# An analysis of the relationship between intellectual capital and performance of enterprise that is refer to Chinese high-tech Industry Company.

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# Abstract

The coming of knowledge economy time, makes the core of enterprise competition, the key of gaining profit no longer depends on traditional material production elements, but on more and more attention in the enterprise special resources – intellectual capital. As the important source of creating value and sustainable competitive advantage, intellectual capital is highly valued for nation and enterprise, but also become the hot topic to scholars. In recent years, many scholars had done intense researches between intellectual capital and corporate performance, and obtained a certain result, researches mainly through the analysis of the structure of intellectual capital, chose some variables as corporate performance alternative variable, concluded that the relationship between the two.

This paper set up five chapters to research the relationship between intellectual capital and corporate performance. The first chapter of the introduction of the first article of the research background and significance are discussed. Chapter 2 is related to the field of intellectual capital research synthesis, systematic review of relevant theories of intellectual capital, intellectual capital at home and abroad about the relationship between corporate performance and research, and intellectual capital to make the definition of related concepts. Chapter 3 is the introduction of intellectual capital measurement methods, and from the selected value-added intellectual capital coefficient (VAIC) as a measure of intellectual capital methods, laid the foundation with the data for statistical analysis. Chapter 4, the paper selected for Chinese information technology industry to meet the requirements of all listed companies in 2014 data for the samples VAIC to build a model of the indicators, the use of statistical software SPSS of intellectual capital and corporate performance the relationship between the empirical analysis. Chapter 5, this article on the conclusions of empirical studies is summarized, pointing out the significance of this study and research restrictions, provides

direction for the follow-up study.

*Key words:* intellectual capital; enterprise performance; value added intellectual capital coefficient (VAIC)

# Content

# Chapter 1 Introduction

Since the 1970s, the global economic growth has been a fundamental change; the intellectual capital has gradually replaced the traditional factors and become the only most important strategic resource to the enterprise value. Therefore, intellectual capital is considered the most valuable business asset and the most powerful competitive weapon at present.

## 1.1 The research background

With the development of global economic growth, intellectual capital is increasingly instead of traditional factors of production since 1970s. According to the higher and higher rate of return on knowledge investment, knowledge is becoming a key element of production of recent economic theories. In addition, the knowledge economy is converting the demands of the labour market in economies over the world (The World Bank, 2003). The knowledge-based economy primarily relies on application of new ideas and technologies rather than physical abilities and low price of raw material and labour (The World Bank, 2003). Knowledge as a kind of new production factor has made more contribution to economic and more influence to enterprise. Moreover, knowledge as a core of intellectual capital makes an important influence on company performance.

In today's knowledge-based economy society, highlights the growing role of knowledge. Knowledge as a new factor is playing an increasingly important role. Put forward the concept of intellectual capital, indicating that the knowledge contribution to economic growth increasing, knowledge as a strategic resource of the enterprise's influence continues it deepens. In order to win in the fierce competition, the information age companies must have new capabilities - to form and take advantage of the ability of intellectual capital.

Good intellectual capital management system for enterprise performance can have a positive impact, and through empirical research to further clarify the understanding of intellectual capital and corporate performance is the use of the relevance of intellectual capital to create value, improve enterprise performance basis.

## 1.2 The research aims and question

With the development and application of information technology and high-tech, intellectual capital is playing a more important role in the economy. Accordingly, in the recent decade, fifty present GDP of most members of OECD comes from industries whose foundation is knowledge. Among the five hundred most highly speed US companies, fifty present are intellectual company (Jiang, 1999). As a result, it is more and more important to focus on intellectual capital and to effectively manage intellectual capital. Since most of intellectual capital is intangible, traditional financial statements are difficult to show the intellectual capital of a company. Therefore, the difference between market value and book value becomes more and more significant.

Investors and stakeholders always communicate through company's annual report or interim report. This report could show audited financial information of corporation and its subsidiary. Previously, lots of researchers are focusing their thoughts on annual report and particularly on financial information (Penrose, 1995; Peteraf, 1993; Ohlson and Penman, 1992). Most researches have a shared purpose is that announce information which are being made public (Smith, 2011).

However, the more and more huge gap between company’s market value and book value has attracted the attention of researchers recently, and the researchers constantly explore the hidden value of financial statements (Lev and Zarowin, 1999; Lev, 2001; Lev and Radhakrishnan, 2003). Because of the big gap between companies’ market value and book value and the small

correlation between tangibles asset investment and business value, the value of intellectual capital has gradually become obvious. Intellectual capital has become an important asset of enterprise; it is increasingly playing a key role in sustainable competitive advantages (Kaplan and Norton, 2001). Recently, numbers of researchers have already realized hidden value and did some related research about measurement of intellectual capital, but most of them are in theory. Thus, it is necessary to proceed a study which combined with theory and practice.

## 1.3 Research Focus and Scope

In modern economy, tangible assets, like equipment and machines, are no longer the only factor for corporate growth. Although tangible assets is still the key factor in improving enterprise performance, intangible assets like technology, human resources and customer-related assets are playing more and more important role. Therefore, scholars begin to conduct researches on the relationship between those intangible assets and enterprise performance. With development of accountancy, some sorts of those intangible assets could be recognized in accounting system and be disclosed in dollar amount on balance sheet. As a result, investors and analysts could use these data of intangible assets to analyze the financial situation of certain corporate in a more comprehensive way. However, intellectual capital, among these sorts of intangible assets, is significant for enterprise performance but still cannot be disclosed in dollar amount on financial statements. This paper mainly focuses on analysis of measurement of intellectual capital, and the relationship of intellectual capital and enterprise performance, in order to reveal how intellectual capital affects enterprise performance.

This paper's data are come from 30 high-tech Chinese industry companies as sample population, using the relative numbers on financial statement and

the value-added intellectual coefficient measures method to analysis the relationship between intellectual capital and company performance. High-tech companies rely on intellectual capital, like human capital, more than companies in other industries. They are more representative in research on intellectual capital, so this paper selected companies in high-tech industry as samples.

All of these data numbers are come from financial statement of high-tech listed company, and these data are usually has been audited by professionally certified public accountants, thus the credibility of data is higher.

## 1.4 Research Methodology

In the aspect of intellectual capital measurement, researchers already raised a variety of measurement methods, and some researchers use the research sample for empirical analysis, but most of those measurement methods are questionnaire and case study. Based on that consideration, the mainly research method is shown as follow:

First of all, using Chinese high technology Company as sample to analysis and test the intellectual capital whether has a prominent effect on enterprise performance by adopting the combination of theoretical research and empirical analysis methods. Selecting the Value-Added Intellectual Coefficient (VAIC) method to analysis research sample and hope through this research study to further explain the intellectual capital has a significant important influence in company obtain and maintain competitive power.

Secondary, through analysis the relationship between elements of intellectual capital and enterprise performance to clarify elements of intellectual capital can directly affect high-tech companies' performance and the interaction of elements also affect those companies' performance. This paper will adopt factor analysis method to obtain the corresponding

comprehensive performance indicators of companies' each financial indicator. Building a comprehensive regression model in order to further study the relationship between intellectual capital and high-tech companies and provide the basis for intellectual capital management. Based on study the relationship between intellectual capitals and company performance to analysis every element of affection of listed enterprise performance in human capital, structural capital and relationship capital, in order to find out which element of intellectual capital has maximal action in impact company performance. This result can lead high-tech company focus on the mainly element in intellectual capital investment to avoid recourses waste.

Moreover, extending the relationship issues around intellectual capital measurement, intellectual capital and company performance to intellectual capital management and systematic study those, in order to provide theoretical foundation for high-tech Company to effectively manage intellectual capital.

## 1.5 Structure of the Study

First of all, this paper is based on national and international literature review to raise questions and analysis them logically; secondly, according to those questions and analysis to pose research hypothesis and making an empirical design; thirdly, adopting the statistical measurement method to empirical those hypothesis and analysis results; come to the conclusion and puts forward related suggestions. This paper is divided by five parts as following:

Chapter one, introduction, the first part mainly introduces the research background and raise questions, and explain the research purpose and research scope.

