and testing a method for measuring  
productivity in the intangible economy

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#### Biographical Notes

Christiaan Stam (1965) is Research Fellow at the Centre of Research in Intellectual Capital. His appointment is a joint initiative of INHOLLAND University and de Baak - Management Centre of the Dutch Federation of Industries (VNO-NCW).

In 1999 he initiated Intellectual Capital Services, an independent research, consultancy and training firm in the field of knowledge management, intellectual capital, and knowledge productivity. He wrote several books, many articles and he is an editor of the Dutch magazine *Intellectueel Kapitaal*. He also initiated a startpage for the intellectual capital community ([www.intellectualcapital.nl](http://www.intellectualcapital.nl)). Furthermore he initiated a series of intellectual capital initiatives in The Netherlands, like 'Strategic Navigation' (2000), 'Knowledge Balance Sheet' (2002), and 'Knowledge Productivity' (2004, [www.productiviteit.nl](http://www.productiviteit.nl)).

# Intellectual Productivity

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## Abstract

*The nature of production has changed. As a consequence, organizations have lost sight of the sources of productivity and productivity developments. Main objective of this research is to identify the sources of productivity in the intangible economy and to design and test a method for measuring intellectual productivity.*

**Keywords:** *Intellectual Capital, Intangibles, Productivity, Knowledge Productivity, Intellectual Productivity, New Growth Theory, IC multiplier, Design Science.*

## 1. Introduction

The past decades our production process has changed. Traditional factors of production, like natural resources, labour and capital have lost significance. At the same time the importance of intangible inputs, like information and knowledge, rose. This transformation had some serious consequences for measuring and managing productivity.

### 1.1 The new productivity challenge

Since Drucker (1993) the recognition of a new type of economy has become generally accepted. The fundamentals and attributes, however, have become one of the main subjects of discussion. Whereas Drucker sees the main difference in the shift in factors of production, Castells (1996) argues that the main difference between past and present is the application of information technology. According to Florida, driving force behind the transformation is the rise of human creativity as the key factor in our economy and society. "Many say that we now live in an 'information' economy or a 'knowledge' economy. But what's more fundamentally true is that we now have an economy powered by human creativity. Creativity – 'the ability to create meaningful new forms' (...) - is now the *decisive* source of competitive advantage" (2002: p.5).

The changing nature of economy – from labour and capital intensive to knowledge intensive – puts management for a problem. Although we are still speaking about 'products' and 'productivity', "an ever increasing share of GDP resides in economic commodities that have little or no physical manifestations" (Youngman, 2003: p.7). Output has become intangible, which makes it hard to quantify. Moreover, production processes have become diffuse, because the traditional clear distinction between input, transformation and output have faded, which makes it very difficult to relate changes in output to changes in the use of means of production. Today's production process is circular rather than linear, because the result of the process also serves as input to the new processes. Any product is also raw material. Finally, the result of today's production process is characterized by a high degree of variability of outcome, which makes comparison and objective measurement impossible (Stam, 2001). Consequence of this change is that managers have lost sight of the sources of productivity and productivity growth.

Castells characterizes this problem as 'the productivity enigma' (1996: p. 78). The sources of productivity have always been the main subject of economic debate, because it is the main determinant of profitability and competitiveness. Productivity is the key to economic progress. In order

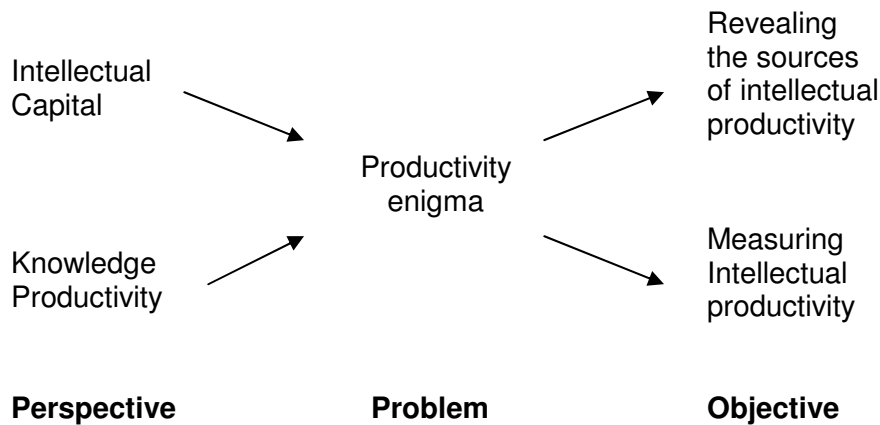
to identify and improve productivity we should be able to identify the sources of productivity. If there is a new, economy, “we should be able to pinpoint the historically novel sources of productivity that make such an economy a distinctive one” (p.78-79). According to Castells, the difference between the old and the new is mainly characterized by the way we produce and distribute information and knowledge. So it is not only about a shift in the factors of production, it is also about the way we are organized or the “cultural-institutional attributes of the whole social system” (p.100). These attributes are the real sources of productivity. In order to get better insight into productivity in the intangible economy, we should be able to reveal these cultural-institutional attributes.

## 1.2 Research objectives

Aim of this research is to investigate the new productivity challenge from two perspectives. First perspective is the concept of *knowledge productivity*. Assumption is that this concept can help us to reveal the sources of intellectual productivity. Second perspective is the concept of *intellectual capital*. Assumption is that intellectual capital can help to design a method to identify and measure the sources of productivity in the intangible economy.

The main objective of this research is to identify the sources of intellectual productivity and to design and test a method for measuring intellectual productivity.

**Figure 1**  
**Intellectual Productivity: a research model**



In chapter 2 and 3 the concepts of *intellectual capital* and *knowledge productivity* are introduced. Chapter 4 goes in to the New Growth Theory and the concept of IC multiplication, which serves as a starting point for this research. Chapter 5 goes in to the research implications.

