

Intellectual Capital Index

Relationships between Intellectual Capital and Value Creation Capability within Italian Regions

Antonio Lerro¹; Daniela Carlucci²; Giovanni Schiuma³

¹ LIEG – DAPIT - University of Basilicata, DET – University of San Marino, lerro@unibas.it

² LIEG – DAPIT - University of Basilicata, carlucci@unibas.it

³ LIEG – DAPIT - University of Basilicata, CBP Cranfield School of Management, UK
schiuma@unibas.it

Abstract

This paper investigates relationships between Intellectual Capital (IC) and value creation capability within local systems as well as the direct and indirect modalities through which IC supports and feeds the value creation dynamics. In accordance with Resource-Based View (RBV), Competence-Based View (CBV) and Knowledge-Based View (KBV) and through the theoretical model of the ‘Knoware Tree’, we provide an Intellectual Capital Index as an aggregated indicator for the evaluation of IC within local systems, and as a conceptual tool to inquire the links between knowledge resources and local systems development. Selected Italian Regions have been chosen as the empirical context of the research and ISTAT data has been used as the data source. The empirical evidence obtained via the statistical analysis confirms the existence of positive relationships between the endowments and the use of IC by the Italian Regions and the value creation capabilities of such regions expressed in aggregated form through a set of synthetic indicators. Moreover, the analysis allows to assert the existence of direct and indirect modalities through which IC sustains and seeds the value creation dynamics within the local systems.

Keywords

intellectual capital, value creation, local regional systems, knoware tree.

Introduction

In the complex and turbulence economic and productive scenario, the competitiveness of firms and systems of firms is not based only on the traditional tangible resources and financial capital, but sustainable and durable competitive advantage results increasingly from the possession and the use of knowledge resources (Delios and Beamish, 2001; Drucker, 1993; Itami and Roehl, 1987; McGaughey, 2002; Nahapiet and Ghoshal, 1998; Nonaka and Takeuchi, 1995; Nonaka and Teece, 2001, Prahalad and Hamel, 1990; Steward, 1997; Teece *et al.*, 1997, 2000).

On a theoretical point of view, on the base of the research contributions elaborated by the Resource-Based View (Barney, 1991; Drucker, 1959; Penrose, 1959; Peteraf, 1993; Rumelt, 1984; Wernerfelt, 1984), the Competence-Based View (Davenport and Prusak, 1998; Prahalad and Hamel, 1990) and the Knowledge-Based View (Nonaka, 1994; Nonaka and

Takeuchi, 1995), new conceptualisations and interpretative frameworks have been introduced into the economic and management literature to analyse and evaluate the importance of the knowledge resources.

In particular, in the last decade, different contributions have analysed the role and the relevance of the Intellectual Capital (IC) into the value creation capabilities of the organizations (Andriessen, 2005; Brooking, 1996, 1997; Edvinsson and Malone, 1997; Kaplan and Norton, 2004; Marr and Schiuma, 2001; Romer, 2003; Roos and Roos, 1997; Schiuma, 2004; Sullivan, 1998; Sveiby, 1997; Teece, 2000).

More recently, the economic and management literature is increasingly inquiring the role and the relevance of knowledge resources and IC into the value creation capabilities of local systems, i.e. clusters, regions, and knowledge cities (Bontis, 2004; Doeringer and Terkla, 1995; Edvinsson, 2002; Edvinsson and Bounfour, 2004; Edvinsson and Stenfelt, 1999; Hassen-Bauer and Snow, 1996; Jacobs and De Man, 1996; Rosenfeld, 1996, 1997; Parkinson, 2005; Saxenian, 1994; Schiuma *et al.*, 2005; Tallman *et al.*, 2004).

Regardless of the different contributions, one needs to collect empirical evidence to be able to prove the existence of meaningful relationships between endowment and use of IC and value creation capability. To this purpose, we developed an empirical explorative research. The relevance of IC within the value creation dynamics can be inquired in different typologies of organizational systems, such as the single firm, a cluster of firms, a local system; for the explorative purposes of the research we focalised our attention on a specific local system, the Italian Regions one. In particular, the following research issues have been inquired: I) Which are the IC dimensions at the basis of the value creation dynamics within Italian Regions? II) Do meaningful relationships between endowment and use of IC by the Italian Regions and their capability to create value exist? III) Which are the components of IC more relevant in order to sustain and seed the value creation dynamics? In order to pursue these research aims the information extracted by ISTAT data base were used.

Essentially, the research is divided in five sections. In the first section, on the base of a literature review, the importance of the knowledge resources and the concept of Intellectual Capital as key-factors for the local development is stressed. In the second section, the “Knoware Tree” (Schiuma *et al.*, 2005) as an identification and analysis knowledge resources model is provided. This model allows defining, mapping and evaluating the intellectual capital at the base of the value creation and of the competitiveness both of mono-dimensional organisational systems (firms and institutions) and multi-dimensional ones (systems of firms and local systems). The definition of the “Knoware Tree” is based on the various approaches proposed by the economic and management literature for the evaluation of the intellectual capital and intangible resources (Edvinsson e Malone, 1997; Kaplan e Norton, 1992, 2004; Hudson, 1993; Marr and Schiuma, 2001; Romer, 2003; Roos *et al.*, 1997, 1998; Stewart, 1997; Sullivan, 1998; Sveiby, 1997; Teece, 2000).

However, in order to provide a more detailed model, the Knoware Tree defines the main categories and sub-categories of the intellectual capital that, getting over the simple classification of the intangible resources provided by other model of analysis, can drive management into the identification and evaluation of knowledge assets. In particular, the “Knoware Tree” assumes that the intellectual capital of the organisational systems can be

analysed according to four dimensions of analysis: Wetware, Netware, Hardware and Software. They reflect the role and the relevance of the human resources, of the relational resources and of the structural tangible and intangible components of the organisational systems into the dynamics of value creation.

