INTELLECTUAL CAPITAL OF THE EUROPEAN UNION

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This paper is suitable for oral presentation

Biographical notes

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Intellectual Capital of the European Union

Abstract

Purpose

The concept of intellectual capital is more and more applied to regions and nations. Intellectual capital of nations reports use a system of indicators that helps to uncover and manage the invisible wealth and gives insight into the hidden value of a country or region of countries. The purpose of this paper is to measure the value of the intellectual capital of the European Union.

Methodology / Approach

The theory of multidimensional value measurement (M'Pherson and Pike, 2001; Pike and Roos, 2000) was used to combine indicators into measures of intellectual capital value. An Intellectual Capital Monitor is developed that encompasses measures for human capital, structural capital and relational capital, and that indicate investments, assets and their effects.

Research limitations / implications

The paper shows that some of the requirements for multidimensional value measurement cannot be fulfilled when measuring the value of the intellectual capital of nations, and others are hard to fulfill. More theoretical research is needed on the use of measurement theory in the social world. The paper also shows it is difficult to find direct effect indicators of intellectual capital.

Practical implications

The results show that the Nordic countries (Sweden, Denmark and Finland) are leading the EU when it comes to investments in Intellectual Capital and the value of their intellectual capital assets. Other EU countries tend to consume more, resulting in higher effects values, and invest less.

Originality / value of the paper

This is the first publication that applies the concept of the intellectual capital of nations to the European Union. It is also the first paper that uses the theory of multidimensional value measurement to the IC of nations.

Keywords

Intellectual capital of nations, measurement theory, European union, Lisbon agenda, multidimensional value measurement.

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Introduction

More and more we hear people say that we have entered a new economy, information economy, a network society, post-industrial society, knowledge-based society, etc. Whatever their names and differences, there is one major similarity between all these new kind of economies: The competitive advantage within these new economies has shifted from material and financial assets to intangible and non-financial assets. The European Union is aware of this shift and is implementing an ambitious program to make the European economy the most dynamic and competitive knowledge-based economy of the world.

In this paper we give an introduction to the concept of the intellectual capital of nations and apply it to the European Union. How do the countries of the European Union perform from an intellectual capital perspective? To answer this question we have developed an IC Monitor for 15 European countries that uses indicators to measure the value of intellectual capital. Thus we provide insight into the value of the intellectual capital of these countries in relationship to the goals set by the European Council on 23-24 March 2000 in Lisbon: The Lisbon Agenda. In addition we apply the theory of multidimensional intellectual capital valuation as developed by M'Pherson and Pike (2001 a,b) and Pike and Roos (2000) and test its applicability for the valuation of the intellectual capital of nations.

Intellectual Capital

As stated above intellectual capital counts for numerous interpretations and definitions. However, after more than a decade of intangibles, we see that definitions are converging. Core-elements within these definitions are:

- Intellectual capital is an intangible resource.
- Competitive advantage is based on intellectual capital.
- Organizational value and value creation is the result of leverage of intellectual capital.
- Main components of intellectual capital are: human resources, organizational resources and relational resources.

Based on the above we define intellectual capital as 'all intangible resources that are available to an organization, that give a relative advantage, and which in combination are able to produce future benefits'.

In order to measure and manage intellectual capital, it is important to be more precise about the different components. One of the main merits of the intellectual capital movement is the development of a so-called taxonomy, a branch of various classes of intellectual capital and their relationships. Comparison of several intellectual capital models (table 1) shows us that many of them are based on a more or less same classification (Stam, 1999; Stam, 2001).

Table 1: Comparison intellectual capital models
(Stam, 1999; Stam, 2001).

	Intangible Assets Monitor (Sveiby)	**Skandia Navigator (Edvinsson)**	**Intellectual Capital Index (Roos)**
Human Resources	Individual's competences	Human Capital	Human Capital
Organizational Resources	Internal Structure	Process Capital	Infrastructure Capital
Relational Resources	External structure	Customer Capital	Relationship Capital

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All three models are based on taxonomy of three[1]. The logic of these models is that intellectual capital is the product of interaction of these three different classes of intangibles: human resources, organizational resources and relational resources (Roos, 2003).

- Human Resources: This first class represents anything related to the people within the organization, the employees, their tacit knowledge, skills, experience and attitude. Human capital per definition represents the most important part of the intellectual capital. It is hard to copy, and thus provides the organization with competitive advantage.
- Organizational Resources: This second class represents the 'tangible' intangibles. Everything of value that stays behind, after the employees have left the organization, like codified knowledge, procedures, processes, goodwill, patents, and culture.
- Relational Resources: This third class represents the relationship with customers, suppliers and other external stakeholders. The value of customer capital is mainly determined by the extent to which an organization is able to maintain confidence in its reputation.

Although the terminology that is used by different academics and practitioners differs, this taxonomy of three could be the main element of an emerging standard. More and more, this classification is used as a starting point for reporting and communicating about intellectual capital.

Intellectual Capital of Nations

Intellectual Capital of Nations is a concept that applies the principles of intellectual capital measurement and management on a macro-economic level, in such a way that it helps to give direction to future economic developments. An intellectual capital of nations report uses a system of variables (indicators) that helps to uncover and manage the invisible wealth and gives insight into the hidden value of a country or region of countries. Indicative for the interest in this subject is the number of presentations held about this topic at international congresses, like McMaster's World Congress on IC in Canada and the IC-Congress in Helsinki.

The concept of intellectual capital can be translated to macro-economic level very easily, because "the stories of our societies and of our nations are mirrors of ourselves and our organizations"(Edvinsson, 2002). The main difference of course is its level of application. Debra Amidon was among the first to recognize the possibilities of applying intellectual capital on a macro-economic level (Amidon, 2001). The most rigorous work in this field until now is done by Nick Bontis. In his work he defines IC of Nations as "the hidden values of individuals, enterprises, institutions, communities and regions that are the current and potential sources for wealth creation" (Bontis, 2004: p.4).

Based on the international developments in this field and our own interpretation of intellectual capital, we would define IC of Nations as *all intangible resources available to a country or region, that give relative advantage, and which in combination are able to produce future benefits*.

The main motivation for measuring the intellectual wealth of a nation is to get insight into the relative advantage of countries. This insight should help to develop policy in order to give direction to future economic developments.

For the measurement and communication of the IC of Nations, we can use the same model as on a firm level. However, on macro-economic the names of the classes of intangibles are usually changed in order to make it applicable on an aggregate level. At national level we usually speak about 'human capital', 'process capital' and 'market capital' (Bontis, 2004).

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- Human capital. This first class represents anything related to people: knowledge, education and competencies of individuals in realizing national tasks and goals. Education is 'the basic building block of human capital' (p.7).
- Process capital. The second class of intangibles on a macro-economic level represents the 'non-human storehouses of knowledge, which are embedded in its technological, information and communications systems as represented by its hardware, software, databases, laboratories and organizational structures' (p.8).
- Market capital. This third class of intangibles represents the intellectual capital embedded in national intra-relationships (p.10). It represents a country's capability in providing an attractive, competitive environment.