## 2. Intellectual capital

Intellectual capital is the concept of identifying, measuring and managing intangibles. This paragraph goes deeper into the different interpretations of the term intellectual capital and gives a definition for this research project.

### 2.1 An intangible-based view of the firm

The past decades a *resource-based view* of the firm emerged. Authors like Penrose (1959), Hamel and Prahalad (1990, 1994), and Stalk et al (1992) contributed to this new strategic paradigm. The resource-based view of the firm is based on the assumption that firm-specific competencies have become the most important source of sustainable competitive advantage. The traditional competitive environment was stable and transparent. It was characterized by clear defined markets, customers and competitors. Today's competitive environment however, is characterized by dynamic changing markets and fast changing customer demands. More and more competition has become the ability to anticipate on these changes and thus asks for a more dynamic strategic approach as an alternative to the traditional product-based, competitive advantage view (Porter, 1980).

Hamel and Prahalad are probably the most influential advocates of the resource-based view. "In the short run, a company's competitiveness derives from the price/performance attributes of current products (...). In the long run, competitiveness derives from an ability to build, at lower cost and more speedily than competitors, the core competencies that spawn unanticipated products. The real sources of advantage are to be found in management's ability to consolidate corporate wide technologies and production skills into competencies that empower individual businesses to adapt quickly to changing opportunities" (1990: p.81). So core competencies are the main resources and can be seen as the collective learning in the organization. The ability to learn is a necessary precondition in order to be able to continuously adapt to changing customer demands.

Authors like Drucker (1993), Nonaka and Takeuchi (1991, 1997), Leonard-Barton (1995), Sveiby (1988, 1997), Davenport and Prusak (1998), and many more, further specify this resource-based view and claim that *knowledge* is the most important resource. "In an economy where the only certainty is uncertainty, the sure source of lasting competitive advantage is knowledge" (Nonaka and Takeuchi, 1997). However, this does not mean that the *knowledge-based view* is a synonym for the resource-based view. Most important and fundamental difference is that the resource-based view only implicitly refers to knowledge, whereas the knowledge-based view gives extensive elaborations on the nature and definition of knowledge and the way it should be managed (Nonaka and Takeuchi, 1997). Knowledge management literature can be seen as a further specification or extension (Bontis, 2002, p.626) of the resource-based view into a 'knowledge-based theory of the firm'.

Parallel, and closely related, a more holistic perspective on the value creating resources of the organization emerged. This *intangible-based view* of the firm is based on the work of authors like Sveiby (1997), Stewart (1997) and Edvinsson and Malone (1997). This so called *Intellectual Capital* movement uses knowledge and intellectual capital interchangeably. Although closely related, the meaning of knowledge in this movement fundamentally differs from the definition of knowledge in the knowledge-based view of the firm. Intellectual capital, intellectual assets, intangible assets, intangibles, knowledge assets, knowledge capital or whatever word is used within this movement, refers to the traditional hidden sources of value creation (of which knowledge is just one). Hidden in the sense that existing management techniques do not have the methods or instruments to reveal them.

This intangible-based view of the firm inspired the intellectual capital movement to further elaborate on the nature of intangible resources and the way they should be measured and managed. This view serves as a starting point for this research project.

### 2.2 Definition Intellectual Capital

The roots of today's intellectual capital movement lies in the mid 1980s in the work of the Konrad Group and Karl-Erik Sveiby (Sullivan, 2000, Edvinsson, 2002). However, it were Leif Edvinsson and

Thomas Stewart who, fueled by the power of popular communication, gave the movement a rocket launch in the mid-nineties.

According to Edvinsson and Sullivan (1996), the term 'intellectual capital' goes back to John Kenneth Galbraith. According to Bontis (2004), it was Machlup who first coined the term to emphasize the importance of general knowledge as essential to growth and development. After more than a decade, the term intellectual capital counts for numerous interpretations and definitions. According to Bontis this divergence can be explained by the fact that the field is still in its 'embryonic stage' (2002). Andriessen (2004) adds to this that each author just wants 'to convey a specific message that he thinks is important' (p.62). Some authors stress in their definition the importance of value creation (Edvinsson, Stewart), others stress the importance of value extraction (Sullivan). Some focus on knowledge (Stewart), others on intellectual properties (Brooking). Some use it as a synonym for 'core competencies' (Andriessen, Viedma), others translate it as a 'capacity-to-act' (Sveiby). However, these differences do not mean that their definitions are excludable. Despite the differences, we also see a lot of agreement about the nature of intellectual capital. Core-elements of agreement are:

- *Intellectual capital is about intangibles.*  
An intangible is something which is 'hidden or not-material', which is 'difficult to understand' and which 'cannot be known by the senses', although 'it is known to be real' (Longman Dictionary). Intellectual capital gives intangibles an object<sup>1</sup>, so that they can be recognized and understood.
- *Intellectual capital makes the difference.*  
As described above, intellectual capital is a further specification of the resource-based view of the firm. Starting point of this intangible-based view of the firm is that intangibles are the main source of value creation and competitive advantage. Intellectual capital is about exploiting intangibles.
- *Intellectual capital gives structure to organizational resources.*  
Recognizing the importance of intangibles is one thing, but translating it into a theory is another. Intellectual capital is the movement that gives content to the challenge expressed by Drucker (1993) that we need a theory that puts knowledge (intangibles) into the centre of the wealth creating process. Moreover, intellectual capital makes it possible to communicate, interpret and control intangibles.
- *Intellectual capital is about human-, and non-human resources.*  
Intellectual capital represents a holistic view of the firm. It is not only about the people (like Human Resource Accounting), but also about the non-human intangible resources, like organizational processes, structures, systems. Intellectual capital goes 'beyond the brain' (Andriessen, 2004: p.60).
- *Intellectual capital is about improving performance*  
Intangibles are the most meaningful resource today. However, management keeps focusing on tangible financial performance. Aim of intellectual capital is to create a focus on improving intangibles performance.