Chapter two, literature review, this part reviews the national and international related article and give a brief review which can help the research

study of this paper.

Chapter three, research methodology, at the first, expounding a variety of intellectual capital measuring method and according to their advantage and disadvantage to choose the value-added intellectual coefficient (VAIC) method, based on this method to design research form for every research variable. Then account for sampling unit and method, select some indexes from enterprises' solvency, service, profit and development, and using factor analysis method to build comprehensive index of company's performance as basic for forward analysis.

Chapter four, data analysis, first of all, propose research hypothesis after describe samples and variable definition, and then build a model to verify the related theory hypothesis. Intellectual capital elements and corporate performance index has carried on the descriptive statistical analysis, correlation analysis and regression analysis by using the statistical software, SPSS. Finally, brief analysis the results of this research study.

Chapter five, conclusion, summarise this research results and figure out inadequacy of this study. Based on those consequences, put forward some recommendation. The holistic research study model is shown as follow:

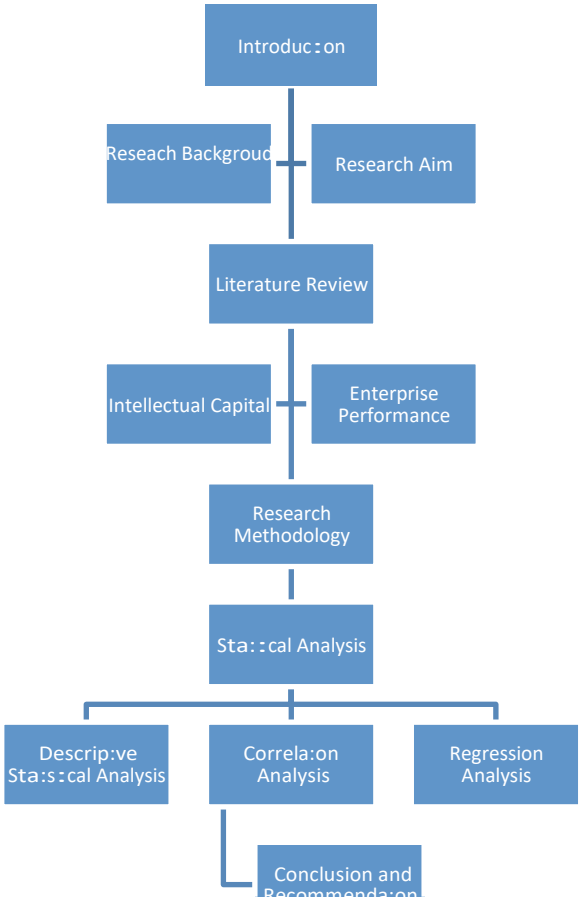

Diagram 1: The holistic research study model

# Chapter 2 Literature Review

## 2.1 Knowledge Base

Many scholars and specialists such as Peter Druker (1993), identified knowledge as the sixth and the most significant input and output key element of the economic activity. There are more and more evidence showing that intangible asset is becoming the most important resource of the 21st century (Carayannis et al., 2006). Current economy is transforming to knowledge based. OECE (1996) points out that the economy is now based on distribution, production and use of knowledge and information. “The interest has shifted rather towards the individual, towards his creativity, capacity of innovation, continuous learning, scientific research and relational capital” (Victoria et al, 2013).

The organization for economic cooperation and development (OECD) economies are increasingly based on knowledge and information. Knowledge is becoming the key driver of productivity, profitability, and economic growth. This leads corporate and their management to focus on the role of information, technology, and knowledge in enterprise performance. The term “knowledge-based economy” comes from this fuller recognition of the role of knowledge and technology in modern OECD economies (OECD, 1996).

## 2.2 Intellectual Capital

Intellectual capital, ‘the source of the competencies and capabilities deemed essential for national economic growth, human development, and quality of life (Malhotra, 2003), have been attracting an increasing amount of

attention'. The main trend is attaching more importance to what an organization knows than to what an organization owns (Grimaldi and Hanandi 2013). This perspective on the organizational intangible assets marks out the significance of the intellectual capital which sustains the organization's performance and effectiveness in response to the environmental opportunities and pressures. Knowledge and intelligent workforce place themselves as paramount tiers of value creation for the organization and its members (Sumedrea, 2013).

Moreover, Sullivan (1998) indicates that intellectual capital is "knowledge that can be converted into profits", and as "the intangible assets of skill, knowledge, and information." There are other definitions of intellectual capital. For example, Hubert Saintonge, Vice President for People, Knowledge and Strategies for Canada's Mutual Group. a pioneer in the field of knowledge creation, prefers the term knowledge capital to intellectual capital: He difines knowledge capital as the sum of human capital, customer capital and structural capital. Leif Edvinsson of Skandia, another pioneer, defines it as "the sum of the firm's human and structural capital." Gu and Lev (2001) emphasize the role of context and declare that knowledge resources do not necessarily mean value, but they turn into values that support and integrate into the wealth and value producing processes. The authors look at R&D, marketing and advertising, HR and IT practices as the most important sources of non-materal assets. Kaufmann and Schneidere (2004) also point out that frequently, those resources are called intangible assets that have no physical-material or monetary shape or existence but still they bear value for the organization.

Further, referring to intellectual capital as a knowledge-based capital (KBC), OECD (2013) emphasizes that investments in many forms of KBC – such as R&D, design and new organizational processes – also create knowledge that spills over into other parts of the economy, again spurring growth. Although the intellectual capital conceptualization was initially placed within the framework of for-profit organizations, over the past years, a

paradigm shift occurred and the concept was extended to the public and academic sectors (Ramírez Córcoles and Vanderdonckt 2013).

### 2.1.1 Components of Intellectual Capital

Intellectual capital can divide to three sectors: human capital, structural capital, relational capital and customer capital.

The key component of intellectual capital is human capital, which could not be replaced by the tangible assets such as plant, property or equipments of a corporate. Mostly, human capital means employees' and owners' expertise, knowledge, skills and intellect in an organization, which can be used for improving organizational performance. It is related to employees' innovation, competence skills capabilities, as well as knowledge (Malone and Edvinsson, 1997). In addition, human capital consists of skills, the know-how, expertise, experience and capabilities of the human members of the enterprise (Kok, 2007). Moreover, human capital is composed of individual employees in a company, and every one of them each has abilities, skills, knowledge, as well as know-how. In order to make use of these, each employee, or a unit of human capital, should be positioned physically no matter where their ability, skill, or knowledge can be used. In every employee, there is uncodified (tacit) knowledge that the company tries to use (Sullivan, 1998). In addition, human capital is the capabilities of the individual required to provide solutions to customers.

Structural capital includes the culture, systems, policies, other organizational capabilities, networks and distribution channels, developed to catch market requirements and intellectual property (Kok, 2007). It is the organizational capabilities of the organization to meet market requirements. Furthermore, structural capital can be described as a bunch of knowledge owned by a respective enterprise and embracing corporate culture, information technology and explicit knowledge (Halim 2010; Kamukama *et al*. 2011). In

addition, structural capital, for companies, is hard assets, which contain all the items on balance sheet, such as financial assets, machinery, buildings, as well as the firm's infrastructure. Besides, it also contains complementary business assets, which usually are necessary to turn a creative idea to a service or product (Sullivan, 1998).

Customer capital is the depth, width, attachment, and profitability of the franchise. Fundamentally, customer capital is based on correlation between customers and organization (Malone and Edvinsson, 1997). It refers to the knowledge which is embedded in the relation between organizations and stakeholders, customers, strategic partners as well as suppliers (Bontis, 1998). Moreover, scholars such as Bontis (2000) pointed out that, organizations can develop marketing channels and establish relationship with customers by doing businesses. Ramezan argued in 2001 that, customer capital is crucial element, and the value is founded in marketing channels as well as the relationship that companies establish through doing business. As Isaac *et al.* pointed out, intellectual capital might contain positive long-term relationship which is established with suppliers, customers, as well as others stakeholders who will ultimately bring better performance to the organization (2010). In addition, it is an important and positive factor for improving organizations' performance. Due to the arguments above and also many researchers' findings, customer capital is believed to be a key part of intellectual capital.