The past few years, more and more reports are published to reveal the intellectual capital of a country or region of countries. Examples are the reports about Sweden, Israel, The Netherlands, Australia, The Arab countries, Canada and the United States, Croatia, and New Zealand[2]. Many of these reports are based on the above taxonomy of three. Examples are the reports about Israel, the Arab countries and Croatia:

The Intellectual Capital of the State of Israel

This was an initiative by Edna Pasher and Yogesh Malhorta, on the occasion of the 50th anniversary of the State of Israel in 1999. Aim is to get insight into the main assets, which have provided Israel with a comparative advantage and such high growth rates during its fifty years of existence. Reporting about intellectual capital should help Israel in navigating towards the future. The report is directly based on the (modified) Skandia navigator by Edvinsson. (Pasher, 1999)[3].

National Intellectual Capital Index

In a pilot study in 2003 Nick Bontis calculated the intellectual wealth and development of 10 Arab countries. The main aim of this project was to articulate a system of variables (National Intellectual Capital Index) that helps to uncover the invisible wealth of a country. This United Nations (UNDP/RBAS) study was the first attempt to measure and benchmark intellectual capital development across several nations. (Bontis, 2004). The Arab pilot-study served as a basis for the calculation of the intellectual wealth and development of the United States and Canada[4].

IC report of Croatia

Pulic (2002) has developed the Value-Added Intellectual Coefficient (VAIC) method and has applied it to Croatia (IBEC, 2003). He measured the value of intellectual capital in 21 regions. This study has contributed considerably to the awareness of the importance of intellectual capital in regional economies[5].

Intellectual Capital Monitor

The above examples are all based on the Skandia Navigator. The taxonomy of this model seems to become the standard in reporting about the intellectual capital of nations. Based on this emerging standard we developed an Intellectual Capital Monitor that measures intangibles. However, we have added a second layer of classification in order to stress the importance and difference of past, present and future developments[6]. Each of the three classes of intellectual capital can be looked at, from three different perspectives.

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1. Assets (present) This perspective gives an indication of the present power of an organization/nation. It provides an overview of the current main assets.
2. Investments (future) This perspective gives insight into the future power of an organization/nation. To maintain or strengthen its present power, organizations/nations should invest in its potential continuously.
3. Effects (past) This perspective shows the extent to which the organization/nation has made its intangibles productive during the past period.

The windows and perspectives are combined in a 3 by 3 matrix (see table 2). Implementation of this monitor means filling the fields with appropriate performance indicators. The power of this format appeared to be its simplicity, which makes it easy to implement, communicate and understand.

Table 2: Intellectual Capital Monitor
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	Human capital	Structural capital	Relational capital
Assets			
Investments			
Effects			

A well-defined Intellectual Capital Monitor consists of a combination of indicators from all three classes and all three perspectives. Measures in it self do not provide any information. It is the comparison of measures of one country against another, or of one period against another that give meaning to the figures. Although the intellectual capital is unique and can never be compared objectively, we can improve comparability by using the same conceptual models. We think the taxonomy of three has proven to be a sound basis for measuring and comparing intellectual capital on both firm and national level.

Methodology

It is our aim to value the intellectual capital of the European Union using the Intellectual Capital Monitor. Value can be defined as "*the degree of usefulness or desirability of something. Especially in comparison with other things*"(Andriessen, 2004, p. 11). What is useful or desirable is subjective. It depends on the person that is doing the valuation. Value, like beauty, is in the eye of the beholder. Valuation requires the availability of values (Rescher, 1969). A yardstick is needed to determine what is useful or desirable. Often this yardstick has many dimensions. If we judge the desirability of an apple we will be looking at things like taste, color, scent and tenability. To come to an overall estimation of the value of that apple we need to combine the separate assessments into one valuation. This process is called multidimensional value measurement.

M'Pherson and Pike (2001a), as well as Pike and Roos (2000), have defined the functional requirements for proper multidimensional value measurement. Their method is based on axiology or value theory, which states that value is measurable if the preferences of the beholder are well defined. This is what Pike et al. (2002) call a *hierarchy of value.* Their method requires that this value hierarchy be made explicit for every stakeholder for whom we want to measure value. This includes a description of the stakeholder's objectives. The method assumes that all stakeholders will have the same set of objectives, but that they will differ in the relative importance of each objective (Pike and Roos, 2000). For each stakeholder a set of weights has to be developed.

The next requirement is that these objectives be translated into attributes that can be measured. These attributes must be *necessary* and *sufficient* with respect to the objective. This implies:

- *Completeness*: they cover the full meaning of the objective as understood by the stakeholder
- *Distinctness*: each attribute must carry one meaning only
- *Independence*: changes in the satisfaction of an attribute must not influence any other attributes
- *Minimality*: the attributes should be minimal sets

Furthermore, each attribute should be observable and measurable.

The next set of requirements deals with the process of combining different measurements into one measure. This includes the problem of different units and scales. To solve this problem the authors normalize all measurements by subtracting the minimal value and dividing it by the total length of the scale. The result is a number between zero and one. Zero denotes the threshold of uselessness; one signifies that the maximum value is completely achieved. In practice, this requirement means that for every indicator, a target value or maximum value needs to be defined. This target value acts as a yardstick to interpret the measure.

The authors also define rules for combining various value streams. Here the authors state that when it comes to combining value, the additive rule (1 + 1 = 2) is an exception. Much more common is the so-called *G-rule,* the goal-oriented rule that indicates that achieving a certain goal requires a trade-off between different values. When we combine indicators into one indicator we need to use the correct combinatory rule. The correct combinatory rule follows from the value hierarchy.

We have tried to apply this approach of multidimensional value measurement to the intellectual capital of 15 European states. The beholder from whose view the valuation takes place is the European Council. The objectives with respect to the EU that we used as the basis for our valuation are the objectives of the Lisbon Agenda. We have translated these objectives into attributes and grouped them into human capital, structural capital and relational capital attributes and into assets, investments and effects. In total we have used 38 indicators.

Then we have tried to create a value hierarchy of the beholder based on the Lisbon Agenda and to identify minimum and target values. We have used these minimum and maximum values to normalize all indicators by subtracting the minimal value and dividing it by the total length of the scale. We have used the value hierarchy to find the appropriate combinatory rules. These were used to develop 9 separate indicators for human capital, structural capital and relational capital and assets, investments and effect, using the 3x3 matrix of the IC Monitor. As a next step the three asset indicators were combined into one intellectual capital assets indicator and the same was done with respect to investment and effects. The result was a set of 12 combined indicators as shown in table 3.

Table 3: Combined intellectual capital indicators

	Human capital	Structural capital	Relational capital	Intellectual Capital
Assets	HCA (Human Capital asset indicator)	SCA	RCA	ICA
Investments	HCI (Human Capital investments indicator)	SCI	RCI	ICI
Effects	HCE (Human Capital effects indicator)	SCE	RCE	ICE

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Findings

Indicators for intellectual capital in the EU

On 23-24 March 2000, the European Council held a special meeting to agree a new strategic goal for the Union in order to strengthen its knowledge-based economy. The goal was set "*to become the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion*.[7]" To achieve this goal an overall strategy was formulated, aiming at:

- Preparing the transition to a competitive, dynamic and knowledge-based economy;
- Modernizing the European social model by investing in people and building an active welfare state;
- Sustaining the healthy economic outlook and favorable growth prospects by applying an appropriate macro-economic policy mix.