So the word intellectual capital should not be taken too literally. Intellectual capital is a metaphor, because it describes the importance of all the intangible resources by stating the ability to use the human mind (intellectual) and financial wealth (capital), with which it can be compared. It is not only about the ability to use the human mind or financial wealth. In fact, the word *intellectual* goes beyond the brain and *capital* goes beyond finance.

The word *intellectual* refers to intangibles in general. It refers to both human- and non-human resources. So, it is not only about the people, their knowledge and skills, but also about organizational processes and relationships with the customers.

The word *capital* refers to financial wealth. However, the essence of the phrase intellectual capital refers almost to the opposite. Intellectual capital goes beyond the traditional accounting principles. It is no longer relevant whether resources can be expressed in monetary terms or not. Moreover, it is also no longer relevant whether an asset is owned by the organization or not. What matters is whether the resource is available or not. Does the company have access to it in order to realize its strategic goals? That is the main qualifying characteristic.

The phrase intellectual capital also makes a strong reference to the word 'important' or 'strategic'. The literal meaning of both words refers to the importance of the 'head'<sup>2</sup>. If we look at the meaning of the word capital in the dictionary it often distinguishes the important from the ordinary (e.g. capital city, capital punishment, capital letters, capital importance). In business language important is frequently translated by 'strategic' (Jacobs, 1999). In this sense intellectual capital refers to intangibles that are of strategic value to the company. It is strategic in the sense that they contribute to creating organizational value and achieving organizational goals. In other words, intellectual capital is about *strategic intangible resources*.

### 2.3 A taxonomy of two

One of the main merits of the intellectual capital movement is the development of a so called *taxonomy*, a branch of various classes of intangibles and their relationships. The past decade many different taxonomies have been developed. Many overviews have already been given (Sveiby, 1998, Bontis et al., 1999, Stam, 1999, Petty and Guthrie, 2000, Bontis, 2001, Guthrie, 2001, Bontis, 2002, Andriessen, 2004).

It seems to be generally accepted that human resources is one of the main classes of intangible resources, because each taxonomy includes a class of intangibles that refers to human-related intangibles (e.g. human capital, individual capital, employee competence, etc.). It also seems to be generally accepted that intellectual capital goes beyond human resources, because each taxonomy includes one or more non-human related intangibles (e.g. organizational capital, relational capital, intellectual properties, technology, process capital, infrastructure capital, etc.).

This distinction between human and non-human resources is closely related to the basic characteristics of knowledge<sup>3</sup>. Knowledge is a combination of human-related or *tacit* knowledge and non human-related or *explicit* knowledge (e.g. Polanyi, 1966, Nonaka and Takeuchi, 1997). The former refers to everything that is related to, controlled by and dependent on the people within the organization. The latter refers to everything related to and controlled by the organization and not dependent on the people. Both elements are necessary but not sufficient. Tacit knowledge needs explicit knowledge, like human resources need non-human resources to create value for the company.

This basic distinction between human- and non-human resources is fundamental to understanding the nature of intellectual capital. The distinction serves as a starting point for several models (Edvinsson and Sullivan, 1996, Edvinsson and Malone, 1997, Roos et al., 1997, Sullivan, 2000). Most well known example is of course the Skandia Navigator, which is based on the distinction between human capital and structural capital as the two main roots of value (Edvinsson and Malone, 1997: p.11):

1. *Human Capital*. The combined knowledge, skill, innovativeness, and ability of the company's individual employees to meet the task at hand. It also includes the company's values, culture and philosophy. Human capital cannot be owned by the company.
2. *Structural Capital*. The hardware, software, databases, organizational structure, patents, trademarks, and everything else of organizational capability that supports those employees' productivity – in a word, everything left at the office when the employees go home. Structural

capital also includes customer capital, the relationships developed with key customers. Unlike human capital, structural capital can be owned and thereby traded.

Based on this taxonomy of two, Edvinsson and Malone define Intellectual Capital as the sum of Human Capital and Structural Capital:

$$\begin{array}{r} \text{Human Capital} \\ + \text{Structural Capital} \\ = \text{Intellectual Capital} \end{array}$$

One of the main subjects of debate within the intellectual capital movement is the further specification of this basic taxonomy. This further specification seems to focus on the non-human resources. Distinction is being made between the internal and external environment. Others stress the importance of processes, innovation, intellectual properties or technology. Although these further specifications highlight the importance of a specific aspect of intangibles, they do not add anything to the fundamental distinction and dynamics between human- and non-human related intangibles. Therefore, starting point of this research project is the distinction between human- and non-human (structural) capital.

### 3. Knowledge productivity

A management topic that is closely related to intellectual capital is knowledge productivity. Knowledge productivity is the concept of improving knowledge-based productivity. The awareness that knowledge and productivity are closely related already goes back for many decades. This paragraph gives an overview of the development of this topic.

#### 3.1 Production and productivity of knowledge

It was in *The Production and Distribution of Knowledge in the United States* (1972, original publication in 1962) that Machlup discovered the importance of knowledge as a product. In his recalculation of the national product of the United States, Machlup discovered that “total knowledge production in 1958 already accounted for almost 29 per cent of adjusted GNP” (p.362). Moreover, the “knowledge-industry” was not only the largest industry, but also grew faster than the traditional industries. These conclusions led to the observation that there should be some relationship between knowledge, value creation and economic growth.