In order to evaluate the endowments and the use of the intellectual capital by the Italian regions, in the third section a system of indicators and metrics, defined on the base of the dimension of analysis of the “Knoware Tree” and built using official data referred to the year 2002 provided by the National Statistic Institute – ISTAT – is presented. More specifically, the set of the indicators and metrics defined to evaluate the different dimensions of intellectual capital as identified by the “Knoware Tree” as well as the methodology to gather, select and elaborate the data in order to reach to the evaluation of the endowments and the use of knowledge resources by the Italian region is presented. The data collected have allowed to calculate a concise index, named Intellectual Capital Index, able to summarize in a unique value the endowments and the use of the intellectual capital by each Italian region. Then, in order to draw the correlation between endowment and use of the intellectual capital and the capability of value creation, expressed in an aggregated form through a set of indicators, analysis of statistical correlation of the data have been developed. In the fifth section, the results obtained by the research are discussed and some relevant academic, managerial and industrial policy implications are highlighted. Finally, some limitations are presented and further and deeper researches on the theme of the relationships between intellectual capital and regional value creation capabilities are suggested.

About the results of the research, the empirical evidence seems to confirm the main hypothesis in according to which exists a positive correlation between the endowments and the use of the intellectual capital by the Italian regions and the value creation capabilities of such regions. Moreover, the statistic correlation we obtained contribute to better the actual level of knowledge about how to identify, measure, understand and analysis of the role and the importance of intangible resources into the regional value creation dynamics, concurring to the resolution of the Bounfour (2005) and Wilcox King and Zeithaml (2003)’ questions about the need of getting over tools of measure of the knowledge and intangible resources often simplistic or unfit.

Intellectual capital and local systems

Traditionally, drivers of organizational performance have been traced in different ways. Starting from the first contributions of Marshall (1890), Penrose (1959) and Drucker (1959), the role of knowledge resources have been increasingly considered the key-value drivers for organizational performance improvement.

On the base of these pioneering works, new theories of strategic management such as the Resource-Based View (Barney, 1991; Peteraf, 1993; Rumelt, 1984; Wernerfelt, 1984), the Competence-Based View (Davenport and Prusak, 1998; Prahalad and Hamel, 1990) and the Knowledge-Based View (Nonaka and Takeuchi, 1995), during the time, have introduced in the economic and managerial literature new theoretical plannings, frameworks, techniques and tools finalized to examine, in direct or indirect way, the increasing importance of the knowledge resources for organizational performance improvements.

More recently, in order to a better understanding of the role of the knowledge resources and to render less abstract and more operative their relevance, the concept of Intellectual Capital (IC) has been introduced and developed by different scholars. It can be considered a conceptualization of the cognitive and intangible resources that answers in a better way to the managerial needs to have interpretative and operative tools for their identification and evaluation.

However, although different scholars have analysed the role and the relevance of IC for the value creation capabilities of the firms, it is possible to say that the economic and management literature has referred to IC with different and often not shared definitions (Tab.1).

Table 1. Intellectual Capital definitions

AUTHORS	INTELLECTUAL CAPITAL
Stewart (1991)	It is defined as the sum of everything everybody in your company knows that gives you a competitive edge in your marketplace.
Hall (1992)	It can be classified as particular "assets" and "skills"
Hudson (1993)	It is defined as a personal asset of individuals and a combination of genetic inheritance, education, experience and attitude about life and business.
Edvinsson and Sullivan (1996)	It is knowledge that can be converted into value.
Sveiby (1997)	It consists of three categories of intangible assets: internal structure, external structure and human competence.
Roos and Roos (1997)	It is composed by human capital, business process capital, business renewal and development capital, customer relationship capital.
Roos et al. (1997)	It is composed of a thinking part, i.e. the human capital, and a non-thinking part, i.e. the structural capital.
Edvinsson and Malone (1997)	It is composed by human capital and structural capital. It involves applied experience, organizational technology, customer relationships and professional skills that provide an organization with a competitive advantage.
Brooking (1996; 1997)	It is composed by market assets, human centered assets, intellectual property assets and infrastructure assets.
Bontis et al. (1999)	It is a concept that classifies all intangible resources as well as their interconnections.
Lev (2001)	It is the source of future benefits which are generated by innovation, unique organizational designs, or human resource practices.
Marr and Schiuma (2001)	It is composed of all knowledge-based assets, distinguished between organizational actors (relationships, HR) and infrastructure (physical and virtual).

More recently, the economic and management literature is increasingly inquiring the role and the relevance of knowledge resources and IC into the value creation capabilities not only of the firms, but also of local systems, i.e. clusters, regions, and knowledge cities (Bontis, 2004;

Doeringer and Terkla, 1995; Edvinsson, 2002; Edvinsson and Bounfour, 2004; Edvinsson and Stenfelt, 1999; Hassen-Bauer and Snow, 1996; Jacobs and De Man, 1996; Rosenfeld, 1996, 1997; Parkinson, 2005; Poyhonen and Smedlund, 2004; Saxenian, 1994; Schiuma *et al.*, 2005; Tallman *et al.*, 2004).

In particular, as argued by Malhotra (2001), it seems that regions and nations are the territorial contexts that are paying major attention to their IC development, as highlighted by different studies conducted in particular within Arab region (Bontis, 2004), Croatia (Pulic, 2005), Sweden (Rembe, 1999), Israel (Pasher, 1999).

This new interest, however, grounds on consolidated roots of the literature, since knowledge, the local values and their diffusion, individual and social behaviors, inter-personal and inter-firm relationships, skills and know-how, social and institutional actors, and, more generally, all the positive externalities provided by the development of a network of stakeholders, have been traditionally considered and represented a fundamental resource and a key success factor in local systems (Albino and Schiuma, 2003; Becattini, 1987; Camagni, 1991; Marshall, 1920; Rosenfeld, 1997; Saxenian, 1994).