The Lisbon Agenda gives an indication of the kind of intellectual capital the Union wishes to create in order to become competitive and dynamic. Let us take a closer look at the underlying goals and measures to see if we can find indicators for intellectual capital.

An information society for all

First goal is to ensure that businesses and citizens have access to a world-class communications infrastructure and possess the skills to use it. This means the Union wants to create structural capital taking the form of ICT technology and human capital taking the form of ICT competencies. To measure this intellectual capital the following indicators were chosen:

	Human capital	Structural capital	Relational capital
Assets	• Proportion of active population using a computer for professional purposes that had computer training at the workplace	• Percentage of households who have Internet access at home • Percentage of enterprises who have access to the Internet	•
Investments	•	• Expenditure for IT hardware, equipment, software and other services as a percentage of GDP	•
Effects	•	• Percentage of businesses using the Internet for purchasing and selling	•

Establishing a European Area of Research and Innovation

Second goal is to boost the amount of research taking place within the Union thereby creating explicit knowledge (structural capital) and implicit knowledge (human capital). At the European Council meeting in Barcelona in 2002 it was agreed that, in order to close the gap between the EU and its competitors, overall spending on R&D and innovation should be increased with the aim of approaching 3% of GDP by 2010. Two-thirds of this new investment should come from the private sector.

In addition the Union wants to integrate the research activities at national level thereby creating relational capital. To measure this intellectual capital, we choose the following indicators:

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	Human capital	Structural capital	Relational capital
Assets	• Researchers per thousand total employment	• Number of patent applications to the European Patent Office (EPO) per million inhabitants • Number of patents granted by the United States Patent and Trademark Office (USPTO) per million inhabitants • Number of scientific publications per million inhabitants	• Percentage of international meetings hosted • SMEs involved in innovation co-operation • international outgoing telecom traffic
Investments	•	• Gross domestic expenditure on R&D as % of GDP	•
Effects	•	• Value added of high tech industry, relative to GDP	• Breadth of international scientific collaboration • Percentage of patents with foreign co-inventors • Export of royalty and license fees • Export of services • High tech export

Creating a friendly environment for starting up and developing innovative businesses, especially Small and Medium-Sized Enterprises

This includes removing red tape, lowering the costs of doing business and improving the access to venture capital. This indicates the creation of structural capital. The following indicators were used.

	Human capital	Structural capital	Relational capital
Assets	•	• Enterprise environment indicator from World Economic Forum • Entrepreneurial attitude • Number of days needed to start a new business • Venture Capital Investment as % of GDP	•
Investments	•	•	•
Effects	•	• Birth rate of enterprises	•

Economic reforms for a complete and fully operational internal market

The Union is working on the removal of barriers to trade, the liberalization in the areas of gas, electricity, postal services and transport and the harmonization of regulations. Most of these measures concern increasing the structural capital of the Union as a whole. Therefore we did not select any country indicators, except for a score of each country on implementing EU directives. The more harmonized the laws within the EU, the easier it becomes to do business.

	Human capital	Structural capital	Relational capital
Assets	•	• Number of EU directives not notified	•
Investments	•	•	•
Effects	•	•	•

Efficient and integrated financial markets

The Union also aims for the integration of the financial markets. In addition the Union wants to increase the efficiency of the risk capital markets. This is a form of structural capital. To measure it we have chosen the following two indicators:

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	Human capital	Structural capital	Relational capital
Assets	•	• Venture Capital Investment as % of GDP	•
Investments	•	•	•
Effects	•	• Birth rate of enterprises	•

Coordinating macro-economic policies: fiscal consolidation, quality and sustainability of public finances

The Union aims to coordinate macro-economic policies of its member states and to improve the quality and sustainability of public finances. The quality of public finances can be seen as a form of structural capital that can be measured using the following indicator:

	Human capital	Structural capital	Relational capital
Assets	•	• General government consolidated gross debt as a percentage of GDP	•
Investments	•	•	•
Effects	•	•	•

Education and training for living and working in the knowledge society

The Union considers people to be its main asset. Therefore it aims at a substantial annual increase in per capita investment in human resources thereby lowering the number of 18 to 24 year olds with only lower-secondary level education. Also the EU wants to stimulate life-long learning. To measure this human capital we selected the following indicators:

	Human capital	Structural capital	Relational capital
Assets	• Proportion of total population having completed at least upper secondary education‘ • Proportion of the adult population aged 25 to 64 participating in education and training • Proportion of active population using a computer for professional purposes that had computer training at the workplace • Employment rate • Employment in Knowledge intensive services and High tech & medium –high tech manufacturing	•	• Foreign students as percentage of all students
Investments	• Total public expenditure on education as % of GDP	•	•
Effects	• GDP per hour worked (as % of US)	•	•

More and better jobs for Europe: developing an active employment policy

One of the Union’s core aims is to reduce unemployment thereby increasing the level of productive human capital within the EU. The employment rate is an indicator of human capital assets. To increase this human capital EU governments invest in labor market policy measures

	Human capital	Structural capital	Relational capital
Assets	• Employment rate	•	•
Investments	• Total public expenditure on labor market policy measures as a percentage of GDP	•	•
Effects	•	•	•

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Modernizing social protection and promoting social inclusion

According to the Union, the European social model, with its developed systems of social protection, must underpin the transformation to the knowledge economy. According to the Council this is possible if the system is sustainable in the long-term, ensures that work pays, promotes social inclusion and gender equality, and provides quality health services. So according to the Union, its social system can be an important part of the structural capital of the EU. To measure this form of structural capital we decided to select the following effects indicators:

	Human capital	Structural capital	Relational capital
Assets	•	•	•
Investments	•	•	•
Effects	•	• The share of persons with an equivalised disposable income below the risk-of-poverty threshold • Life expectancy at birth	•

This results in the 38 indicators for measuring the intellectual capital of EU countries, based on the strategy set out by the Lisbon agenda (see Appendix 1).

Finding targets and minimum values

Multidimensional value measurement requires the use of a maximum and minimum for each indicator. The minimum value denotes the threshold of uselessness; the maximum signifies that the maximum value is completely achieved. Maximum and minimum values can be used to normalize each indicator using a value scale between zero and one.
Unfortunately the European Council has not been very specific about the targets of the Lisbon Agenda. The only quantitative target that has been decided upon is the requirement to spend 3% of GNP on R&D. However, the overall goal is to become the *most competitive and dynamic knowledge-based economy in the world.* This led us to the assumption that the target or maximum value of each indicator (except R&D) should be the value of the country in the world that performs best with respect to that particular indicator. In practice we narrowed this down to the highest value of USA, Japan or one of the 15 EU countries. Finding the threshold of uselessness was more difficult. We decided that the minimum value for an indicator was equal to the value of the lowest value of the 15 EU countries.

Value of intellectual capital in the EU

Intellectual capital investments

Figure 1 shows the value of the *investments* in intellectual capital of the 15 EU countries on a scale from zero to one. We made a distinction between investments in human capital and investments in structural capital. We did not find any indicators for investments in relational capital.

The Nordic countries Denmark, Sweden and Finland invest the most in intellectual capital, whereby the focus of Denmark is on human capital and that of Sweden and Finland on structural capital. There is a group of followers that includes Belgium, Germany, France, The Netherlands and Austria. Belgium is second in terms of investments in human capital but its investments in structural capital are much lower, resulting in a fourth place. Finally there is a group of laggards consisting of the UK, Ireland, Portugal, Luxembourg, Italy, Spain and Greece.