It was Drucker who translated the macro-economic discovery of Machlup to organizational level, because “We know that productivities are created and destroyed, improved or damaged, in what we call the “micro-economy”: the individual enterprise, plant, shop, or office” (Drucker, 1981). Moreover, he realized that the real productive power of organizations is determined by the ability of the so called knowledge workers to make knowledge productive. In *The post-capitalist society* (Drucker, 1993) he stressed the importance of the development of a new economic theory that puts knowledge in the centre of the wealth creating process (p.171).

In *Knowledge worker productivity: The biggest challenge* (Drucker, 1999) he elaborates on this new economic theory and describes management guidelines for knowledge-worker productivity. Six major factors determine knowledge worker productivity (1999: pp.83-84):

1. Knowledge-worker productivity requires awareness of the individual contribution. It demands that we keep asking the question “What is the task?” This helps knowledge workers to focus on their task and eliminate anything else.
2. It demands that we impose the responsibility for their productivity on the individual knowledge workers themselves. Knowledge workers have to manage themselves. They have to have autonomy.

3. Continuing innovation has to be part of the work, the task and the responsibility of knowledge workers.
4. Knowledge work requires both continuous learning and continuous teaching on the part of the knowledge worker.
5. Productivity of the knowledge worker is not – at least not primarily – a matter of the quantity of output. Quality is at least as important and depends on the task of the knowledge worker.
6. Knowledge-workers should be seen and treated as an “asset” rather than a “cost”. Knowledge productivity requires that knowledge workers want to work for the organization in preference to all other opportunities.

According to Drucker, the competitive advantage of businesses increasingly depends on the ability of organizations to make the knowledge worker more productive. The above guidelines are based on the presupposition that the person that does the job (the knowledge-worker) is the only true expert of productivity (Drucker, 1981: p.27). However, the productivity of knowledge and knowledge workers is primarily seen as a management responsibility. “Knowledge-worker productivity is the biggest of the 21<sup>st</sup>-century management challenges”(Drucker, 1999: p.92). In order to face this challenge we should develop a theory that discloses the relationship between the productivity of knowledge workers and the environment. “Not to see the forest for the trees is a serious failing. But it is an equally serious failing not to see the trees for the forest. One can only plant and cut down individual trees. Yet the forest is the “ecology”, the environment without which individual trees would never grow. To make knowledge productive, we will have to learn to see both forest and tree. We will have to learn to connect” (Drucker, 1993: p.180). To get better insight in the sources of productivity we will have to see the interaction between people and their environment.

### 3.2 Improving knowledge-based productivity

Closely related to and in line with the ‘production of knowledge’ by Machlup and the ‘productivity of knowledge’ by Drucker, it was Joseph Kessels who introduced the concept ‘knowledge productivity’. “Knowledge productivity has been described as the key ability of an organization, a team, or employee, to signal relevant information and to develop new competencies. These new competencies are to be applied to the incremental improvement and radical innovation of work processes, products and services” (Kessels and Van der Werff, 2002: p. 20). Main underlying assumption of this concept is that “The character of labour is changing: routine work is more and more taken over by machines and computers. The work that remains requires independent decision-making and creative thinking; the physical activities of employees are being replaced by mental and social activities. (...) As this change of the character of labour takes place, it is inevitable that the workplace turns into a learning environment. (...) The conditions for good work become similar to the conditions for good learning” (Kessels and Van der Werff, 2002: p.20). So knowledge productivity requires a good learning environment.

In order to help organizations improve their knowledge productivity, Kessels introduced the *Corporate Curriculum*: ‘the plan for learning to increase knowledge productivity, leading to constant improvement and radical innovation, and ultimately to economic advantage’ (Kessels, 1996, Kessels and Van der Werff, 2002). Kessels’ *Corporate Curriculum* identifies seven critical *learning functions*:

1. Acquiring *subject matter expertise* and skills directly related to the scope of the core competencies.
2. Learning to identify and *solve problems* by using existing (domain specific) expertise.
3. Developing *reflective skills and meta-cognitions* that contribute to finding, acquiring and applying new knowledge.
4. Securing *communication skills* that provide access to the knowledge network of others and that enrich the learning climate within the workplace.
5. Acquiring skills for *self regulation of motivation and affection* related to working and learning.

6. Promoting *peace and stability*, in order to enable specialization and incremental improvement.
7. Causing *creative turmoil* in order to stimulate innovation.

The policy and activities that an organization develops to promote these seven learning functions form its Corporate Curriculum. At the end of the day, the quality of this 'Corporate Curriculum', or 'plan for learning' determines the knowledge productivity of a firm. The question remains, how can we create an environment that firmly supports the seven learning functions of the Corporate Curriculum? Based on a design approach Kessels identified three principles of development (Kessels, 2001, Keursten and Kessels, 2002):

1. Enhancing reciprocal appeal  
A knowledge productive workplace is a rich learning environment in which the social context fosters collaborative efforts. In this respect, Kessels refers to the conditions for successful Communities of Practice as described by Wenger et.al. (2002).
2. Searching for a passion  
People can not be forced to be clever. A knowledge productive environment encourages people to find their passion. It stimulates curiosity and it encourages and facilitates the cultivation of a personal, substantive theme.
3. Tempting towards knowledge productivity  
The first principle refers to the social context. The second establishes the foundation for substance. The third principle is a meta-competence that enables us to work systematically on the social context and the substantive component.

These three principles heavily lean upon Kessels' humanistic definition of knowledge. "Knowledge is to be seen as a personal capability, as a skill; not as an objective entity that resides outside the individual, stored in documents, systems and machines. In this sense, knowledge cannot be separated from the bearer of knowledge, the individual human being" (2002: pp.20-21). In this respect, knowledge management in the sense of planning and control of knowledge will appear to be an anachronism (Kessels, 1996: pp.11-12). So knowledge productivity is a personal competence that can not be managed. The only thing managers can do is create an environment in which employees can thrive. This environment has to be supported by a so called Corporate Curriculum.