However, the literature, as already underlined by some scholars (Bontis, 2004; Bounfour and Edvinsson, eds, 2005) is appeared often confused and rarely has focalised the attention both on empirical researches finalized to explore and test the relationships among cognitive resources, IC, value creation and sustained competitive advantage; and on the managerial implications linked to the direct and indirect modalities through which such resources can support the multidimensional systems performance improvement. In other terms, it is possible to state there is still a lack of systematic approaches and tools designed for the identification, analysis, classification and management of the knowledge resources within local systems. Moreover, both theoretical literature and empirical studies about IC and cognitive resources within multidimensional systems have highlighted some structural and contents lacks referred to the models of identification, analysis and evaluation of such resources.

In order to get over these limitations, the Knoware Tree has been developed as detailed interpretative framework finalized to the identification, analysis and evaluation of the cognitive resources and IC at the basis of the value creation capabilities and the competitiveness of the multidimensional systems (Schiuma *et al.*, 2005). In particular, the Knoware Tree adopts a cognitive approach for the analysis and evaluation of IC (Marr and Schiuma, 2001).

The model of the “Knoware Tree” shares the basic hypothesis of the various approaches proposed by the economic and management literature for the identification and the evaluation of IC and knowledge and intangible resources (Edvinsson e Malone, 1997; Kaplan e Norton, 1992, 2004; Hudson, 1993; Marr e Schiuma, 2001; Romer, 2003; Roos *et al.*, 1997, 1998; Stewart, 1997; Sullivan, 1998; Sveiby, 1997; Teece, 2000): these approaches, traditionally, identify three main categories of IC, such as “Human Resource”, “Organisational Resource” and “Structural / Relational Resource”

Although the definition of these categories can be particularly useful to drive the management into the comprehension of the cognitive components of the organizational system, it does not allow having an analytical tool for the analysis. It needs to go over the mere identification and

classification of three categories and identify in a more detailed way the components of IC of the organizational systems in order to drive and support the management and the policy-makers first of all about the evaluation of the cognitive resources and then the definition, implementation and control of effective management process and initiatives based on them. The Knoware Tree faces this need providing a classification based on four categories of analysis: Wetware, Netware, Hardware and Software. They reflect the role and the relevance of the human resources, of the relational resources and of the structural tangible and intangible components sustaining the dynamics of value creation of the organizational systems (Fig. 1).

In particular, on a theoretical point of view, the Wetware can be essentially defined the group of the real and potential knowledge resources which are enjoyed by a local system, in terms of know-how, formal and informal competences, skills owned and embodied into the human resources operating within an organizational system.

The Netware can be defined as the group of the intangible and tangible assets of a local system linked to the number and the width of the networks created and used by its actors and finalised to the increase of the competitive capabilities of the local system and functional to the satisfaction of their wants. Such network can be internal to the local system and comprise then the relationships among firms, institutions and all the actors operating in it, or external to the local system and comprise the relationships among firms, institutions and actors operating in different contexts.

The Hardware includes all that assets relevant for the development, acquisition, management and diffusion of knowledge but tangible in nature, as well as all the components linked to structural features of an organizational system. Within this category it is possible to consider two sub-categories: the physical infrastructures and the technological infrastructures. The first comprises both the transport infrastructures, which endowment often represents a pre-condition for the transfer of tangible and intangible assets from and towards the local system; and territory infrastructure, linked to the number and the features of the urban contexts and the territory properties. The technological infrastructures include all that assets at the basis of the production and distribution of wealth and social wellness within a local system.

Finally, the Software comprises essentially the social capital of a local system, its socio-cultural values and the attention about the environmental sustainability and the quality of the life. For this, within a local system it results relevant to consider the creation and the development of inter-personal relationships not formalized, the tacit knowledge stratified and used by its actors, the socialization processes, the sharing of values, ways of thinking and acting, life styles, implicit behavioural codes.

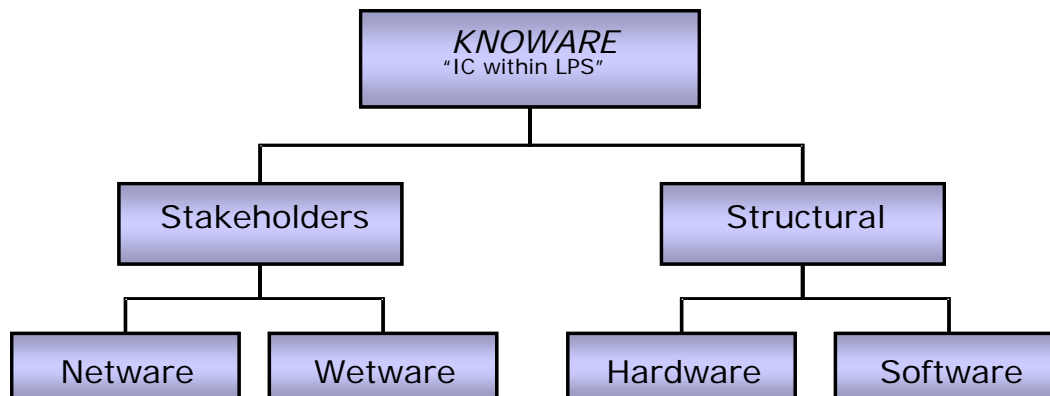


Figure 1. The Knoware Tree model

The empirical analysis

In order to measure the IC of a local system, each category of analysis identified by the Knoware Tree can be populated with a system of indicators and metrics acting as proxies of evaluation about the endowment and the use of IC. Although the definition, the assumption and the definition of the indicators can be subjective and generally submitted to the management operating the findings, it is important to underline that the level of subjectivity linked can be different in function of the nature of the indicator. In other terms, some indicators are clearly assigned to a single category of the Knoware Tree, other indicators can be assigned to different categories.

In the specific case of this research, in order to evaluate empirically the existence of a relationship between endowment and use of IC and value creation capabilities of a local system, the Italian Regions were adopted as context of analysis. It allowed to adopt the official data base of the ISTAT – National Institute of Statistics – as source for the definition of the indicators and metrics as well as for the related data collection. The ISTAT classification of these indicators has represented also a guide line for the attribution of the different indicators to the theoretical categories of the Knoware Tree.