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For comparison we have included Japan and the USA. However, it should be noted that in those values the indicator "Total public expenditure on labor market policy measures as a percentage of GDP" is not included. Japan scores high on investments in structural capital but low on investments in human capital. The USA have the highest values on both. The average value of investments of the EU-15 is slightly higher then Japan but substantially lower than the USA.

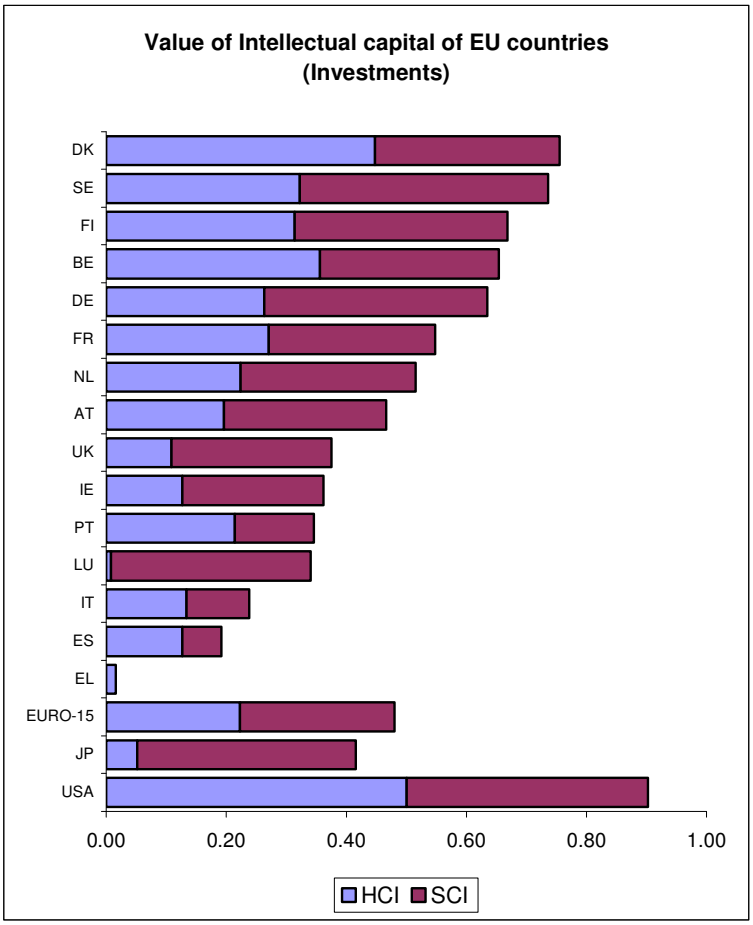

Figure 1: Investments in Intellectual Capital in 2001

Intellectual capital assets

Do these differences in intellectual capital investments lead to differences in the value of intellectual capital assets? Figure 2 shows the value of human, structural and relational capital *assets* of the 15 EU countries. Again Sweden, Denmark and Finland have the highest values. Then there is a big group headed by the United Kingdom that includes Ireland, Austria, The Netherlands, Belgium, Germany, Luxembourg, and France. At the bottom we find the South European countries Spain, Portugal, Greece and Italy. As we would expect there is a strong and significant correlation between *invesstments* in human capital and human capital *assets* (0.470) and *investments* in structural capital and structural capital *assets* (0.686).

Sweden has the highest value on both human capital and structural capital assets, followed by Denmark (human capital) and Finland (structural capital). Denmark has the highest score on relational capital, followed by Austria and Sweden.

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We have included Japan and the USA for comparison. However, for those countries a number of indicators were missing (see appendix 1): For Japan three indicators were missing for human capital, six for structural capital and two for relational capital. For the USA three indicators were missing for human capital, three for structural capital and two for relational capital. Both countries score high on human capital assets, slightly below Sweden, Finland and Denmark. The USA score high on structural capital, behind Sweden and Finland. Japan scores low on structural capital, slightly below France. The average value of intellectual capital assets of the EU-15 is slightly higher then Japan and substantially lower than the USA. This is the same pattern as we saw with intellectual capital investments.

Both Japan and the USA score low on relational capital. From this one might be tempted to conclude that small countries have higher values for their relational capital because they need other countries more then big countries do. We did however not find a significant correlation between population and the value of relational capital assets.

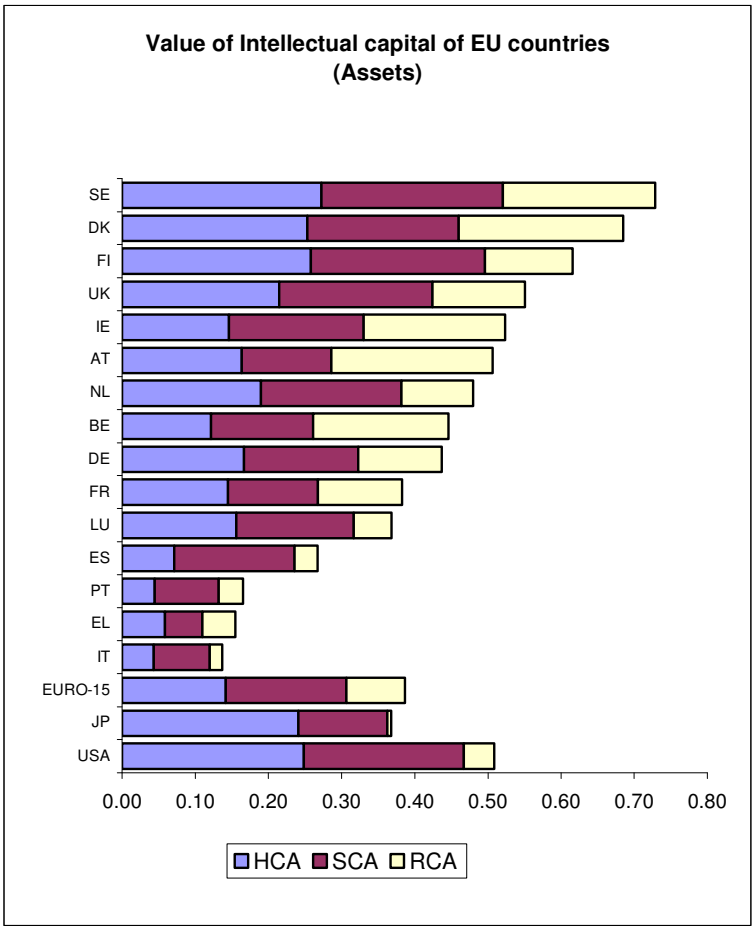

Figure 2: Intellectual capital assets in 2001

Intellectual capital effects

What are the effects of these intellectual capital assets? Figure 3 shows the value of the effects of human, structural and relational capital. The values are rather different from the values of intellectual capital investments and assets. When we measure the value of effects as defined by the Lisbon agenda we find that Germany has the highest score, followed by Luxembourg. Germany has a high score on labor productivity as well as on value added of

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knowledge intensive services, relative to GDP. Luxembourg has the highest score on labor productivity. Germany also scores very high on the use of Internet and absence of poverty. The high scores of Germany and Luxembourg reflect the strong emphasis of the Lisbon Agenda on improving social cohesion. The social items on the Lisbon Agenda are often overlooked but are an integral part of it. This is reflected in the choice of our indicators, including absence of poverty and life expectancy.