Relational capital covers the connections of people who outside companies with their loyalty, the similar issues, and the market share and the level of back orders (Kok, 2007). Relational capital is found in every company, but it is not defined and measured. The impact of relational capital can be noticed only when relational capital disappears and does not function at all (Survilaite *et al*, 2014).

### 2.1.2 Intellectual Capital Measurement Models

Sveiby (2004) and Malotra (2003) proposed four measurement models to measure the intellectual capital, which are return on assets method, scorecard method, direct intellectual capital method and market capitalisation method.

Market capitalization method is that to calculate the difference between equity of stockholders and market capitalization (Kok, 2007). In this method, it is proposed capitalization ratio, and uses it as the ratio of the capitalization of stock exchange market, to OFBV calculated from many listed companies. Under this method, when capitalization ratio is constructed, individual economy's data of stock market might be used if the economy's stock market is broad, and there is a high trading volume; and various regional indexes need to be used if there is no such circumstance (Velarde and Razin, 2014). Market capitalization method is based on the calculation of the difference between the market value of an enterprise and its assets which is equaled to the value of intellectual capital. It is difficult to apply this method in enterprises of public sector or non-profit entities (Ramanauskaite and Rudzioniene, 2013). Furthermore, market capitalization method computes intellectual capital as difference between stockholder equity and a company's market capitalization. The method is of great use to demonstrate intellectual capital's financial value and the inter-company benchmarking in the same industry. The method has a disadvantage, which is it does not offer information about the components leading to intellectual capital. The focus on only money is a limited angle of view, and it does not suit the comprehensive human development and socio-economic approaches which an organization usually seeks (Malhotra, 2003).

Return on assets method (ROA) usually use the tangible assets and the annual financial figures to compared with the industry average, the above-average earnings can be used to forecast the value of intangible assets (Kok, 2007). Return on assets method is based on the average income before tax versus the calculation of average capital unit. Then, the result worked out is

in comparison with the industry branch's value in average. The result is regarded as intellectual capital's return in average. Some of this method is on the basis of the calculation of discounted cash flow, and there may be some errors (Ramanauskaite and Rudzioniene, 2013). Moreover, with the method of ROA, it is calculated through dividing the organization's earnings before tax by tangible asset in average; and the result is compared with the industry average. Afterwards, the average tangible asset of the firm is used to multiply the difference in order to work out the annual earnings made from intangibles (Malhotra, 2003).

Direct intellectual capital method deems that components are identified and valued (Kok, 2007). This method is based on valuation of intellectual capital by finding out specific elements or components in monetary units (Ramanauskaite and Rudzioniene, 2013). Thanks to the measurement model of direct intellectual capital, identifying all kinds of components is used to estimate the intangible assets' monetary value. Such a model can be adopted together with scorecard method, because it is limited in the use of analyzing and assessing intellectual capital's specific aspects. When the model is used for deriving standard indicators, then such standards should be both reliable and valid. Besides, the model takes into consideration the valuation of intellectual capital's separate components, as well as the combinations of non-monetary and monetary valuations. It offers a holistic overview of the organization's all intellectual capital. But Malhotra argued that it has a biggest disadvantage, which is that it is hard to benchmark and compare (Malhotra, 2003).

Scorecard method is always employing scorecards and graphs to identify and reflect the carious components of intellectual capital (Kok, 2007). This method is based on identifying intellectual capital's different components and specific indicators' attribution, as well as the indexes that are intended for

measuring the components. It is different from the first type because it does not calculate evaluation in terms of monetary units (Ramanauskaite and Rudzioniene, 2013). Besides, in the scorecard model, all kinds of components of intellectual capital or intangible assets are identified, and indices and indicators are worked out and showed in scorecards. As a result, based on the synthesis of intellectual capital's components, the composite indices are thus created. With this model, measurement is closer to real processes, inputs and outcomes. Also, the reporting is consequently faster. In particular, it is very good to use for detecting and correcting the errors occurred in adjusting inputs and processing with the outcomes and outputs. In knowledge management, the model of scorecard does not belong to the models that are used most widely. It is most applicable for the measurement of higher-learning institutions' intellectual capital. Malhotra proposed that the model is used to measure the intangible assets that have not been measured currently (Malhotra, 2003).

### 2.3 Value Added Intellectual Coefficient Measures

The Value Added Intellectual Coefficient (VAIC) is an estimation of return on investment in considering capital. The premise of VAIC is that labours have different roles (Stewart, 2001 cited by Anthony, 2004): Nevertheless, previously, a certain amount of work led to a certain amount of product, and a certain amount of work could implement putrid outputs at present (Pulic, 1999 cited by Anthony, 2004).

The Value Added Intellectual Coefficient equals outputs (like revenues) minus non-employee inputs (like expenses). This process works out a result of value-added, and then use this value-added divided by total payroll costs to fighter out a coefficient measure of how much value has been added per monetary unit of labour cost (Anthony, 2004).

Furthermore, the value added intellectual coefficient point out that

corporate value creation efficiency, or corporate intellectual ability. The value added intellectual coefficient estimates 'how much new value has been created per invested monetary unit in resources' (Pulic, 2000 cited by Turner, G, 2011). If there is higher value added intellectual coefficient, then the value creation potential of a company will be better. At the first time Pulic (2000) tested the value added intellectual coefficient on 30 companies which were selected randomly from UK's FTSE 250 between 1992 and 1998 (Pulic, 2000 cited by Turner, G, 2011). The average values of value added intellectual coefficient and a firm's market value shown a correspondence at high degree has found out.

More and more evidence in literature motivates the potential of value added intellectual coefficient. There are many advantages for the method (Pulic, 2000 cited by Turner, G, 2011): audited information leading verifiable and objective calculations; the approach of standardized measures makes international comparative analysis possible; and also easy calculation that allows for universal acceptance in the future to measure corporation performance (for instance, MA/BV and ROA). In addition, value added intellectual coefficient consist of the total value creation efficiency, and intellectual capital includes two parts: structural and human capital as well as physical capital (Pulic, 2000 cited by Turner, G, 2011).

## 2.4 Factor Analysis

Rose and Eijk (2015) point out that 'factor analysis is a process that accounts for the common variance among a set of items by their linear relations to latent dimensions'. This model is causal, such that the latent dimensions are supposed to cause responses on the individual items (Rose and Eijk, 2015). Furthermore, factor analysis is helpful to organize multivariate data characterizing speech, language, and auditory abilities (McFarland, 2014).

Mostly, factor analysis is used to reduce data, one is to obtain a small batch of variables (uncorrelated) from a large batch of variables (correlated to each other); another one is to produce indicatrixes with variables which could measure similar things. Moreover, there are two forms of factor analysis which are exploratory and confirmatory. Exploratory is a research which is conducted when there is not any pre-defined concept. Exploratory research is aimed at collect preliminary data that will help define problems and figure out hypotheses. Confirmatory is that when researchers intend to verify certain hypothesis on the number or the structure of dimensions which underlie a series of variables, such as researchers may take a consideration about there are two dimensions exist in their data and they need to verify that (Osborne, 2015).

Hinton, McMurray, Brownlow and Cozens pointed out in 2004 that, it is of great help to use factor analysis to examine the relations between variables in data of questionnaire so as to create underlying factors or variables which show the difference of the original (measured / questionnaire) variables. If the relation between variables is high, then possibly it may confuse certain factors and/or which many variables reduced to many limited series of useful and important factors (K'Akumu, 2015).