Kessels' work, particularly the Corporate Curriculum, inspired many to further elaborate on knowledge productivity<sup>4</sup>. Central theme of most of the publications is 'learning'. In this respect, the knowledge productivity movement seems to be more closely related to the concept of the 'learning organization', than to the concept of 'knowledge management' (Stam, 2004).

This dominant focus on tacit knowledge and learning is an important point of critique. Authors like Weggeman (2001) and Jacobs (2001) stress the importance of the organizational dimension of knowledge productivity. Knowledge productivity is not only about stimulating personal passion, it is also about management and control. The reality of management is that we have to do both. Within organizations it is about the balance between personal empowerment on the one hand and planning and control on the other: without clear organizational frameworks, -structures and systems, no minimal efficient and effective personal empowerment of the knowledge worker (Jacobs, 2001: p.32).

The competitive advantage of organizations does not come from knowledge itself, but from knowledge productivity, or the extent to which it has been put into use. Knowledge productivity is a set of guidelines or principles that shows the relationship between the environment (cultural-institutional attributes) and the productivity of the knowledge worker. Managers can use this concept to stimulate productivity.

Like intellectual capital, knowledge productivity is a metaphor too, because it compares the efficient and effective use of knowledge with measuring the ratio between input and output. Inherent to

the definition of knowledge, knowledge productivity has two faces (Stam, 2004). On the one hand the face that stresses the importance of management and control (efficiency), on the other hand the face that stresses personal empowerment and learning (effectiveness). The first approach has a dominant focus on explicit knowledge. Although knowledge is created by people, it is the responsibility of managers to capture as much knowledge as possible for the organization, in order to guarantee continuity and increase efficiency. The second approach has a dominant focus on tacit knowledge, because that is the only knowledge of real importance. In this view it is about creating an environment in which employees are stimulated to learn, because learning is the production process with which knowledge is created. Drucker can be seen as a representative of the first approach. Examples are his strong emphasis on management responsibilities and his plea for systematic and organized application of knowledge. Kessels is a representative of the second approach. Examples are his definition of knowledge, his focus on the individual competences and his aversion to management.

#### **4. Multiplier effect**

Concepts like knowledge, intellectual capital and knowledge productivity are all based on the idea that the individual parts enhance each other. This idea of enhancement reflects the concept of multiplication in the 'New Growth Theory'. Both in intellectual capital- and in knowledge productivity literature, we find many references to this theory (Stewart, 1997, Lev, 2000, Aberg and Edvinsson, 2001, Edvinsson, 2002, Zegveld and Den Hartigh, 2002). This paragraph introduces the New Growth Theory and the concept of intellectual capital multiplication.

#### 4.1. New growth theory

The New Growth Theory, “distinguishes itself from neoclassical growth by emphasizing that economic growth is an endogenous outcome of an economic system, not the result of forces that impinge from outside” (Romer, 1994). Starting point of endogenous growth models is that “technological advance comes from things that people do”. Moreover, larger total stock of human capital leads to faster growth (Romer, 1990: p.99). Second distinguishing starting point of endogenous growth models is that technology, knowledge and information are partially excludable, or excludable for at least some period of time (temporary monopoly or imperfect competition). “Because people and firms have some control over the information produced by most discoveries, it cannot be treated as a pure public good” (Romer, 1994: p.13). In other words, knowledge and information can be a valuable source of (temporary) competitive advantage.

Another starting point of the New Growth Theory is the concept of ‘increasing returns’ (Romer, 1986). Unlike traditional factors of production, knowledge can be used over and over again. As a result of multiplication of knowledge, total output will rise more than in proportion to the rise in inputs. According to Romer, people have difficulty with understanding the power of multiplication. However, understanding this mechanism is a precondition to understanding economic growth. In his articles he gives numerous examples.

*“In the modern version of an old legend, an investment banker asks to be paid by placing one penny on the first square of a chess board, two pennies on the second square, four on the third, etc. If the banker had asked that only the white squares be used, the initial penny would double in value thirty one times, leaving \$21,5 million on the last square. Using both the black and white squares makes the penny grow to \$92,000,000 billion”.*

“People are reasonably good at forming estimates based on addition, but for operations such as compounding that depend on repeated multiplication, we systematically underestimate how fast things grow” (Romer). This is also true for economic growth.

*“Income per capita in 2000 was about \$36,000 in year 2000 dollars. If real income per person grows at 1.8 percent per year, by 2050 it will increase to \$88,000 in year 2000 purchasing power. Not bad. But if it grows at 2.3 percent per year, I will grow to about \$113,000 in year 2000 purchasing power” (Reason, 2001).*

In his New Growth Theory Romer distinguishes between ‘ideas’ and ‘things’ (Romer, 1993). The critical difference is that things can only be used by one person and ideas can be used by many people at the same time, provided that it can be communicated. Ideas have high impact, because they can be replicated at a large scale and at low costs. They are the true force behind productivity improvements and economic growth. “The ability to leverage physical and financial assets is limited and getting more so. The ability to leverage knowledge capital is unlimited and getting less so. An airplane can fly on just one route. A reservation system is limited only by the number of people in the world” (Baruch Lev in: Stewart, 2002: p.17). So the main source of productivity lies in the system, not in the airplane. Although conceptually distinct, there are also many tight interactions between ideas and things. In fact, human capital makes ideas, and ideas help to make human capital. Both ideas and things are necessary, but not sufficient. They enhance each other.