Germany and Luxembourg are followed by the UK, The Netherlands and Denmark. Denmark scores very high on structural capital effects, especially the use of Internet, the birth rate of enterprises, and absence of poverty, but low on relational capital effects. A third group consists of Sweden, France, Ireland, Finland, Belgium and Austria. At the bottom we find the same group of countries as we found above: Italy, Spain, Greece and Portugal.

Comparison with Japan and the USA is difficult as the value of their structural capital effects is only based on one indicator (life expectancy). However, the USA have the third highest score on human capital effects and the highest score on relational capital effects. Japan scores low on human and relational capital effects, performing slightly better then Spain and The Netherlands respectively. Because Japan has the highest score on life expectancy and because this is the only Japanese structural capital effect indicator Japan ends in third place.

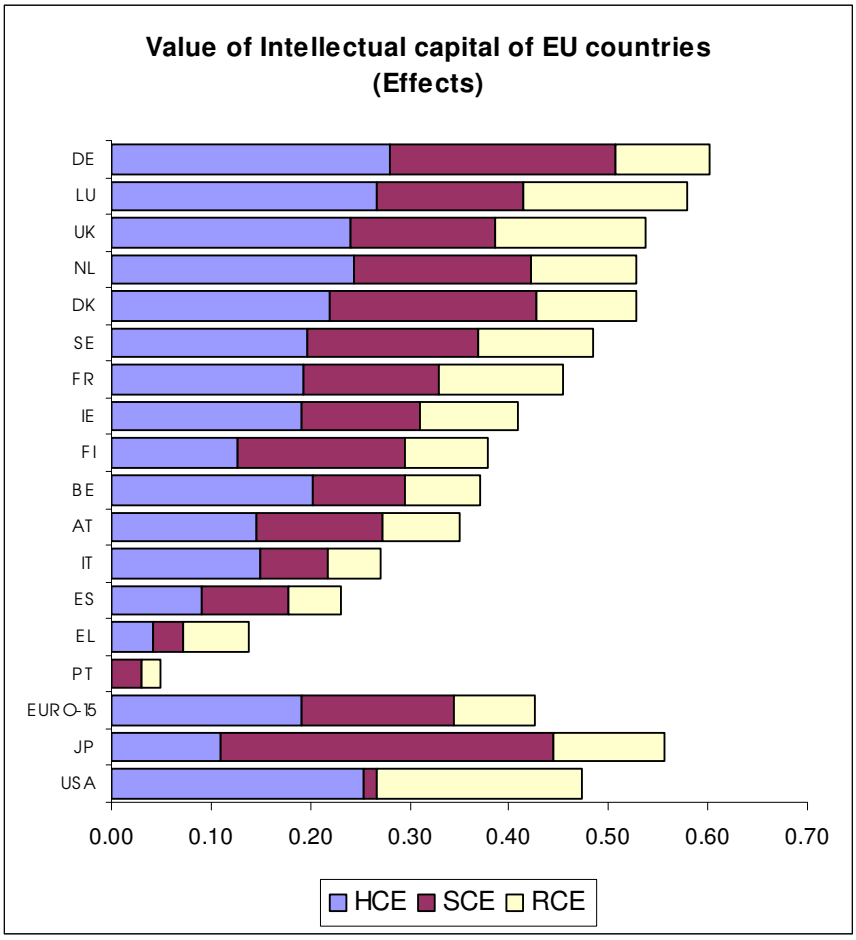

Figure 3: Intellectual capital effects in 2001

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Intellectual capital and GDP

One could think there is a relationship between intellectual capital *investments* and wealth. However, we only found a significant statistical correlation between GDP per capita and investments in structural capital (0.531), not with investments in human intellectual capital. This means that richer countries do not invest relatively (per capita) more in human capital then poorer countries, although they will invest more in absolute terms.

We also did not find a statistical correlation between GDP and intellectual capital *assets*. We did find significant correlations between human capital & relational capital *effects* and GDP per capita. This indicates that the effects we are measuring are not only the result of intellectual capital, but also the effect of wealth. This may explain why Germany and Luxembourg score high on intellectual capital *effects* but much lower on intellectual capital *assets*. We probably need more direct measures of intellectual capital effects to isolate the effects from intellectual capital then the ones derived from the Lisbon Agenda.

Intellectual capital over time

Not all data was from the same year. The average year of the 38 indicators was 2001. To see what the development was in intellectual capital we searched for data from earlier years. We aimed for data from 1995, however because of unavailability of data we did not succeed for all indicators. As a result the average year for the earlier indicators turned out to be 1999 (see appendix 1). To calculate the value of the intellectual capital for 1999 we used the same value scale as constructed for 2001. This means that the minimum and maximum values from 2001 were used for 1999. This allowed us to measure the development in value between 1999 and 2001.

Figure 4 shows the development in the value of intellectual capital *investments* between 1999 and 2001. Most countries have increased the value of their intellectual capital investments, except for Ireland, Finland, the UK, Greece and the USA. Ireland and Finland have cut back significantly on expenditure on education, while Ireland has also lowered expenditure on labor market policy measures. In the UK, Greece and the USA there has been a lowering of investments in ICT between 2000 and 2003. For Germany (0.16), Italy (0.13), Spain and France (0.12) the growth in the value of intellectual capital investments has been the highest. These countries have substantially increased investments in their intellectual capital. Europe as a whole has increased the value of its intellectual capital investments with 0.09 between 1999 and 2001.

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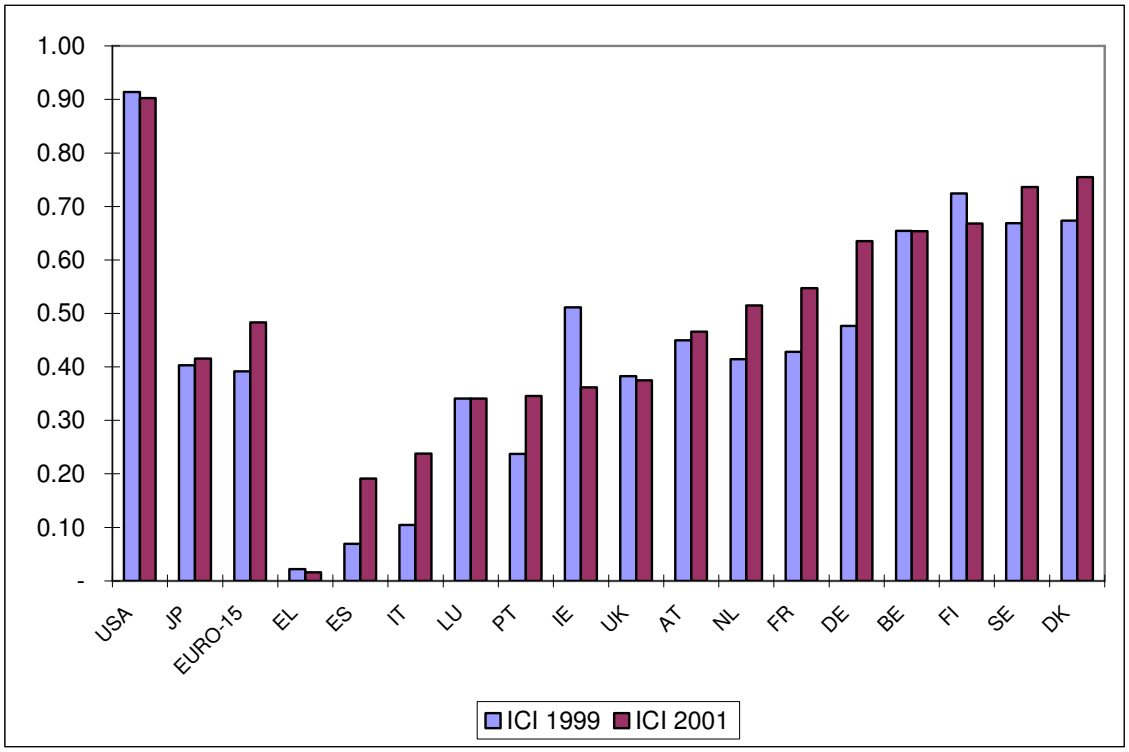