Before beginning factor analysis, it is necessary to do tests so as to make sure that data is suitable for the aim, such as the KMO test, i.e. the Kaiser-Meyer-Olkin measure. As Hinton and other researchers argued in 2004, the outcome of a KMO test of 0.5 or above means the data is suitable for factor analysis. This study also uses another test, which is called the Bartlett test of sphericity. Hinton *et al.* aslo said that Bartlett test is used to find if there are correlations for investigation (2004). These two tests work out respectively KMO as well as the sig. values (.848 and .000), which means that the procedures of factor analysis can go on (K'Akumu, 2015).

## 2.5 Descriptive analysis

Descriptive analysis is “the sensory method by which the attributes of a food or product are identified and quantified using human subjects who have been specifically trained for this purpose.” Also, “the analysis can include all parameters of the product, or it can be limited to certain aspects, for example, aroma, taste, texture, and aftertaste”. Likewise, Sidel and Stone (2004) gave a definition of descriptive analysis to be “a sensory methodology that provides quantitative descriptions of products, based on the perceptions of a group of qualified subjects…”

The above definitions suggest that, in descriptive analysis, qualified people is used to be an instrument for quantitative measurement for evaluating a product’ certain or all aspects.

## 2.6 Regression analysis

In 2004, Berk defined regression analysis particularly clear: “…as for as possible with the available data how the conditional distribution of the response y varies across subpopulations determined by the possible values of the predictor or predictors.” This means that, researchers are interested in the fact of the distribution of y changes along with predictors’ values. In addition, researchers use regression analysis in order to measure the coo correlation in average between 2 or even more variables, as well as to predict a variable’s values and other variables’ certain values (Jain, 2006).

## 2.7 Correlation analysis

Correlation, which is a statistical measure, is used to find out the strength or degree of the relationship of 2 or even more variables. Connor pointed out that, correlation analysis as a statistical tool could be adopted for deciding the degree of how one variable relates to another variable (Jain, 2006). In short,

correlation aims at making an explanation whether or not variables move together habitually.

According to Mukras, correlation could be multiple or simple. Multiple correlations mean association degree among 3 or even more variables, whereas simple correlations refer to that association degree in 2 variables (1993).

When the simple correlation of variable X and variable Y is taken into consideration, then correlation is distinguished to be negative and positive. Mukras pointed out that, positive correlation happens if two variables have the tendency of moving together for a same direction, and negative correlation happens when the two variables have the tendency of heading for opposite directions (1993).

Besides, correlation could be non-linear or linear. Again, Murkas said that, non-linear correlation happens if the cluster forms a non-linear curve, whereas linear correlation happens if variable X and variable Y are on a cluster of scatter diagram of a straight line (Mukras, 1993).

Furthermore, correlation could be categorized into perfect and also less than perfect. One the one hand, perfect correlation happens if the scatter diagram observations are on a non-linear or linear curve; on the other hand, if the observations cluster is nearly a non-linear or linear curve, then it is less than perfect correlation (Mukras, 1993)

## Chapter 3 Research Methodology

Usually, research means the search for knowledge. Also, research can be also defined to be a systematic and scientific search for a certain topic's pertinent information. As a matter of fact, in Kothari's words, research is "scientific investigation" (2006). This chapter will introduce different research

method from different angel, and clearly and logically indicate the reason to choose VAIC measurement method and the way to choose index sample.

### 3.1 Research Paradigm

Basically, there are two epistemological approach are used for research methodology.

One is positivist perspective; it owes its origins to early sociology. Besides, it is based on the assumption of a scientific stance in order to understand deviance. In this sense, deviance could and should be understood and examined by adopting research methods which social scientists have access to, for instance, survey and field research. According to the opinion of positivists, sociologists have the responsibility to identify deviant conduct's reasons and results (Franzese, 2009).

The other one is constructivist. Constructivism is a perspective that identifies how individual describe their experience in personal constructs, which explains one or many events that becomes the lens that individual can look at the world through. Such constructs become invidious interpret, and at the same time make sense of their experiences (Chang *et al*, 2012).

According to both define positivist and constructivist perspective above, the epistemological approach of this paper will choose positivist perspective.

### 3.2 Research Purpose

Usually, research belongs to one of the 3 kinds: exploratory research, descriptive research, and explanatory research.

Exploratory research discovers facts of a particular setting or subject. Its aim is to find out information about a general topic as much as possible, and then to develop hypotheses or propositions for examination in the future. A

rationale for such a study could be phrased in the following qualitative way:' what can be learned from the study of local figure-skating clubs. (Slack and Parent, 2006). Exploratory research is concerned with the 'why' aspect of consumer behaviour, such as, it tries to understand the problem and not measure the result. This research does not require large samples, and sample need not be representing the population. Moreover, due to imprecise statement, data collection is not easy. Characteristics of interest to be measured are not clear. There is no need for a questionnaire for collecting the data. Data collection methods are: focus group, literature searching and case study. Furthermore, exploratory research helps the researcher to become familiar with the problems. It helps to establish the priorities for further research. It may or may not be possible to formulate hypothesis during exploratory stage. (Murthy and Bhojanna, 2008).

Descriptive research, as the name suggests, becomes deeper on a certain topic for analysing in more detail. For instance, if exploratory study decided that the research had three main findings including power structures, management strategies, as well as volunteer commitment, researcher may want to delve deeper into the management strategies. (Slack and Parent, 2006). Descriptive research concerns about 'when', 'what' or 'how often' on the consumer behaviour. This research method needs large samples of respondents. Samples must be representative of population. The statement of this research is precise; therefore, data collection is easy. Furthermore, characteristics of interest to be measured are clear. There should be a properly designed questionnaire for data collection. This research method uses panel data, longitudinal and cross-sectional studies. (Murthy and Bhojanna, 2008). Moreover, descriptive research is rigid. This type of research is basically dependent on hypothesis. Descriptive research is used to describe the characteristics of the groups. It can also be used forecasting or prediction (Murthy and Bhojanna, 2008).

Lastly, explanatory research in nature is causal, and it examines variables'

relationships to explain as well as to predict behaviour. It is more about the cause-and-effect relationship (Slack and Parent, 2006). In addition, explanatory research questions take the form:" what is the effect of x on y?" often the x are not known at the beginning. Usually, an explanatory research question has a single y; there will usually be two or more x. (Bell, 2009). When researchers conduct explanatory research, they try to find potential reasons and to explain events. Such research includes interpretive research, so as to explain events. (Rubin et al, 2010). Moreover, it seeks for explaining the causes of some events. Explanatory research is quite crucial when one tries to figure out the reasons why some kinds of individuals turn to serial murderers, and the reasons of criminality. Finding out the reasons behind the event could help find out countermeasures to solve the problems. For instance, study about gang membership might assist to give explanation to the reasons of some people instead of other people taking part in gangs. The information can help prevent potential gang members in the future. Finally, such kind of research could answer questions of why and how. (Dantzker and Hunter, 2012). Therefore, explanatory seeks to use hypothesis to test the assumptions or new theories. Normally, it is in deductive logic.

Above all, considering about this paper's topic, "intellectual capital effect enterprise performance", and this study should adopt explanatory research method.

### 3.3 Research Approach

Denzin and Lincoln (1994) provide one define of qualitative research is considered by one after another authoritative contribution on qualitative research methodologies as:

> Muliti method in focus, involving an interpretive, naturalistic approach to its subject matter. This means that qualitative

> researchers study things in their natural settings, attempting to make sense of or interpret phenomena in terms of the meanings people bring to them. Qualitative research involves the studied use and collection of a variety of empirical materials – case study, personal experience, introspective, life story, interview, observational, historical, interactional, and visual texts – that describe routine and problematic moments and meaning in individuals' lives (Denzin and Lincoin 1994:2 cited by Neergaard, 2007).

However, statistical methods and numbers are usually used on quantitative research. Quantitative research numerically measures particular aspects of a certain phenomenon. It aims at find general description or verify causal hypotheses by abstracting from specific instances; it also aims at figure out measurements and analysis, which could be easily reproduced by other researchers. (King, Keohane and Verba, 2994.pp. 3-4 cited by Thomas, 2003). Researchers who use quantitative methods look for interpretation and forecast to extend to other persons and places. Aiming at produce generalizable results, quantitative methods contain two main aspects: careful sampling strategies and experimental designs. In quantitative research, the researcher is responsible to observe and measure, and to take care to prevent the data from comtaminating by researchers through personal involvement with the research subjects. Objectivity is the most important concern for researchers. (Glesne and Peshkin, 1992, p.6 cited by Thomas, 2003).