For the explorative nature of the research mainly finalised to: (i) test the theoretical model of the Knoware Tree; (ii) collect empirical evidence and explore the relationships between IC and value creation; (iii) identify the most important dimensions of IC within the value creation dynamics; we thought to develop a static analysis referred to the Italian Regions using indicators and metrics of the year 2002. Then, the empirical research inquired first of all the explaining and interpreting capability of the model of the Knoware Tree to analyse the dimensions of the IC of a local system. Then, on the base of a positive evaluation of the capability of the Knoware Tree, the following fundamental hypotheses were tested:

Hypothesis H (1). It exists a positive relationship among IC of a region and value creation expressed in terms of regional GDP, productivity, employment rate, low levels of the regional poverty index.

Hypothesis H (2). The components of IC contribute in different ways into the regional value creation dynamics.

Hypothesis H (3). The components of IC create value through inter-dependent and dynamic relationships.

As regard the data set, the sample we used is composed by the twenty Italian Regions. This sample has allowed the adoption of the official data base of the ISTAT as source of definition of indicators and metrics finalised to constitute some proxies both of evaluation of the endowments and use of IC by the Italian Regions, and their value creation capabilities in economic and financial terms, of efficiency and distribution of the wealth.

The empirical research has been conducted in different steps. In the first step, in order to evaluate the endowment and use of IC by the Italian Regions, as well as all the other factors that directly or indirectly concur or condition its development and on the base of the literature review and the theoretical content of the Knoware Tree, the first indicators and the first metrics for the Wetware, Netware, Hardware and Software categories have been defined. Such indicators and metrics have been then submitted, discussed, controlled and further on selected by a panel of academics, practitioners, experts of IC and local systems and policy-makers in order to reduce subjective judgements. Moreover, in this step, it has been possible to test the explaining validity of the Knoware Tree model.

In the second step we collected the data about IC of the Italian Regions, and then the statistical elaborations were made. It allowed building the Intellectual Capital Index as synthetic indicator able to express in a unique value the endowment and the use of IC by the Italian Regions. Then, the Intellectual Capital Index was correlated to the value of the proxy indicators of the value creation capabilities of such regions. However, this process does not pretend to be exhaustive. In fact, considering the absence of official statistics about this issue, it is not possible to define indicators strongly explaining the endowment and the use of IC, as well as the elements that foster or hamper its development: for these reasons, the choose and the content of the indicators represent, as previously underlined, some proxies of such aspects. At the same time, we faced also the difficulties to define synthetic indicators able to express the capability of a region to create value. Moreover, the choose to focus the attention on the only ISTAT data has been dictated by the difficulties to use alternative data banks, since they tend to present statistical data often dispersed, farraginous, dated and not homogeneous. However, the adoption of the ISTAT data, although can represent a limitation of the research has ensured the homogeneity of the indicators for all the regions in terms of time and space.

Variables and methodology

In this research the Intellectual Capital Index was used as independent variable expressing endowment and use of IC. As dependent variables expressing the value creation capabilities, for each region, were used the value of the regional GDP, the employment rate, the productivity and the regional poverty index. The Intellectual Capital Index is composed by four sub-variables that reflect the four categories of the Knoware Tree.

Specifically, four synthetic indices for each of the four category were calculated. The first, related to the Wetware, measure essentially the human capital through the definition and the use of indicators finalised to capture information proxy about the quality, the composition, the use and the potential of development of such dimension of IC. One of the main indicators used to characterize the Wetware has been the formal education. However, it is not enough for the continuous development of the Wetware: also the continuous training of the employees and not has been considered, since through it people can renewal or acquire new knowledge and competences that better answer to the needs of the actual competitive scenario (Wood, 2003). In order to develop Wetware, it is important, at the same time, both the capacity of renewal of such cognitive dimension, expressed for example, by the birth rates or by the presence more or less consistent of people attending courses of formal education; and the use and the exploitation of such knowledge within the regional productive system. Finally, the Wetware has been evaluated considering the innovative capability of a region expresses essentially by the levels of human resources specifically and continuously involved in R&D activities into the PA, Universities, firms, institutions.

The second index, related to the Netware, has been calculated using some indicators able to evaluate, through some proxies, the relevance of the relational dynamics or sustaining the regional value creation capabilities. In fact, the system of the relationships contributes to improve the capabilities to create and exploit knowledge (Yli-Renko *et al.*, 2001; McFadyen and Cannella, 2004). Through relationships it is possible to transfer information, knowledge, products and services, aspects linked to the emotions. In order to highlight some aspects more strictly linked to the development and the use of IC, the research focalised mainly interpersonal relationships, finalised to transfer information and knowledge and to share experiences and problems.

The third index, related to the Hardware, has been built on the basis of indicators finalised to evaluate the endowment of tangible and intangible infrastructures able to exploit the Wetware and to foster the transformation of the knowledge into action and then in a durable form of capital (Stewart, 1997). The analysis of the Hardware category is based on the assumption that the territorial and demographic structure of a local system conditions strongly the development and the use of IC.

Finally, the index related to the Software evaluates essentially the social capital of a region through some indicators able to capture some information proxies about the socio-cultural values and atmosphere, the mechanisms of socialisation, the tacit knowledge, etc. (Tsai and Ghoshal, 1998).

About the regional value creation capabilities, four indicators were used. The first is the GDP, indicator internationally used to indicate the levels of the wealth of a nation, region, local system. The second indicator, the productivity, provides a meaningful indication about the effective and the efficiency of the activities of the work-force involved into the productive processes of the region and about how the exploitation of the knowledge and the technology generate value. At the end, according to the economic theory, the employment rate and the poverty index have been considered consistent indicators of the distribution of the value created.