Figure 4: Growth in the value of intellectual capital investments between 1999 and 2001

Figure 5 shows the development in value of intellectual capital. All countries have increased the value of their intellectual capital assets except for the USA. In the USA employment, the number of scientific publications and the number of patents has decreased, which explains a decrease in value of –0.005. Sweden has managed to achieve the highest growth in value (0.11). This is largely due to an increase in human and relational capital. Human capital has increased as a result of progress in lifelong learning, number of researchers and employment. Relational capital has increased as a result of a rise in the number of foreign students and international outgoing telecom traffic. Second highest growth in value has been achieved by Finland and Ireland. Finland has almost doubled its number of researchers between 1995 and 2001. Its employment rate has increased by 6.1% between 1995 and 2003 and the number of foreign students has increased by 38% between 1998 and 2002. In Ireland employment has risen with 10% and the international outgoing telecom traffic has risen with 240% between 1995 and 1999, probably as a result of the growth in number of international call centers. Europe as a whole has increased the value of its intellectual capital assets with 0.05 between 1999 and 2001.

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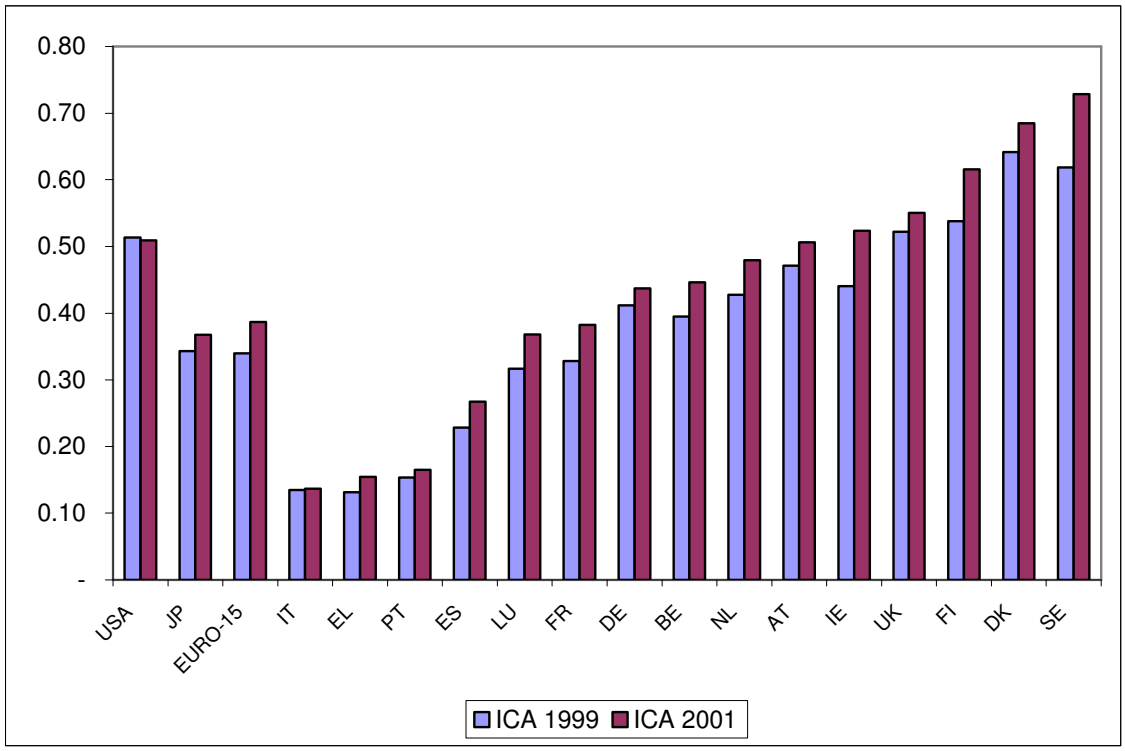

Figure 5 Growth in the value of intellectual capital assets between 1999 and 2001

Figure 6 shows the development in the value of intellectual capital *effects*. The biggest progress in value has been achieved by Denmark (0.10) mainly because of a substantial growth in relational capital effects: the export of services in Denmark rose from 16% of all exports in 1995 to 27% in 2002, and there was a substantial growth in the number of countries it collaborated with writing scientific publications. Denmark is followed by France (0.08) and Belgium (0.07). Portugal is the only country where the value of intellectual capital effects has decreased, due to a relative decrease in labor productivity, compared with the USA. The growth of Japan is biased because the structural capital effect indicator for Japan only includes life expectancy, whose value has risen by 67%. In addition the value of the indicator royalty and license fees has grown with 113%. Europe as a whole has increased the value of its intellectual capital effects with 0.06 between 1999 and 2001.

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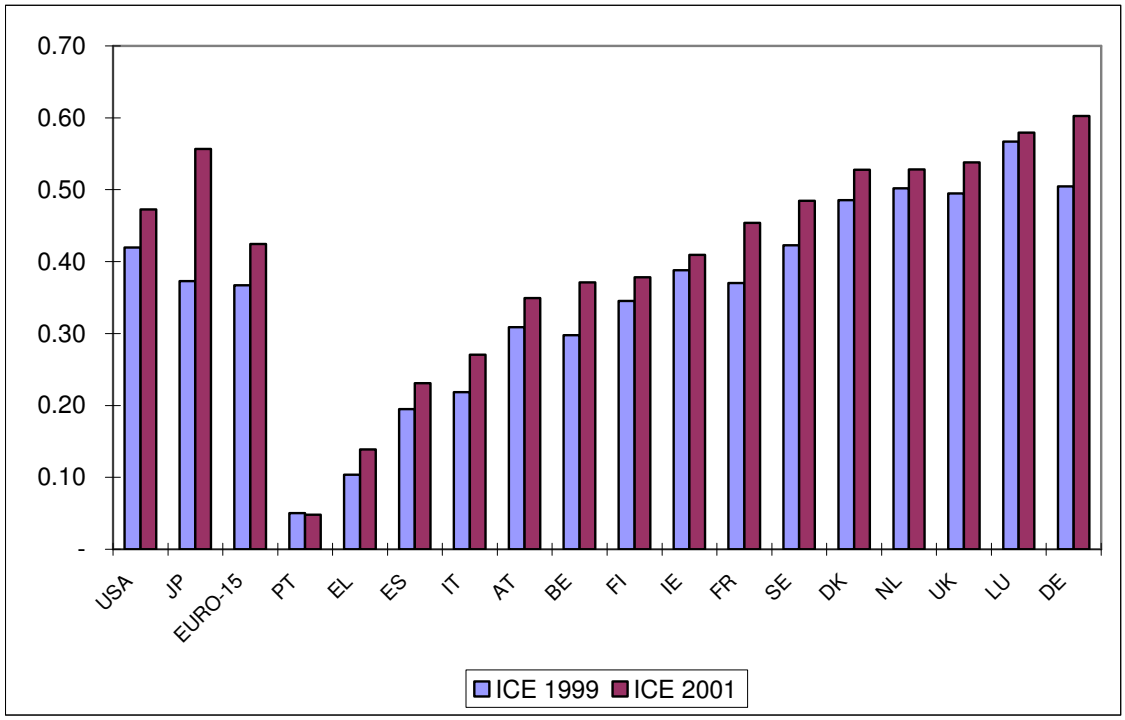