In this paper will chose 30 high-tech industry companies in China as sample population, selecting relative financial statement numbers and use the value added intellectual coefficient measures method to analysis the relationship between intellectual capital and company performance. Thus, quantitative researchers should be adopted in this paper.

### 3.4 Research Strategy

As for research strategy, it is a generalized plan to a certain problem, and includes desired solution, structure, as well as outline for the planned devices which are necessary for carrying out the strategy. Research strategy constitutes a part of research approach's development scheme. (Singh and Bajpai, 2008). Yin pointed out in 2009 that, social sciences have five basic research strategies: surveys, experiments, histories, archival analysis, and also case studies.

Historical method deals with the past. It tries to trace the past so as to look at the current prospective. Such a historical method could be categorized into three kinds: legal, historical, and also documentary. (Singh and Bajpai, 2008).

Experimental method concerns with finding out the primary relationship in phenomena so as to predict, and then to control the happening. It can be further categorized into four kinds: simple experimental designs, multivariate analysis, and case study and predictive or correlation. (Singh and Bajpai, 2008).

Archival research means research which is done by using data which researchers are not involved in collection. Archival data refer to the data existing in archives or records. Researchers only select or examine data for date analysis. Such research is suitable in lots of cases. The data related to hypothesis might be available already, so the collection of new data could be wasteful. Also, it might be infeasible for logistics or ethics to experiment and conduct related variables of interest. (McBurney and White, 2010).

In 2008, Robert Yin gave a definition to case study that case study refers to empirical inquiry which studies current phenomenon in the actual situation when there is no clear evident boundaries between context and phenomenon. Case study deals with technically unique situation where lots of variables of interest exceed data points. Therefore, it depends on various sources for evidence. Besides, it can get benefit from propositions' prior development so

as to lead the collection as well as analysis of data (p.8). Based on such a definition, such various ways make case study different from other non-experimental methods. Some problems lead to case studies, so researchers get the opportunities. Otherwise, researchers would miss the chances. Researchers may have very little time to make plans. Very often, the research should be carried out under hard conditions. (McBurney and White, 2010).

Surveys are used very widely. In survey, scientific information is gathered. Usually, the aim of surveys is only to find out the feelings of people about certain events or things. In other surveys, researchers might try to figure out the influence on people's behaviour by certain events or things. Moreover, surveys offer researchers a chance to study the relationship of participants' answers and also to find if there is any possible pattern in the reason and the effect (McBurney and White, 2010).

This paper uses historical method and archival research method to analyze how intellectual capital affects enterprise performance as a whole, as well as how components of intellectual capital affect enterprise performance individually. Since it is impossible to collect original data from documentary inside companies, all data used are collected from audited financial reports of public companies. After that, several calculations were conducted on these data to obtain information, like indexes, to conduct further analysis. To be more updated, the most recent data of year 2014 is used.

### 3.5 Intellectual capital measurement and evaluation

The total value of intellectual capital measurement is that seen intellectual capital as a whole to measure its value. Since 90s the concept of intellectual capital has gradually drawn greater attention by business circles and academic circles, measurement of intellectual capital has become a more and more

important field in intellectual capital research. Different researcher point out intellectual capital measurement methods from different angle, each method has their advantage and disadvantage and conditions. In general, there are two ways to research intellectual capital, one is focus on a single organization's intellectual capital and calculate its specific amount of money; the other one is according to elements of intellectual capital, build an evaluation system to provide suggestions for manage and develop intellectual capital.

### 3.5.1 Principles of intellectual capital measurement

Like other researches of value measurement, there are several principles for the value measurement of intellectual capital:

Determinacy: Any approach of value measurement should scientifically determine the value of object, in order to theoretically support its management and development. Value has various forms, which could be classified as quantitative result and qualitative result. Quantitative result means to figure out a measure to reflect the quantity, mass, capacity of the object. Quantitative result could be classified into stock and flow result. Qualitative result consists of a series of indexes which could reflect the characteristics and quality of the object. By describing object's performance though these indexes, qualitative result could reflect the hidden value of the object.

Comparability: With the rising status of intellectual capital, more and more companies realize that intellectual capital is a valuable resource which should be disclosed, like financial capital. However, users are confused about how to compare the intellectual capital of different companies and how to use the value of intellectual capital. At present, any measurement of intellectual capital is not able to avoid subjective factors. Therefore, detail description is much more important while seeking approach to measure the value of intellectual

capital.

Practicalness. The measurement of intellectual capital should be able to guide company to build and manage intellectual capital. Measurement of intellectual capital should be integral with knowledge management. Though analysis of the measurement of intellectual and comparing with other companies, company could figure out the strength and weakness of intellectual capital and then establish policy for intellectual capital.

### 3.5.2 The main ideas of The Value-Added Intellectual Coefficient

The Value-Added Intellectual Coefficient (VAIC) measurement method point out that labour or potential knowledge has influence to any organization, and expenditure of salary (direct cost of labour or productivity or indirect expenses of administration or manager) is significant for value added. Enterprise operations capital has two main types, financial capital and intellectual capital; in addition, the whole value of enterprise is present through those two kinds of capitals. Moreover, VAIC indicate that market value of enterprise is made up of financial capital operation and intellectual capital, thus the added of enterprise value is because of those capitals.

Assessment of performance consist of capital employed efficiency (CEE) and intellectual potential efficiency (IPE), and VAIC = CEE + IPE. According to Skandia model, intellectual capital can divide into human capital, structure capital and customer capital, thus intellectual potential efficiency (IPE) = human capital efficiency (HCE) + structure capital efficiency (SCE) + customer capital efficiency (CCE). Therefore, VAIC = CEE + HCE + SCE + CCE. Human capital, structure capital and customer capital are main elements of intellectual capital. Human capital is the most important component of intellectual capital, including the skills, expertise, and experience of employees. In twenty-one century, human resource becomes one of the most important

resources for companies. Companies pay more and more attention on training and maintenance on their employees. Structure capital includes competitive intelligence, information systems, policy, processes, etc. It helps organizations operating in an efficient way. Customer capital is the value of relationship that firms build with their existing and potential customers.

### 3.5.3 Calculation of indexes in VAIC

Value added intellectual coefficient (VAIC) means to use value added (VA) and efficiency to define the value-added factor of intellectual capital. In other words, it calculates the intellectual potential efficiency (IPE) in company's VA through calculation of efficiency. Meanwhile, in order to understand the efficiency of value created, company should consider the use of financial capital. Intellectual capital cannot create value by itself, so company should understand the efficiency of capital application, namely capital employed efficiency. Then a totaling index is used to reflect the efficiency and intellectual capacity. The calculation and relationship of these indexes are following:

Calculate VA: Under VAIC method, VA is the difference between total output (OUT) and total input (IN). It reflects the value added during the reporting period. This paper uses earnings before interest, taxes, depreciation and amortization (EBITDA), namely operating income before taxes+ interests expenses + depreciation + amortization, to calculate the VA.

Considering the disclosure requirement and practice in China, this paper define capital employed (CE) as total cash and cash equivalent, which is the key factor for value added. Considering the accessibility and reliability of information, the paper uses cash outflows paid to employees in the Cash Flows Statement as human capital (HC). Under Chinese accounting principle, selling expense and administration expenses are disclosed in separate lines of Income Statement. Structure capital (SC) is administration expenses without salary paid to employees. Considering the disclosure in financial reports of listed companies, the paper uses administration expenses to reflect SC.

Customer capital (CC) is reflected by selling expenses.