## 4.2 Intellectual capital interdependencies

This idea of interdependent and mutual enhancing factors can be found at many places. Examples are Castells' (1999) dialectical interaction between society and technology, Florida's (2002) "creative capital theory", Nonaka and Takeuchi's (1997) theory of knowledge conversion, Weggeman's (1997) definition of knowledge and, last but not least, Edvinsson's (1997) definition of intellectual capital. Despite Edvinsson's definition, the early intellectual capital literature did not really elaborate on this subject. Authors like Brooking (1998), Sveiby (1997), Edvinsson and Malone (1997), and Stewart (1997) were more concerned with identifying and measuring the different classes of intangibles, than revealing their interrelationships. This does not mean that interdependencies kept unnoticed.

First of all, the idea of interdependence is present in almost all intellectual capital models, because the logic of these models is that intellectual capital is the product of interaction of the different classes of intangibles. (Roos, 2003). Example of this logic is Sveiby's (1997) suggestion of measuring 'competence-enhancing customers' and the 'customers contributing to internal structure'. According to Sveiby customers are important sources of individual competences and organizational development.

The best evidence of the idea of interdependence can be found in the respective definitions of human capital and structural capital. Sveiby (1997), Stewart (1997) and Edvinsson and Malone (1997) are all very clear about the interdependence between these two classes of intellectual capital. Sveiby refers to Weick (1995) if he argues that "People create the organization by interacting with each other and thus enacting the environment" (Sveiby, 1997). Edvinsson refers to the interdependence between human capital and structural capital as a 'double-arrow dynamic'. "Human capital is what builds structural capital, but the better your structural capital, the better your human capital is likely to be" (Hubert Saint-Onge in: Edvinsson and Malone, 1997: p.35)<sup>5</sup>. So structural capital is both the enabler and the result of human capital at the same time. Finally, Stewart makes the connection with the New Growth Theory: "Human capital matters because it is the source of innovation and renewal (...). But smart individuals don't necessarily make for smart enterprises". Structural capital is what "packages human capital and permits it to be used again and again to create value (...)" (Stewart, 1997: p.76-77). So human capital is what Romer would call a 'thing', because it can not be replicated. Structural capital is, what Romer would call 'ideas', because it can be replicated at a large scale and at low costs. This implies that structural capital is the true force behind productivity.

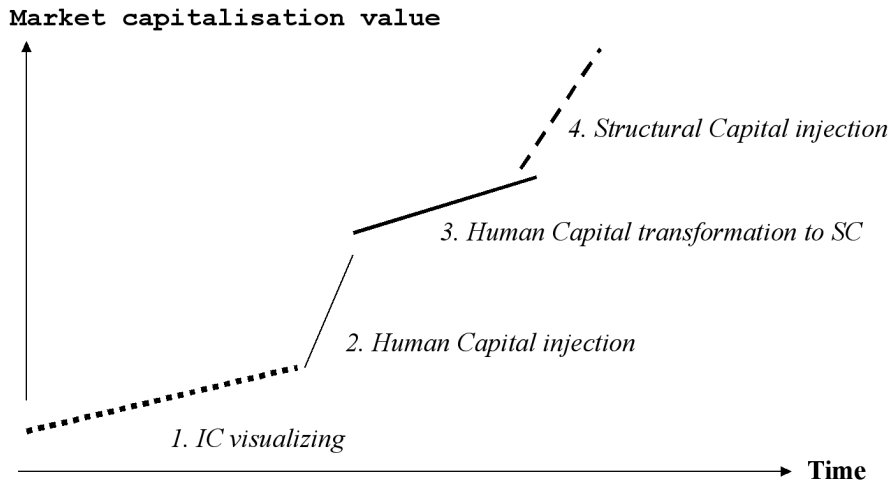
Already in 1997, Sveiby and Edvinsson claim to see "an evolution in thinking, from identifying the components of intellectual capital to an understanding of the dynamic interaction between these components" (Sveiby in: Edvinsson and Malone, 1997: p.19).<sup>6</sup> Apart from the above statements, this understanding is not reflected in the intellectual capital literature of that time. Only very recently we see some more attention to the interdependencies between different classes of intangibles.

## 4.3 IC-multiplier<sup>7</sup>

In 1997 Edvinsson defined intellectual capital as the sum of human capital and structural capital ( $IC=HC+SC$ ). Five years later he defines intellectual capital as the multiplication of human capital and structural capital ( $IC=HC \times SC$ ) (2002: p.95). This small, but significant change indicates an important deepening in the understanding of the dynamics of intellectual capital.

In Corporate Longitude, Edvinsson elaborates on the subject of intellectual capital multiplication. Based on the work of Romer (1990) he suggests that the multiplier effect of intellectual capital leads to an exponential relationship instead of a linear relationship. "The whole can be many times greater than the sum of the parts" (Edvinsson, 2002: p.93). Within the evolution of intellectual capital, Edvinsson sees a shift from the identification and visualization of intangibles, with a dominant focus on human capital, towards a systematic transformation of human capital into structural capital as a multiplier.

## Figure2 Evolution of intellectual capital



Source: [www.kwork.org/stars/edvinsson.html](http://www.kwork.org/stars/edvinsson.html)

Phase one focused on the visualization of intangibles from a reporting perspective. Example of this phase are the Skandia intellectual capital reports. Phase two concerned human capital injection, often labelled *knowledge management*. Phase three 'is the systematic transformation of human capital into structural capital as a multiplier, with much more sustainable earnings potential for the organization' (2002: p.93). This phase is focused on the packaging of knowledge into multiplicative recipes to be shared globally and rapidly. It is focused on collectively growing structural capital, because 'knowledge recipes are set to become the new global export items rather than the flow of goods' (p.94). Finally phase four is characterized by structural capital injections from external sources. This will have a 'turbo-effect' on the maximizing of IC.