About the methodology, it is important to underline that the calculation of the independent variable “Intellectual Capital Index” has required different logic and mathematical-statistic steps. First of all, on the base of the raw data available into the ISTAT data-bases, a first series of matrices able to capture the value of each selected indicators has been built according to the four categories of the Knoware Tree. Then, a process of normalization of the data – based on the criteria of maximum - finalised to obtain comparable and dimensionless values has been made. Then the Cronbach’s alpha as measure of the reliability of the scales of the standardized values has been calculated (Cronbach, 1951). The results of the Cronbach’s alpha – 0.57 for the Wetware, 0.69 for the Netware, 0.65 for the Hardware and 0.59 for the Software – and the ANOVA test have confirmed the reliability, the robustness and the non casualty of the data.

Finally, in order to consider the different relevance to determine the Intellectual Capital Index, all the indicators belonging to the four categories have been weighted through the analysis of the variance. On the basis of the normalized and weighted values of each indicators belonging to the four categories of the Knoware Tree and through the weighted addition of the elements of the line of each matrix, the synthetic values of the indices corresponding to the four categories of the Knoware Tree have been calculated for each region. Also the four synthetic indices have been weighted according to the previous criteria. In this way, it has been possible to determine the so-called Intellectual Capital Index as aggregated indicator able to summarize in a unique value the endowment and the use of IC by each Italian region. Finally, for each region, the Intellectual Capital Index has been correlated with the corresponding normalized indicators of the value creation capabilities: it allowed to determine the coefficients of correlation among the variables in object. The coefficient of correlations have been determined through the regression analysis, in particular using the linear model:

$$y_i = \beta_0 + \beta_1 \cdot x_i + e_i \quad (1)$$

with $i = 1, 2, \dots, n$ where β_0 = intercept; β_1 = corner coefficient

Empirical evidence

Tables 2 and 3 provide, for each Italian regions, the synthetic values of the indices related to the four dimensions of the Knoware Tree, the value of the Intellectual Capital Index and the values of the GDP, productivity, employment rate and poverty index. Table 4, instead, presents the more significant statistical results, in particular highlighting the different correlation coefficients among the variables in object. Finally, the Figures 2 and 3 show graphically such results.

The hypothesis H (1) postulating the existence of a positive relationship between endowment and use of IC by the Italian regions and their capability to create value seems to be confirmed, although the level of statistical sense is not homogeneous for all the variables in object.

Table 2. Synthetic indices of the categories and RIC1

REGIONS	I(WET)	I(NET)	I(HARD)	I(SOFT)	IC Index
Piemonte	0,25846	0,31139	0,06213	0,05573	0,68772
Valle D'Aosta	0,19628	0,25516	0,03591	0,05280	0,54014
Lombardia	0,34268	0,27084	0,07635	0,07568	0,76554
Trentino Alto Adige	0,23106	0,31294	0,05513	0,06378	0,66290
Veneto	0,27206	0,26299	0,05931	0,08551	0,67987
Friuli Venezia Giulia	0,25258	0,24422	0,04603	0,06923	0,61207
Liguria	0,21086	0,24677	0,04761	0,07600	0,58124
Emilia Romagna	0,30231	0,24617	0,06007	0,09185	0,70040
Toscana	0,25910	0,25595	0,06046	0,07932	0,65483
Umbria	0,23053	0,21479	0,04230	0,04421	0,53183
Marche	0,23257	0,22278	0,04109	0,07458	0,57103
Lazio	0,35417	0,22529	0,06288	0,08213	0,72448
Abruzzo	0,21968	0,22077	0,04457	0,07615	0,56117
Molise	0,19015	0,08410	0,03369	0,07359	0,38153
Campania	0,30339	0,22628	0,06044	0,06074	0,65085
Puglia	0,24445	0,18945	0,05858	0,06631	0,55879
Basilicata	0,20360	0,06567	0,03916	0,06513	0,37355
Calabria	0,22074	0,24862	0,05318	0,06117	0,58371
Sicilia	0,26733	0,18325	0,06134	0,06035	0,57227
Sardegna	0,23251	0,24670	0,05987	0,05714	0,59622

Table 3. Indicators of the value creation capability

REGIONS	GDP	PROD.	EMPL. R.	POVERTY IND.
Piemonte	0,41	0,81	0,92	0,25
Valle D'Aosta	0,01	0,75	0,98	0,28
Lombardia	1	0,87	0,93	0,13
Trentino Alto Adige	0,10	0,85	0,98	0,38
Veneto	0,44	0,77	0,93	0,13
Friuli Venezia Giulia	0,11	0,80	0,92	0,31
Liguria	0,14	0,89	0,86	0,19
Emilia Romagna	0,43	0,79	1	0,16
Toscana	0,32	0,79	0,91	0,20
Umbria	0,07	0,78	0,87	0,23
Marche	0,12	0,68	0,93	0,18
Lazio	0,50	1	0,81	0,32
Abruzzo	0,09	0,73	0,82	0,54
Molise	0,02	0,82	0,77	0,82
Campania	0,10	0,85	0,62	0,79
Puglia	0,31	0,74	0,67	0,76
Basilicata	0,22	0,74	0,68	0,81
Calabria	0,03	0,77	0,62	1
Sicilia	0,10	0,88	0,62	0,75
Sardegna	0,27	0,76	0,69	0,63

Table 4. Statistical results of the research

	R	R²	Estimate error
IC Index - GDP	0,761	0,579	0,157
IC Index - Productivity	0,423	0,179	0,093
IC Index – Poverty index	0,556	0,309	0,085
IC Index – Employment rate	0,404	0,163	0,094
Wetware – IC Index	0,800	0,640	0,062
Netware – IC Index	0,823	0,678	0,058
Hardware – IC Index	0,823	0,678	0,058
Software – IC Index	0,330	0,109	0,097
Netware - Wetware	0,336	0,113	0,044
Hardware - Wetware	0,811	0,657	0,027
Software - Wetware	0,404	0,163	0,043
Hardware - Netware	0,512	0,262	0,054
Software - Netware	0,000	0,000	0,063
Software - Hardware	0,240	0,058	0,011

The collected empirical evidence confirms the hypothesis according to which the various categories of IC contribute in a different way to the value creation. All the four categories are positively correlated with the value creation and in particular with the regional GDP.