Calculate IPE: IPE equals the total of human capital efficiency (HCE), structure capital efficiency (SCE), and customer capital efficiency (CCE). HCE equals VA divided by HC. HCE could be explained as the value added by one RMB investment in HC. SCE equals VA divided by SC. SCE represents the value added by structure capital. CCE equals VA divided by CC. It represents the value added by customer capital.

Calculate VAIC: According to the definition, VAIC equals the total of CEE and IPE. IPE equals the total of HCE, SCE and CCE. Thus, VAIC equals the total of CEE, HCE, SCE and CCE.

Equations:

CEE = VA/CE

HCE = VA/HC

SCE = VA/SC

CCE = VA/CC

VA = Earning before interests, taxes, depreciation and amortization (EBITDA)

CE = Cash and cash equivalent

HC = Cash outflows paid to employees

SC = Administration expenses

CC = Selling expenses

IPE = HCE + SCE +CCE

VAIC = CEE + IPE = CEE +HCE +SCE+ CCE

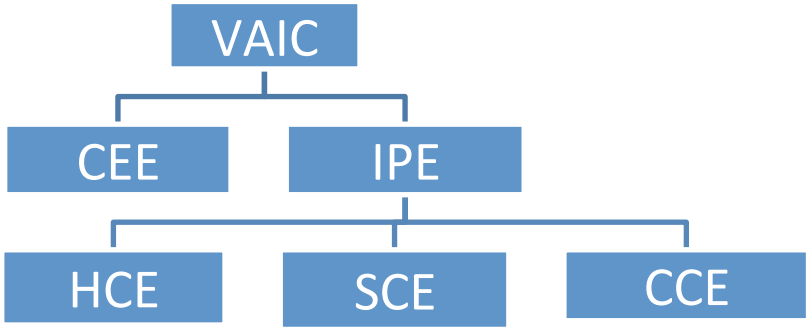


Diagram 2: Constitute of VAIC

## 3.6 Design of performance index

### 3.6.1 Principles of design of performance index

Whether the design of company's performance index is reasonable and scientific determines whether the index could be understood correctly and objectively. To clearly describe the nature and law of the system, obviously, single or few indexes are unconvincing, in order to comprehensively reflect the company's performance. Therefore, combining some key indexes is an effective way to comprehensively value company's intellectual capital. The design of index should base on analysis of system and follow principles following:

- Scientificalness

Scientificalness is mutual principle for all scientific researches, and also the basic principle for design of performance index. Structure of index system must conform to theory of related subjects. The selection of index should be explicit and be able to reflect the relationship among indexes.

- Objectivity

The selected indexes should be able to reflect the company's performance objectively and correctly. To ensure the result objective and reliable, objectiveness and correctness of data and documents should be guaranteed.

- Systematicness

Company's performance is influenced by various factors, like its operation, profitability and liquidity. Thus, it is unreasonable to only consider a single factor to design the performance index. In order to measure the company's performance, it is necessary to consider the relationship and logic among those factors and their weights.

- Completeness

Completeness means that indexes included in the index system should be complete to cover each aspect of performance, including measuring the value

of intellectual capital. On the other hand, the structure of index system should be flawless. However, the completeness is a relative concept. Completeness should be considered along with feasibility. Otherwise, if the design of index is too detail, it will be difficult to apply the index and not cost efficient.

- Comparability

First, company should use existing data as much as possible to design performance index. Second, the index should be comparable vertical (with historical data) and horizontal (with industry data or competitors' data).

- Feasibility

The index should be simple and explicit, and not repetitive. The data for measurement should be easy to collect. It is not appropriate to make the index too complicated to understand and apply.

- Timeliness

The index system should cover different time horizons, including short-term and long-term. Moreover, the designed index should be able to be used to measure the performance periodically.

- Pertinence

There is huge difference among different industry, even among different companies in the same industry. When designing the performance index, the character of company should be considered to adjust index, in order to fulfil various measurement demand.

### 3.6.2 Indexes selected

By designing performance index reasonably, most factors to measure performance could be included in the index. Thus, intellectual capital's influence on performance could be found, by building relationship between intellectual capital and performance. To measure company's performance objectively and scientifically, this paper select 16 indexes for four aspects,

including profitability, asset management, liquidity, and growth.

- Profitability

For company, the profitability is most important to increase its value. Return on asset (ROA) and return on equity (ROE) are the most common indexes to measure the profitability as a whole. Return on invested capital (ROIC) is another index to measure the profitability as a whole, which focus on the return on total invested capital including equity and liability with interest. Since ROA, ROE, and ROIC measures profitability as a whole, they could be used to compare companies with different characteristics, like different industry or different business model. Gross margin reflects the ability to create profit in the main production cycle, regardless with indirect expenses. Therefore, gross margins of companies in different industry or with different strategy could be extremely different.

X1: Return on asset (ROA) = EBIT/average total assets * 100%

X2: Gross margin = Gross profit/Revenue * 100%

X3: Return on equity (ROE) = Net income/average equity * 100%

X4: Return on invested capital (ROIC) = EBIT * (1-tax rate)/(equity + liability with interest)

- Asset management

Asset turnover is the most powerful index to measure the efficiency of asset management. Generally, higher turnover means more efficient corporate manage their assets. However, asset turnovers are in various levels among difference companies. Retailer companies always have high assets turnovers, while construction companies have low assets turnovers. Therefore, asset turnover alone could not truly reflect enterprise performance.

X5: Total asset turnover = Total revenue / average total asset

X6: Accounts receivables turnover = Total revenue / average account receivables

X7: Current asset turnover = Total revenue / average current assets

X8: Ratio of working capital to total asset = working capital / total asset *

100%

- Liquidity

Liquidity indexes reflect company's ability to repay liabilities including principal and interests. This article selects current ratio and quick ratio to measure short-term liquidity, and selects debt to assets ratio and ratio of current assets to total assets to measure long-term liquidity. Current ratio and quick ratio measure the liquidity in similar ways but in different current level. It is easier for the assets used to calculate quick ratio to be converted to cash than that in current ratio.

X9: Current ratio = Current assets / current liabilities * 100%

X10: Quick ratio = (Cash+ Marketable Securities+ Accounts receivables)/current liabilities *100%

X11: Debt to assets ratio = Total liabilities / total assets * 100%

X12: Ratio of current assets to total assets = Current assets / total assets *100%

- Growth

Besides profitability, asset management efficiency and liquidity, growth is another important factor for enterprise performance. For those companies in introduction or growth stages, their indexes for profitability, assets management efficiency and liquidity may not truly reflect their performance. Especially for companies in introduction stages, they may have negative ROE and ROA, since they mainly focus on growth rather than profit. Therefore, indexes to measure growth are necessary to be added into the index system, in order to make the measurement of performance more comprehensive and precise. Sales growth rate and net income growth rate measures the growth of profitability for organizations. Capital maintenance and increment ratio and total assets growth rate measures the growth of business size and shareholders' equity.

X13: Sales growth rate = (revenue of current period – revenue of last period)/ revenue of last period * 100%

X14: Capital maintenance and increment ratio = Ending equity / beginning equity * 100%

X15: Net income growth rate = (Net income of current period – net income of last period)/ net income of last period * 100%

X16: Total assets growth rate = Ending total assets / Beginning total assets *100%

# Chapter 4 Research design

Nowadays, the management of intellectual capital is becoming a key problem for corporate development. To all companies of which knowledge is foundation, intellectual capital is the key factor for the future competition. The study of the relationship between intellectual capital and corporate performance becomes an important topic in the area of corporate finance. Valuing the intellectual capital to corporate competition and effective managing knowledge become the consensus between academic and business circles. This paper analyzed the measurement of intellectual capital and index system for corporate performance. Based the comprehensive index F which comes from VAIC and factor analysis, this chapter does an empirical statistical research on intellectual capital and corporate performance. Moreover, this chapter verified the effectiveness of models through statistical analysis, verified relationships among elements of intellectual capital, and then made several recommendations for measurement and management of intellectual capital.