Figure 6 Growth in the value of intellectual capital effects between 1999 and 2001

Conclusions

Conclusions about multidimensional value measurement

What can we learn from applying M'Pherson and Pike's (2001) requirements for multidimensional value measurement to the valuation of the intellectual capital of the European Union? Let us look at each of the requirements one by one:

Derive indicators from the stakeholder's objectives

We treated the Lisbon Agenda as a set of objectives of our stakeholder, the European Council. We managed to come up with a list of 38 indicators that reflected those objectives. Using a stakeholder's objectives to determine indicators seems to work fine.

Make sure the indicators are complete, distinct, independent and minimal

This turned out to be problematic. First of all, the requirement is that the indicators cover the full meaning of the objective of the stakeholder. However, the meaning of the European Council was in many cases far from clear. It is therefore difficult to judge whether the indicators are complete.

We believe there is even a more fundamental problem when it comes to the requirement of completeness applied to the social world of human interaction, as opposed to the natural world of physical objects. M'Pherson and Pike's theory is based on measurement theory coming from systems engineering and physics. It is used to do measurements in the physical world where the laws of physics are applicable and where clearly defined concepts refer to observable manifestations of physical objects. When we try to measure the intellectual capital of a nation we try to measure attributes of human behavior (investments, activities,

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effects) that only can be observed indirectly. We believe these attributes only exist after we have constructed them using concepts like intellectual capital or structural capital. As Van Aken (1996) puts it: "The social world ontologically is the accumulation of people's internalized images of that world" (p.16, translated by D. Andriessen). Consequently, the social world can be described in an almost infinite number of ways (Andriessen, 2004). One can therefore never say with any degree of certainty that a set of indicators completely describes a particular attribute of this social world. This makes it also impossible to judge whether a set of indicators is the minimal set.

The requirement of distinctness turned out to be difficult to fulfill too. Indicators can refer to different attributes. For example, the number of patents can be seen as an indicator of the stock of knowledge within a particular country and thereby as an indicator for structural capital assets. It can also be seen as the output of the R&D processes of a country and thereby as an indicator for structural capital effects. It can even be seen as the output of all the researchers in a country and thereby as an indicator for human capital effects. Again this problem can be traced back to the problem of the nature of the social world. Weick (1995) referred to this problem as the equivocality of the social world.

In the complex social world many things correlate. Therefore the requirement of independence is almost never fulfilled. For example, the Lisbon Agenda speaks of investments in education and in labor market policy measures. Both can be seen as investments in human capital. However, both measures are statistically correlated (0.592) significant at the 0.05 level. The requirement of independence does not allow us to combine them into a multidimensional human capital investment indicator. When we combined the 38 indicators into 9 intellectual capital indicators (see table 3) there was a total of 119 possible correlations of which 48% was correlated significantly at the 0.05 level.

Normalize each indicator and create a value scale

This requirement forced us to define a minimum and maximum value for each indicator from the viewpoint of the stakeholder. However, the European Council did not set explicit numeral targets (except for R&D investments), nor did it indicate what was the 'threshold of uselessness'. As it is impossible to question the Council about this issue, we were forced to use a general rule: the maximum value is the value of the country that has the highest score on the particular indicator (which is justified by the fact that the Council wants the European economy to become the most dynamic and competitive economy *in the world*), and the threshold value is the value of the country that has the lowest score. We expect that in most cases of measuring the value of the intellectual capital of a nation the stakeholder (in many cases the government) can't be questioned about these issues.

Combine the indicators using the appropriate combinatory rule

The combinatory rules are based on the value hierarchy of the stakeholder. This hierarchy expresses the preferences of the stakeholder with respect to the relative importance of the various objectives and underlying indicators. However, the European Council did not state what its preferences were. This forced us to create our own hierarchy. For matters of transparency we choose to make every objective and indicator equally important and to apply the additive combinatory rule.

Conclusions about multidimensional value measurement

These findings lead us to the following conclusions about applying the requirements for multidimensional value measurement to the valuation of the intellectual capital of nations. First, in the context of a nation or a group of nations the obvious stakeholder to choose is a political body like a national government or the European Council. However, in most cases

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this stakeholder cannot be questioned about objectives and their relative importance. As a result, the researcher needs to apply a number of assumptions with respect to the value hierarchy of the stakeholder.

Second, a number of requirements in principle cannot be fulfilled when this theory is applied to the social world. Social phenomena like 'intellectual capital' are constructions of human beings, not objective phenomena waiting to be observed. They have no objective referent but can only be described indirectly using metaphors. These phenomena are not only abstract but also complex and interrelated. As a consequence, the requirements of completeness, distinctness, independence, and minimality cannot be fulfilled. We need more theoretical research on ways to do multidimensional value measurement in the social world.
This does not mean that multidimensional value measurement theory is useless. It can function as a useful guideline for combining indicators to measure value. Nor does it mean that multidimensional value measurement is impossible. However, the results of a multidimensional value measurement should be interpreted with care.

Conclusions about the intellectual capital of the EU

Before drawing any conclusion about the intellectual capital of the EU, we have to make some restrictions. First of all the restriction of the methodology we used, as described in the previous paragraph. Another restriction, not related to the methodology, is the limited availability of data. Aim of this report was to monitor the progress of the Lisbon Agenda of March 2000. The data available, however, on average does not go further than 2001. This means that it is impossible to identify effects of Lisbon policy measures. In this sense it would be better to consider this report as a base measurement for monitoring the Lisbon agenda.

Value of intellectual capital of EU-countries

The Nordic countries (Sweden, Denmark and Finland) perform considerably better than the others. The value of their intellectual capital assets is substantially higher than the value of a large group of followers (Belgium, The Netherlands, Luxemburg, Germany, France, Austria, United Kingdom and Ireland). Finally a group of laggards (Italy, Spain, Greece and Portugal) follows at considerable distance. In general we can conclude that the outcome of this research is consistent with comparable research. For example, the top 3 of most competitive European countries in the ranking of the World Economic Forum in 2004 is Finland, Sweden and Denmark.