However, significant statistical relationships can be noticed only for the Wetware and the Hardware. According to the approach of the systems dynamics it seems possible to notice the existence of a mechanism of strengthening among three elements: GDP, Wetware and Hardware. Moreover, it is possible to notice different positive correlations between the categories of IC. The Software category, besides with the GDP ($R^2=0.18$), is correlated also with the Wetware ($R^2=0.16$); while the correlation with Netware and Hardware is null: it allows to affirm that Software contribute on one side directly to the value creation dynamics and on the other side indirectly sustaining the development of the human capital.

About the Netware, it is positively correlated, besides with the GDP, also with the Wetware ($R^2=0.11$) and the Hardware ($R^2=0.26$). It can be meant that the Netware sustains and feeds the value creation dynamics through its capability to influence the development of the Hardware. Also the third hypothesis according to which the different categories of IC are inter-dependent into the value creation dynamics seems to be confirmed by the evidence of correlations of positive inter-dependence. However, it remains to understand through longitudinal analysis the dynamic nature of these relationships. Finally, it is interesting to note that the Wetware, the Hardware and the Netware concur in a positive and significant way to the definition of the Intellectual Capital Index, while the Software remains a category that assumes its relevance in relation to its capability to sustain the development of the Wetware.

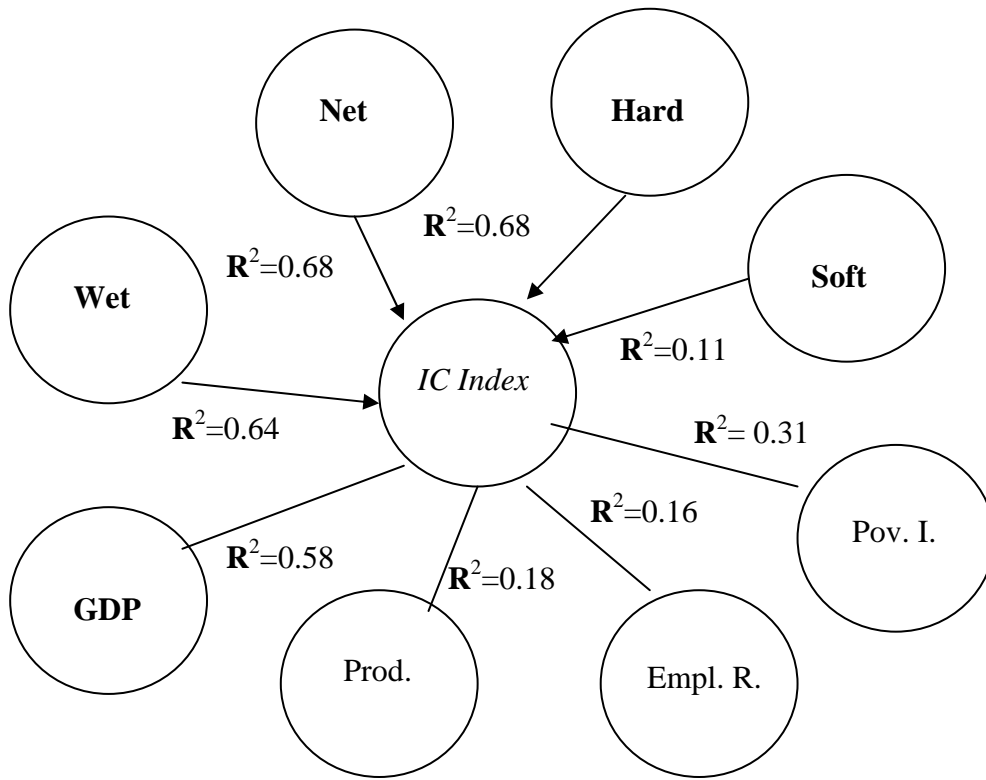


Figure 2. Value creation dynamics Intellectual Capital-based

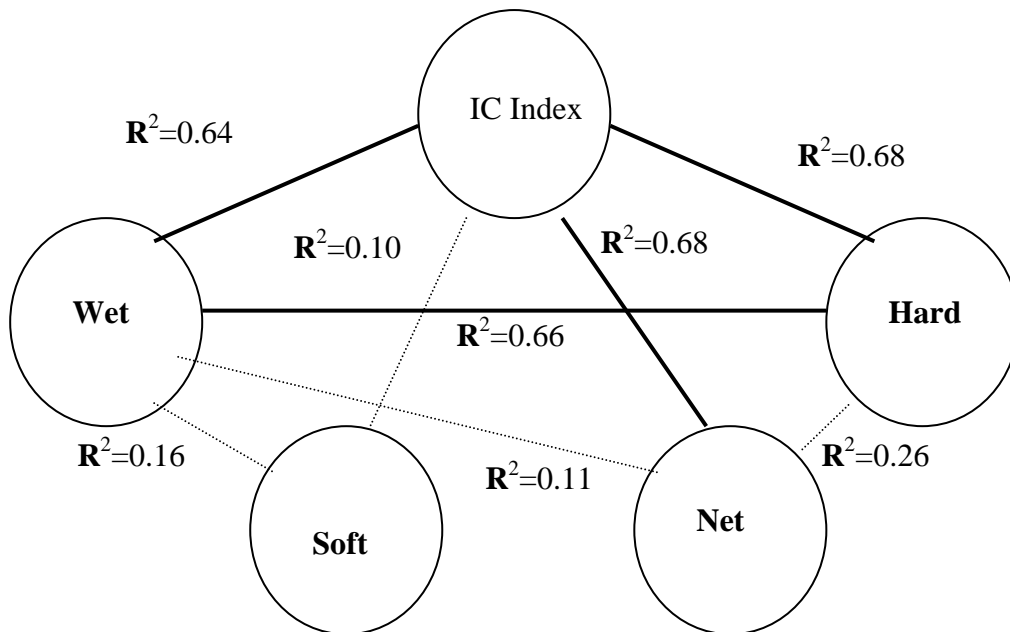


Figure 3. Correlations of the components of IC

Conclusions

This research contribution has investigated, on an explorative level, the relationships between IC and value creation capability within local systems and the direct and in direct modalities through which IC sustains and feeds the value creation dynamics.