## 4.1 research method design

### 4.1.1 Sample description

For convenience of analysis and reliability of result, all samples are selected from listed companies in Shanghai Stock Exchange (SSE) and Shenzhen Stock Exchange (SZSE). Eliminating some companies with incomplete data, 30 public companies in IT industry are selected as samples. All data comes from financial reports of year 2014 from database of CNINF (http://www.cninfo.com.cn/). To make data more credible and reliable, this paper collects original finance data from financial statements instead of using existing data of financial index from other analysis database, due to different calculation methods for those indexes. All data of these 16 indexes are calculated using equations identified in chapters above. According to those 16 indexes in 3.6.2, they are all efficiency-type (the big the better) expect X11 Debt to assets ratio is cost-type (the small the better). Therefore, X11 needed to treat as the same direction with other 15 indexes, means that using its reciprocal instead of original index and the other indexes keep unchanged. In addition, indexes need to be unified by SPSS software in order to facilitate the analysis.

### 4.1.2 Variable definition

Explained variable – substitution variable of corporate performance

In existing researches, ROE or EPS is used to measure corporate performance. However, a comprehensive index F is used to measure corporate performance in this paper. ROE and EPS are both based net income, while companies have motivation to modify the net income. A system of indexes will increase the cost to modify the financial situation, thus leading corporate to pay more attention on development rather than modifying financial statements. Therefore, this paper uses factor analysis to scientifically analyze the weight for 16 indexes to figure out a comprehensive index F as the substitution variable for corporate performance. Selected indexes are following:

| Profitability | Asset Management | Liquidity | Growth |
|---|---|---|---|
| X1 ROA | X5 Total asset turnover | X9 Current ratio | X13 Sales growth rate |
| X2 Gross margin | X6 AR turnover | X10 Quick ratio | X14 Capital maintenance and increment ratio |
| X3 ROE | X7 Current asset turnover | X11 Reciprocal debt-to-asset ratio | X15 Net income growth rate |
| X4 ROIC | X8 Ratio of working capital to total assets | X12 Ratio of current assets to total assets | X16 Total assets growth rate |

Table 1: Financial indexes

Explanatory variable -- substitution variable of intellectual capital

At present, there are several methods to measure intellectual capital. However, existing methods cannot measure all kinds of intellectual capital. A lot of scholars are trying to apply various methods into empirical research. This paper uses VAIC to measure intellectual capital. Based on explanation of VAIC method in 3.2.3, VAIC is the sum of capital employed efficiency (CEE) and intellectual potential efficiency (IPE). VAIC = CEE + IPE = CEE + HCE + SCE + CCE.

This paper use variables on the right side of the equation as substitution variables for intellectual capital.

| | |
|---|---|
| Explanatory variables | Capital employed efficiency (CEE = VA/CE) |
| | Human capital efficiency (HCE = VA/HC) |
| | Structure capital efficiency (SCE = VA/SC) |
| | Customer capital efficiency (CCE = VA/CE) |
| | Intellectual potential efficiency (IPE = HCE +SCE +CCE) |
| Explained variables | Comprehensive performance index : $F = (a_1F_1 + a_2F_2 + a_3F_3 + a_4F_4)/\ \delta$ |

Table 2: Variables

### 4.1.3 Model design

According to VAIC measurement method and principal component analysis (PCA) to calculate and obtain the comprehensive performance index F, the testing model is given as follow:

Model F = a0 + a1CEE + a2HCE + a3SCE + a4CCE + ε

In above model, a is solve-for paramete, ε is random disturbance term. This model is used for test the relationship among company performance and intellectual capital and its each element (capital employed, human capital, and structural capital and customer capital).

### 4.1.4 Research hypothesis

Although intellectual capital is intangible, it is extensive knowing as a key structure asset of organizations. Intellectual capital could help companies build sustainable competitive strength and good financial performance. If intellectual capital is valuable for corporate competitive strength, it could help to improve financial performance. Intellectual capital plays an important role in increasing corporate value and improving financial performance. Based on intellectual capital management model discussed before, this paper uses VAIC method to measure intellectual capital, but there is a difference in the method to decompose of intellectual capital. Based on the H-S-C of intellectual capital, this paper adds analysis of capital employed into the model. The contribution of intellectual capital to corporate performance does not independently result from separate portions of intellectual capital, but results from combination of various factors. Portions of intellectual capital have significant influence on corporate performance directly or indirectly. Therefore, although VAIC method is used to comprehensively measure the whole value of intellectual capital, analyzing components of intellectual capital and their relationship with

corporate performance is more feasible. This paper conducts empirical research targeted on knowledge-intensive companies and samples companies from SSE and SZSE. Based on existing research on relationship between intellectual capital and enterprise performance and situation of knowledge-intensive companies, this paper makes hypothesis as following:

H1: Without considering other situation, intellectual capital has positive influence on enterprise performance.

H2: Without considering other situation, capital employed has positive influence on enterprise performance.

H3: Without considering other situation, human capital has positive influence on enterprise performance.

H4: Without considering other situation, structure capital has positive influence on enterprise performance.

H5: Without considering other situation, customer capital has positive influence on enterprise performance.

H6: Intellectual potential, which is combined of human capital, structure capital and customer capital, has positive influence on enterprise performance.

To sum up, the structure of hypothesis of this paper is showed as following:

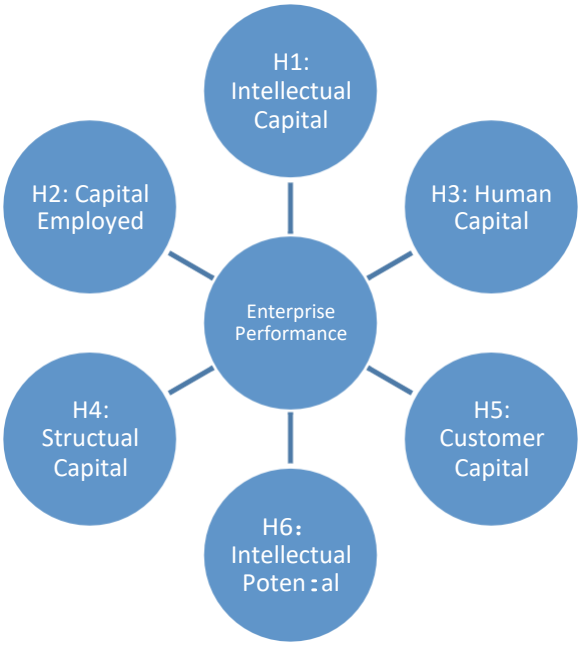


Diagram 3: structure of hypothesis

### 4.2 Factor analysis for enterprise performance

This paper uses SPSS to analyze the financial data for 16 indexes of 50 listed IT companies, and got result as following:

- KMO and Bartlett's tests, as table 3

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy | | 0.553 |
| Bartlett's test of Sphericity | Approx. Chi-Square | 646.943 |
| | Df | 120 |
| | Sig. | 0.0000 |

Table 3: KMO and Bartlett's tests

KMO and Bartlett's tests are used to measure the appropriateness of data for factor analysis. KMO test measures the sampling adequacy. Bartlett's test of sphericity tests the hypothesis that the correlation matrix is an identify matrix.

The result of KMO test is 0.553>0.5. The approximate chi-square of Bartlett's test of sphericity is 646.943; and significance is 0.0000<0.01. The result shows that data selected is appropriate for factor analysis.