Noticeable is that these three groups are geographically divided. The leading group consists of northern European countries (>54˚ latitude), the group of followers consists of middle European countries (45˚-54˚ latitude). The laggards are all southern European countries (<45˚ latitude). A possible cultural explanation for this could be that the Nordic countries throughout history have developed an attitude of looking at the future. In order to survive the long and severe winters they always had to plan their resources carefully.

If we look at intellectual capital assets we see that the leading group has considerably higher value of human capital *and* structural capital and laggards have considerably lower value of human capital *and* structural capital. This supports the idea that human capital and structural capital are interdependent and mutual enhancing factors. They "go together" in the creation of intellectual capital. This is what Edvinsson (2002) calls the multiplier effect. This is further supported by a strong and significant correlation between human capital and structural capital assets (0.806). However, we did not find a significant correlation between relational capital assets and other types of intellectual capital.

The strength of the Nordic countries mainly comes from their high values of intellectual capital assets and investments. If we look at the value of their effects, we see a different order, where Sweden, Denmark and Finland fall to a respective 5th, 6th and 9th place. So high

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values of investments and of present assets do not automatically lead to high productivity. It seems that intellectual capital investments and assets are necessary, but not sufficient to make intellectual capital productive. One possible explanation is that there is a time-lag between investments, the creation of assets and the productivity of those assets.

Comparison of the value of intellectual capital over time (1999 and 2001) shows growth for almost all countries from all perspectives (investments, assets, effects). Almost all countries are increasing the value of their intellectual capital investments to become more knowledge-intensive. As a result almost all countries have become more intellectual capital intensive. This is a clear sign that the knowledge economy is growing.

The intellectual capital of the EU

The goal of the EU is 'to become the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion'. To reach this goal Europe has set goals for investments in intellectual capital. These investments must lead to the best intellectual capital assets in the world that will bring Europe economic growth. However, if we compare the EU as a whole with the USA and Japan we see that the value of its intellectual capital assets is considerably lower then the USA and slightly higher than Japan. This means that Europe, in 2001, still had a long way to go. In order to investigate the impact of the Lisbon Agenda this research has to be repeated in the future. The main question will then be whether the increased intellectual capital assets and -investments resulted in an increase in the value of intellectual capital effects.

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Appendix 1: Overview of indicators

Indicator	Source	Year 1	Year 2	Missing countries
HCA_1: Proportion of total population having completed at least upper secondary education	EUROSTAT, OECD	2000	2002	-
HCA_2: Proportion of active population using a computer for professional purposes that had computer training	European Commission	2001	2002	JP, USA
HCA_3: Proportion of the adult population aged 25 to 64 participating in education and training	EUROSTAT	2001	2003	JP, USA
HCA_4: Researchers per thousand total employment	OECD	1995	2001	LU
HCA_5: Employment rate	EUROSTAT	1995	2003	-
HCA_6: Employment in Knowledge intensive services and High tech & medium –high tech manufacturing	EUROSTAT	2002	2002	JP, USA
HCI_1: Total expenditure on education as % of GDP	OECD	1995	2001	-
HCI_2: Total public expenditure on labor market policy measures as % of GDP	EUROSTAT	1999	2002	JP, USA
HCE_1: GDP per hour worked (as % of US)	OECD	1999	2002	EURO-15 ('99)
HCE_2: Value added of knowledge intensive services, relative to GDP	EUROSTAT	2000	2000	EL, JP, USA
SCA_1: Percentage of households who have Internet access at home	EUROSTAT	2001	2003	JP
SCA_2: Percentage of enterprises who have access to Internet	EUROSTAT	2001	2003	USA
SCA_3: Number of patent applications to the European Patent Office (EPO) per million inhabitants	EUROSTAT	2000	2002	-
SCA_4: Number of patent applications to the United States Patent and Trademark Office (USPTO) per million inhabitants	EUROSTAT	1999	2001	-
SCA_5: Number of scientific publications per million inhabitants	National Science Foundation	1995	1999	-
SCA_6: Enterprise environment indicator from World Economic Forum	World Economic Forum	2004	2004	JP
SCA_7: Entrepreneurial attitude 1	Flash Eurobarometer	2001	2001	JP
SCA_8: Entrepreneurial attitude 2	Flash Eurobarometer	2001	2001	JP
SCA_9: Number of days needed to start a new business	Worldbank	2001	2001	LU, EURO-15
SCA_10: Venture Capital Investment as % of GDP	European commission	2002	2002	LU
SCA_11: Number of EU directives not notified	European commission	2004	2004	JP, USA
SCA_12: General government consolidated gross debt as a percentage of GDP	EUROSTAT, Statistics Sweden	2003	2003	-
SCI_1: Gross domestic expenditure on R&D as % of GDP	EUROSTAT	1999	2001	-
SCI_2: Expenditure for IT hardware, equipment, software and other services as a percentage of GDP	EUROSTAT	2000	2003	-
SCE_1: Percentage of businesses using the Internet for purchasing and selling	EUROSTAT	2001	2001	BE, FR, IE, USA, JP
SCE_2: Birth rate of enterprises	EUROSTAT	1998	2000	AT, DE, EL, EURO-15, FR, IE, USA, JP
SCE_3: The share of persons with an equivalised disposable income below the risk-of-poverty threshold	EUROSTAT	1995	2001	JP, USA
SCE_4: Value added of high tech industry, relative to GDP	EUROSTAT	1998	2000	JP, USA
SCE_5: Life expectancy at birth	OECD	1995	2001	-
RCA_1: Percentage of international meetings hosted	Union of International Associations	2003	2003	LU
RCA_2: SMEs involved in innovation co-operation	EUROSTAT	1996	1996	JP, USA
RCA_3: Foreign students as percentage of all students	OECD	1998	2002	BE, EL, EURO-15, LU, NL, PT
RCA_4: international outgoing telecom traffic	EUROSTAT	1995	1999	LU, JP, USA
RCE_1: Breadth of international scientific collaboration	National Science Foundation	1986	1999	EURO-15, LU
RCE_2: Percentage of patents with foreign co-inventors	OECD	1999	1999	-
RCE_3: Export of royalty and license fees	EUROSTAT	1995	2002	DK
RCE_4: Export of services	EUROSTAT	1995	2002	-
RCE_5: High tech export	EUROSTAT	2001	2001	-

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Appendix 2: Abbreviations

AT Austria
BE Belgium
DE Germany
DK Denmark
EL Greece
ES Spain
FI Finland
FR France
IE Ireland
IT Italy
JP Japan
LU Luxembourg
NL The Netherlands
PT Portugal
SE Sweden
UK United Kingdom
USA United States

Notes

1 Sveiby was probably the first to use this family of three in *The New Annual Report*, 1988.
2 For a more detailed comparison of the reports of Australia, Israel, New Zealand and The Netherlands see: Cees Schouten, *De Kenniseconomie Gekend*, Amsterdam, 2004
3 www.pasher.co.il
4 www.bontis.com
5 www.vaic-on.net
6 The Intellectual Capital Monitor could be seen as a combination of Edvinsson's Skandia Navigator and Sveiby's Intangible Assets Monitor.
7 Presidency Conclusions Lisbon European Council 23 And 24 March 2000. Available at: http://ue.eu.int/ueDocs/cms_Data/docs/pressData/en/ec/00100-r1.en0.htm

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