On the base of the economic and management literature and through the theoretical model of the Knoware Tree, this contribution has developed the Intellectual Capital Index and presented the first results of an empirical explorative research finalised to analyse the links between IC and value creation referred to a specific local system, the Italian regions one.

In particular, about the first results of the research, the empirical evidence seems to confirm the main hypothesis according to which exist significant, or at least positive, relationships between the endowment and the use of IC by the Italian Regions and the value creation capabilities of such regions.

Moreover, the statistical correlations we obtained contribute to improve the actual knowledge about the modalities of identification, measurement, comprehension and analysis of the role and the relevance of the intangible resources within the value creation dynamics at regional level, concurring to the resolution of the problems underlined by Bounfour and Edvinsson (2005) and Wilcox King and Zeithaml (2003) about the difficulties of measuring the impact of the knowledge resources in the organizational performance improvement. Finally, the empirical evidence obtained through the use of the Knoware Tree, as a model of evaluation of IC, can represent a useful framework in order to define, in a more precise and coherent way, a series of management and political processes and initiatives finalised to the improvement of the competitive capabilities of the local system through the exploitation of IC.

References

- Albino V., Schiuma G., (2003), 'New forms of knowledge creation and diffusion in the industrial district of Matera-Bari', in Belussi F., Gottardi G., Rullani E. (eds.), *The Net-Evolution of Local Systems – Knowledge creation, collective learning and variety of institutional arrangements*, Kluwer, Dordrecht.
- Amit, R., Zott, C. (2001), "Value Creation in e-business", *Strategic Management Journal*, Vol. 22, pp. 493-520.
- Andriessen, D. (2005), *Making Sense of Intellectual Capital*, Elsevier Butterworth-Heinemann.
- Barney, J.B. (1991), "Firm resources and sustained competitive advantage", *Journal of Management*, Vol. 17 No. 1, pp.99-120.
- Becattini, G. (1987), *Mercato e forze locali: il distretto industriale*, Bologna, Il Mulino.
- Becattini, G. (1990), "The Marshallian Industrial District as a Socio-economic Notion", in Pyke, F., Becattini, G. and Sengerberger, W. (eds) *Industrial Districts and Inter-Firm Co-operation in Italy*, Geneva, International Institute for Labor Studies.
- Bontis, N. (2004), "National Intellectual Capital Index" – A United Nations initiative for the Arab region", *Journal of Intellectual Capital*, Vol. 5 No. 1, pp. 13-39.
- Bontis, N., Dragonetti, N.C., Jacobsen, K., Roos, G. (1999), "The Knowledge Toolbox: a review of the tools available to measure and manage intangible resources", *European Management Journal*, Vol. 17 No. 4, pp. 391-401.
- Bounfour, A., Edvinsson, L. (2005, eds), *Intellectual Capital for Communities*, Elsevier Butterworth-Heinemann

- Brooking, A. (1996), *Intellectual Capital: Core Assets for the Third Millennium Enterprise*, Thompson Business Press, London.
- Brooking, A. (1997), "The management of intellectual capital", *Long Range Planning*, Vol. 30 No. 3.
- Camagni, R.P. (1991), *Innovation Networks. Spatial Perspectives*, London, Belhaven Press.
- Davenport, T.H., Prusak, L. (1998), *Working Knowledge: How Organizations Manage What They Know*, Harvard Business School, Boston, MA.
- Delios, A., Beamish, P.W. (2001), "Survival and profitability: the roles of experience and intangible assets in foreign subsidiary performance", *Academy of Management Journal*, Vol. 44 No. 5.
- Doeringer, P.B., Terkla, D.G. (1995), "Business strategy and cross-industry clusters", *Economic Development Quarterly*, Vol. 9, pp. 225-237.
- Drucker, P. (1993), *Post-capitalist society*, Harper Business, New York.
- Drucker, P. (1959), "Challenge to management science", *Long Range Planning*, Vol.30 No. 3..
- Edvinsson, L. (2002), "The knowledge capital of nations", *Knowledge Management*, April, pp. 27-30.
- Edvinsson, L., Stenfelt, C. (1999), "IC of nations for future wealth creation", *Journal of Human Resource Costing & Accounting*, Vol. 4 No. 1.
- Edvinsson, L. (1997), "Developing intellectual capital at Skandia", *Long Range Planning*, Vol.30 No. 3, pp.320-31.
- Edvinsson, L., Malone, M.S. (1997), *Intellectual capital: The proven Way to Establish Your Company's Real Value by Measuring its Hidden Values*, Piatkus, London.
- Hall, R. (1992), "The Strategic Analysis of Intangible Resources", *Strategic Management Journal*, Vol. 13, No. 2, pp. 135-144.
- Hall, R. (1993), "A Framework linking Intangible Resources and Capabilities to Sustainable Competitive Advantage", *Strategic Management Journal*, Vol.14.
- Hassen-Bauer, J., Snow, C.C. (1996), "Responding to Hypercompetition: The Structure and Processes of a Regional Learning Network Organization", *Organization Science*, Vol. 7 No. 4.
- Hudson, W.J. (1993), *Intellectual Capital: How to Build It, Enhance It, Use It*, Wiley, New York, NY.
- ISTAT – Istituto Nazionale di Statistica – *Annuario Statistico 2003*.
- ISTAT – Istituto Nazionale di Statistica – *Annuario Statistico 2004*.
- Itami, H. (1987), *Mobilizing Invisible Assets*, Harvard University Press, Cambridge, MA.
- Jacobs, D., De Man, A.P. (1996), "Clusters, Industrial Policy and Firm Strategy: A Menu Approach", *Technology Analysis and Strategic Management*, Vol. 8 No. 4, pp. 425-437.
- Kaplan, R.S., Norton, D.P. (2004), *Strategy Maps – Converting Intangible Assets into Tangible Outcomes*, Harvard Business School Press, Boston, Massachusetts.
- Kogut, P. (1992), "National Organizing Principles of Work and the Dominance of the American Multinational Corporation", *Industrial and Corporate Change*, Vol. 1.
- Lev, B. (2001), *Intangibles: Management, Measurement, and Reporting*, The Brookings Institution, Washington, DC.
- Malhotra, Y. (2001), "Knowledge assets in the global economy : assessment of national intellectual capital" , in Malhotra, Y. (eds), *Knowledge Management and Business Model Innovation*, Idea Publishing Group, London.
- Marr, B., Schiuma, G. (2001), "Measuring and Managing Intellectual Capital and Knowledge Assets in New Economy Organizations", in Bourne, M. (eds), *Handbook of Performance Measurement*, Gee, London.
- Marshall, A. (1920), *Principles of Economics*, 8th ed., London, Macmillan.
- Maskell, P., Eskelinien, H., Hannibalsson, I., Malberg, A., Vatne, E. (1998), *Competitiveness, Localized Learning and Regional Development*, Routledge, London / New York.
- McFadyen, M.A., Cannella, A.A., (2004), "Social Capital and knowledge creation: diminishing returns of the number and strength of exchange relationships", *Academy of Management Journal*, Vol. 47 No. 5, pp.735-746.
- McGaughey, S.L. (2002), "Strategic interventions in intellectual assets flows", *Academy of Management Review*, Vol. 27 No. 2, pp. 248-74.
- Nahapiet, J., Ghoshal, S. (1998), "Social Capital, intellectual capital and the organizational advantage", *Academy of Management Review*, Vol. 23 No.2, pp. 242-66.