According to Edvinsson, the multiplier effect has become the critical perspective. "This shifts the focus of leadership from human capital to structural capital as a multiplier of human talents" (2002: p.93). "The mistake has been to see human capital in a vacuum. Human capital requires infrastructure to create a springboard for people's talent potential. (...) Human capital can only flourish if the structure is established to enable it to do so. Either in a void is worthless" (2002: p.95). Most companies struggle with the notion of structural capital (especially with its sub-component organizational capital). Organizational capital should be seen as the structure of the organization that allows knowledge workers to leverage their talents. The question then becomes: What is the optimal way to organize? "How do you create structures which maximize human potential?" (2002: p.96). In order to create a springboard effect or multiplier effect we should develop effective organizational structures to optimize the efforts of knowledge workers. This interpretation of the multiplier effect is closely related to the concept of knowledge productivity as described above.

Based on Edvinsson's concept of IC multiplication and the IC-rating™ method<sup>8</sup> of IC Sweden AB, Aberg and Edvinsson (2001) introduced the IC Multiplier as 'an indication on how good the human capital of the organization use the structural capital to leverage its potential' (p.6). The ratio is calculated by looking at the relationship between structural capital and human capital. The formula for this indicator is:

$$IC \text{ Multiplier} = \text{Structural Capital} / \text{Human Capital}$$

Ratios higher than 1 indicate a multiplication, lower than 1 indicate erosion, which leads to reduced value creation. Moreover, 'the IC Multiplier assesses the relationship between structural capital and human capital and indicates at what level of efficiency the company is operating' (p.9). Aberg and Edvinsson tested the IC Multiplier with data from 43 companies, based on values from their respective

IC Rating™ report. The test shows that there is a significant correlation between the value of the structural capital and the human capital (p.11). A sub-selection of the companies was also analyzed in terms of their IC Multiplier and three traditional financial key figures indicating organizational efficiency:

- IC Multiplier and Value added / Employees
- IC Multiplier and Result / Employees
- IC Multiplier and Net Sales / Employees

All the tests within this report indicate a relationship between the IC Multiplier and the efficiency of the company. Although not all of these tests are conclusive, they all point in the same direction. “The higher IC Multiplier a company has, the more efficient it becomes” (p.18). This means that the IC Multiplier is a good indicator for knowledge-based productivity.

Berglund, Grönvall and Johnson (2002) also examined the IC Multiplier as a possible indicator for leveraging the efficiency of intellectual capital. Their research among 40 Swedish companies listed on the Stockholm stock exchange, shows that there is a strong correlation between the IC Multiplier and value added. “A small improvement of the SC/HC-ratio dramatically can effect the market value” (Berglund et al., 2002: p.101). The relationship between IC Multiplier and Market Value is expressed as follows:

$$\uparrow IC \text{ Multiplier} \rightarrow \uparrow IC \rightarrow \uparrow Market \text{ Value}$$

Although the above reports show significant correlations between the IC Multiplier, organizational efficiency, and several financial indicators, they do not elaborate on how to calculate the IC Multiplier itself (Aberg and Edvinsson, 2001), or they have to make an approximation (Berglund et al., 2002), because an exact calculation of the SC/HC-ratio was not possible. This makes it difficult for others to calculate the IC Multiplier.

Moreover, although these reports confirm that structural capital should be larger than human capital (otherwise you have not a multiplier, but the opposite), they do not go into the underlying causes. Why do some companies exploit their intellectual capital better than others? What are the specific attributes of their structural capital that allows them to leverage their human talents? Answers to these questions would give insight in the sources of intellectual productivity.

#### 4.4 Conclusion

The nature of economy and the production process has changed. Intangibles have become the main factor of production and knowledge productivity has become the main source of competitive advantage. As a result of this shift managers have lost sight of the sources of productivity and productivity growth.

In order to deal with this, two new business metaphors emerged: ‘intellectual capital’ and ‘knowledge productivity’. Intellectual capital is about *strategic intangible resources*, and is a further specification of the resource-based view of the firm, which claims that intangibles have become the most important resources. Knowledge productivity is about *improving knowledge-based productivity* by showing the relationship between the environment (cultural-institutional attributes) and the productivity of the knowledge worker.

Both concepts (intellectual capital and knowledge productivity) are inspired by the New Growth Theory, which distinguishes between ‘ideas’ and ‘things’. According to this theory, ‘ideas’ are the true force behind productivity improvements, because they can be replicated at a large scale and at low costs. However, although conceptually distinct, there are also many tight interactions between ideas and things. Both ideas and things are necessary, but not sufficient. They enhance each other. If we translate this to the concept of intellectual capital, this means that structural- and human capital enhance each other and that structural capital is the main source of productivity.

## 5 Research

As described in chapter one, the main objective of this research is to identify the sources of productivity in the intangible economy and to design and test a method for measuring intellectual productivity. This objective can be divided into two sub-objectives:

1. to provide insight in the sources of productivity in the intangible economy.
2. to develop and test a method for measuring and improving intellectual productivity in organizations.

### 5.1 Research questions

These objectives can be translated into one main research question and two sets of sub-questions:

#### Main research question

What are the main sources of productivity in the intangible economy and how to develop and test a method for measuring and improving intellectual productivity in organizations?

#### Sub-questions

1. What are the main sources of productivity in the intangible economy?
  - a. What are the characteristics of the intangible economy?
  - b. What do the concepts of intellectual capital and knowledge productivity learn us about the sources of productivity in the intangible economy?
  - c. How can we define the concept of intellectual productivity?
  - d. How can we measure intellectual productivity and its sources?
2. How to develop and test a method for measuring and improving intellectual productivity in organizations?
  - a. What are the additional requirements for developing a method for measuring and improving intellectual productivity in organizations?
  - b. What are the consequences of the additional requirements for the object and realization design of measuring intellectual productivity in organizations?
  - c. What can we learn from implementing the design?
  - d. How can we improve the design?