- Nonaka, I., Takeuchi, H. (1995), *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*, Oxford University Press, Oxford.
- Parkinson, M. (2005), "Localised Strategies in a Globalised Economy: Lessons from Competitive Cities", OECD Conference on Local Development and Governance in Central, East and South East Europe, Trento, Italy.
- Penrose, E. T. (1959), *The Theory of the Growth of the Firm*, John Wiley, New York, NY.
- Peteraf, M.A. (1993), "The cornerstones of competitive advantage: a resource-based view", *Strategic Management Journal*, Vol.14, pp. 179-88.
- Prahalad, C.K., Hamel, G. (1990), "The core competence of the corporation", *Harvard Business Review*, Vol. 68 No. 3, pp.79-91
- Pulic, A. (2005), "Value Creation Efficiency at National and Regional Levels: Case Study – Croatia and the European Union", in Bounfour, A., Edvinsson, L. (eds), *Intellectual Capital for Community – Nations, Regions, and Cities*, Elsevier Butterworth-Heinemann.
- Rosenfeld, Stuart A. (1997), "Bringing Business Clusters into the Mainstream of Economic Development", *European Planning Studies*, Vol. 5 No.1, pp. 3-23.
- Rosenfeld, Stuart A. (1996), *Overachievers, Business Clusters that Work: Prospects for Regional Development*, Chapel Hill, NC.
- Roos, G., Roos, J. (1997), "Measuring your company's intellectual performance", *Long Range Planning*, Vol. 30 No. 3.
- Roos, J., Roos G., Dragonetti, N.C., Edvinsson, L. (1997), *Intellectual Capital: Navigating the New Business Landscape*, Macmillan, London.
- Rumelt, R.P. (1984), "Towards a strategic theory of the firm", in Lamp, R.B. (eds), *Competitive Strategic Management*, Prentice-Hall, Englewood Cliffs, NJ.
- Saxenian, A.L. (1994), *Regional Advantage. Culture and Competition in Silicon Valley and Route 128*, Cambridge, MA, Harvard University Press.
- Schiuma, G., Lerro, A., Carlucci, D. (2005), "An Interfirm Perspective on Intellectual Capital", pp. 155-169, in Marr B. (eds), *Perspectives in Intellectual Capital*, Elsevier Butterworth-Heinemann.
- Stewart, T.A. (1991), "Brainpower", *Fortune*, 3 June, pp.44-56.
- Stewart, T.A. (1997), *Intellectual Capital: the new wealth of organizations*, Doubleday/Currency, New York.
- Sullivan, P.H. (1998, eds), *Profiting from intellectual capital: extracting value from innovation*, Wiley, New York.
- Sveiby, K.E. (1997), "The Intangible Asset Monitor", *Journal of Human Resource Costing & Accounting*, Vol. 2 No. 1.
- Tallman, S., Jenkins, M., Henry, N., Pinch, S. (2004), "Knowledge, Clusters, and Competitive Advantage", *Academy of Management Review*, 2.
- Teece, D.J. (2000), *Managing Intellectual Capital : Organizational, Strategic, and Policy Dimensions*, Oxford University Press, Oxford.
- Tsai, W., Ghoshal, S. (1998), "Social capital and value creation: the role of intrafirm networks", *Academy of Management Journal*, Vol. 41.
- Wernerfelt, B. (1984), "A resource-based view of the firm", *Strategic Management Journal*, Vol.5 No.3, pp.171-80.
- Wilcox King, A. e Zeithaml, C.P. (2003), "Measuring organizational knowledge: a conceptual and methodological framework", *Strategic Management Journal*, Vol. 24.
- Wood, J. (2003), "Australia: an under performing knowledge nation?", *Journal of Intellectual Capital*, Vol. 4 No. 2, pp. 146-164.
- Yli-Renko, H., Autio, E., Sapienza, H., (2001), "Social capital, knowledge acquisition and knowledge exploitation in young technology-based firms", *Strategic Management Journal*, Vol. 22, pp.587-613.