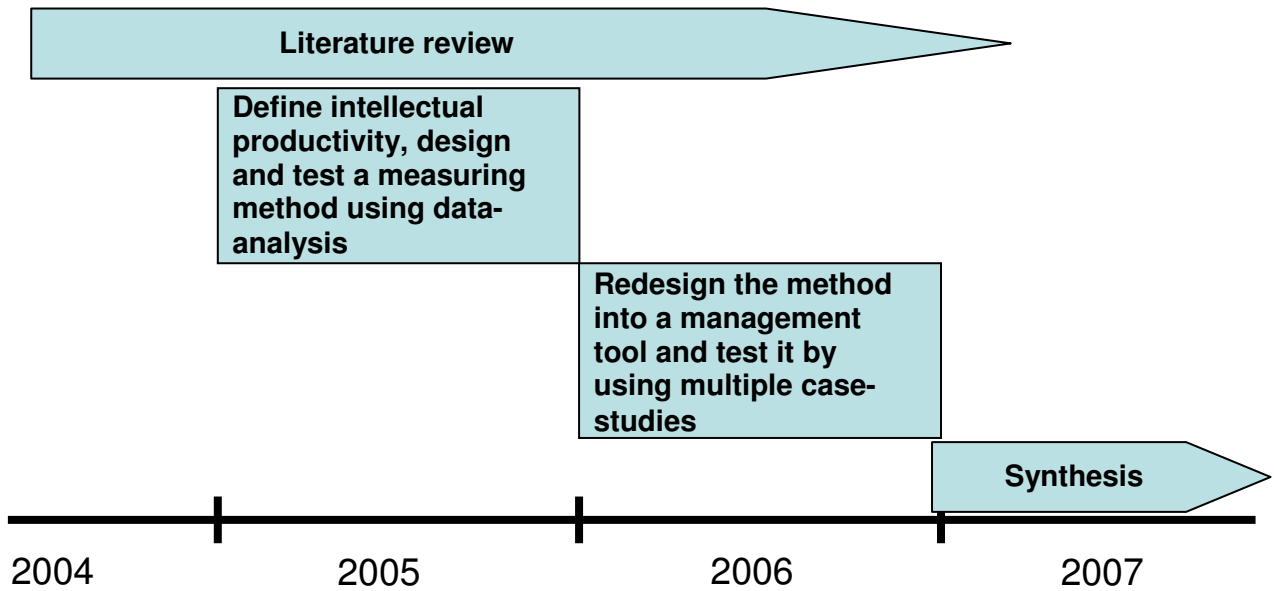
### 5.2 Methodology

One of the main aims of doing a PhD-research is to develop the ability to design and execute a scientific sound research project. In order to experience different kinds of scientific approaches, this research will be based on a variety of methods.

“The choice of methodology depends on the type of research question and the characteristics under investigation” (Andriessen, 2004: p.19). Major element of this research is to design and test a new method, therefore this research follows a design approach (Van Aken, 1996, 2000, Andriessen, 2004).

The first part of the research (sub-question 1) will be based on literature research and data analysis. The data analysis will be primarily based on publicly available data about organizational performances. However, if specific data is not publicly available, the data will be completed by questionnaires. The second part of the research (sub-question 2) will be based on the *inventorying multiple case study method* (Andriessen, 2004), in which the same method is tested several times in different cases.

Figure 3: Planning PhD-project Intellectual Productivity



### 5.3 Importance of research

The importance of this research to society in large is that it contributes to creating awareness about intangibles as the main source of value creation. The contribution to organizational science is that it gives more profound insight in the dynamics of intangibles. The contribution to management is that it results in a method to measure and improve productivity (and thus competitiveness and profitability) in the intangible economy.

## 5.4 Acknowledgement

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## 7 Notes

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<sup>1</sup> Mouritsen, J., Designing and interpreting intellectual capital statements. Presentation at IC-congress "Interpretation and communication of intellectual capital, Hanken Business School, 2-3 September 2004, Helsinki Finland.

<sup>2</sup> 'The word *capital* is derived directly from the Latin *capitale*, with the adjective corresponding to the noun *caput*, meaning head. It originally referred to the head part of a debt, as distinguished from the interest'. A further elaboration on the word intellectual capital can be found in Andriessen, D. G. (2004), *Making Sense of Intellectual Capital*, Elsevier Butterworth-Heinemann, Amsterdam.

<sup>3</sup> Therefore intellectual capital and knowledge capital are frequently used as two of a kind (e.g. Stewart, 1997).

<sup>4</sup> Driving force behind this Knowledge productivity movement is the Vanwoodman Society for Knowledge Productivity, a joint initiative by the Rijksuniversiteit Leiden and Durham University Business School, founded in 1998. [www.vanwoodman.com](http://www.vanwoodman.com).

<sup>5</sup> Quote from Saint-Onge, H., in: "The Rush on Knowledge", p.56.

<sup>6</sup> Quote from Sveiby, K.E., "Towards a Framework for Our IC Dialogue". The Knowledge Organization. London: Barret-Koehler.

<sup>7</sup> IC-multiplication should not be confused with the phrase 'intellectual capital leverage'. The latter usually refers to the contribution of intellectual capital to increasing the financial value or the profitability of the firm Sveiby, K. E. (1997), *The New Organizational Wealth. Managing & Measuring Knowledge-based Assets*, Berret-Koehler Publishers Inc., San Fransisco, Sullivan, P. H. (2000), *Value-driven Intellectual Capital. How to convert intangible corporate assets into market value*, Wiley, New York..

<sup>8</sup> IC Rating™ is based upon data collected from internal as well as external interest groups related to the company. See: [www.intellectualcapital.se](http://www.intellectualcapital.se).