●● Factor extraction

SPSS is used to conduct the factor analysis. This paper use principal component analysis to extract factors (Table 4).

| Component | Initial Eigenvalues | | |
|---|---|---|---|
| | Total | % of Variance | Cumulative % |
| 1 | 5.317 | 33.231 | 33.231 |
| 2 | 3.322 | 20.761 | 53.993 |
| 3 | 2.535 | 15.841 | 69.833 |
| 4 | 1.929 | 12.056 | 81.889 |
| 5 | .859 | 5.370 | 87.259 |
| 6 | .729 | 4.555 | 91.813 |
| 7 | .591 | 3.694 | 95.508 |
| 8 | .281 | 1.758 | 97.266 |
| 9 | .179 | 1.122 | 98.387 |
| 10 | .117 | .733 | 99.120 |
| 11 | .065 | .406 | 99.526 |
| 12 | .050 | .312 | 99.839 |
| 13 | .014 | .087 | 99.926 |
| 14 | .005 | .029 | 99.955 |
| 15 | .004 | .028 | 99.982 |
| 16 | .003 | .018 | 100.000 |

Table 4: Initial Eigenvalues

When conducting multivariate analysis, variables are always closely correlated to each other's, thus leading to overlap. Therefore, scholars desire to find fewer uncorrelated variables to reflect information of original variables. This set of values of linearly uncorrelated variables is called principal components in principal components analysis. Since contribution percentage represents the extent of reflection of original data, this paper selected 4 principal components to substitute original 16 indexes to keep the cumulative contribution percentage above 80%. In other words, these 4 principal components could reflect 81.889% of total information of original data.

●● Principal components analysis (PCA)

In order to make factors uncorrelated, this paper uses factor analysis and varimax rotation to analyze factors. (Table 5, Table 6)

| | Factor 1 | Factor 2 | Factor 3 | Factor 4 |
|---|---|---|---|---|
| ROA | .470 | .831 | .081 | -.144 |
| Gross margin | .728 | .130 | -.193 | -.236 |
| ROE | .372 | .853 | .244 | -.065 |
| ROIC | .343 | .894 | .143 | -.083 |
| Total asset turnover | -.600 | .328 | .261 | .626 |
| AR turnover | -.345 | .095 | .298 | .521 |
| Current asset turnover | -.620 | .245 | .447 | .494 |
| Ratio of working capital to total assets | .512 | .341 | -.642 | .361 |
| Current ratio | .876 | -.154 | -.130 | .411 |
| Quick ratio | .710 | .081 | -.420 | .182 |
| Reciprocal of Debt-to-asset ratio | .804 | -.354 | .214 | .364 |
| Ratio of current assets to total assets | -.268 | .392 | -.569 | .445 |
| Sales growth rate | .276 | .007 | .682 | -.342 |
| Capital maintenance and increment ratio | .743 | -.336 | .430 | .271 |
| Net income growth rate | .197 | .472 | .498 | -.026 |
| Total assets growth rate | .726 | -.388 | .425 | .284 |

Extraction Method: Principal Axis Factoring

Rotation Method: Promax with Kaiser Normalization

Table 5: Structure Matrix

| | Factor 1 | Factor 2 | Factor 3 | Factor 4 |
|---|---|---|---|---|
| ROA | .029 | .943 | -.182 | .126 |
| Gross margin | .339 | .349 | -.621 | .130 |
| ROE | .032 | .963 | .002 | .034 |
| ROIC | -.041 | .963 | -.033 | .114 |
| Total asset turnover | -.188 | .080 | .928 | .155 |
| AR turnover | .042 | -.013 | .697 | .029 |
| Current asset turnover | -.187 | .064 | .918 | -.089 |
| Ratio of working capital to total assets | .265 | .275 | -.257 | .841 |

| | | | | |
|---|---|---|---|---|
| Current ratio | .876 | .101 | -.270 | .353 |
| Quick ratio | .479 | .195 | -.431 | .516 |
| Reciprocal of Debt-to-asset ratio | .964 | -.004 | -.142 | -.008 |
| Ratio of current assets to total assets | -.280 | .051 | .262 | .773 |
| Sales growth rate | .234 | .326 | -.079 | -.701 |
| Capital maintenance and increment ratio | .928 | .057 | -.074 | -.231 |
| Net income growth rate | .119 | .627 | .176 | -.268 |
| Total assets growth rate | .938 | .003 | -.066 | -.235 |

Extraction Method: Principal Axis Factoring

Rotation Method: Promax with Kaiser Normalization

a. Rotation converged in 7 iterations

Table 6: Pattern Matrix

●● Calculating factors' scores

Based on scores showed in Table 6, equations of 4 factors could be showed as following:

F1=0.029X1+0.339X2+0.032X3-0.041X4-0.188X5+0.042X6-0.187X7+0.265X8+0.876X9+0.479X10+0.964X11-0.28X12+0.234X13+0.928X14+0.119X15+0.938X16

F2=0.943X1+0.349X2+0.963X3+0.963X4+0.08X5-0.013X6+0.064X7+0.275X8+0.101X9+0.195X10-0.004X11+0.051X12+0.326X13+0.057X14+0.627X15+0.003X16

F3=-0.182X1-0.621X2+0.002X3-0.033X4+0.928X5+0.697X6+0.918X7-0.257X8-0.27X9-0.431X10-0.142X11+0.262X12-0.079X13-0.074X14+0.176X15-0.066X16

F4=0.126X1+0.13X2+0.034X3+0.114X4+0.155X5+0.029X6-0.089X7+0.841X8+0.353X9+0.516X10-0.008X11+0.773X12-0.701X13-0.231X14-0.268X15-0.235X16

Finally, regression analysis is used to calculate scores of factors. Using contribution percentage of variance as weight for factors, comprehensive performance index F could be represented as following:

| | Factor 1 | Factor 2 | Factor 3 | Factor 4 |
|---|---|---|---|---|
| Contribution of variance | 4.077 | 3.507 | 3.070 | 2.448 |

Table 7: Contribution of variance after rotation

F = (4.077F1 + 3.507F2 + 3.070F3 + 2.448F4)/ 13.102

Based on this equation, comprehensive performance index F could be calculated. Higher the index F, better the enterprise performance. In following, index F is used as substitution variable for enterprise performance.

### 4.3 Empirical analysis

In order to verify the hypothesis, this paper use SPSS to conduct statistical analysis on the data and model, including factor analysis, descriptive statistical analysis, correlation analysis, and regression analysis, to analyze the relationship between intellectual capital and enterprise performance. The comprehensive performance index F is the explained variable.

First of all, this paper conducted descriptive statistical analysis for enterprise performance, intellectual capital, and its components, in order to study the characteristics of enterprise performance and intellectual capital. Results are showed as following：

#### 4.3.1 Descriptive statistical analysis

| | Mean | Standard deviation | N |
|---|---|---|---|
| F | 5.248214863 | 6.4407619909 | 30 |

| | | | |
|---|---|---|---|
| Capital Employed Efficiency (CEE) | .34196769253 | .307905947534 | 30 |

| | | | |
|---|---|---|---|
| Human Capital Efficiency (HCE) | 2.9976158883 | 5.56394226421 | 30 |
| Structure Capital Efficiency (SCE) | 1.9972004683 | 2.46887726891 | 30 |
| Customer Capital Efficiency (CCE) | 4.5519652593 | 6.49890118238 | 30 |
| Intellectual Potential Efficiency (IPE) | 9.546781677 | 10.1718572098 | 30 |
| VAIC | 9.8887492517 | 10.24362739561 | 30 |

Table 8: Descriptive statistic

From Table 8, the means of four components of intellectual capital are 0.3420, 2.9976, 1.9972, and 4.5520. Relatively, capital employed efficiency is lowest; and human capital and customer capital are more efficient than capital employed and structure capital in adding value. The mean of IPE is 9.5468, which means that intellectual capital for selected companies is managed above average level. The mean of comprehensive performance index F, which is 5.2482, shows that IT companies operated well in 2014.

### 4.3.2 Univariate analysis

In order to analyze the correlation between intellectual capital and enterprise performance, univariate analysis on related variables is necessary. This paper conducted correlation analysis on enterprise performance and intellectual capital and its components. Correlation analysis is a statistic method to measure relationship among various variables, including bivariate correlation, partial correlation, and distances correlation.

First of all, this paper conducted bivariate correlation analysis on components of intellectual capital and other variables.

1. Bivariate correlation analysis on components of intellectual capital

From Table 9, the three components of intellectual potential efficiency, HCE, SCE and CCE, are correlated to each other significantly. The correlation coefficient between HCE and SCE is 0.584, while the p-value is 0.001<0.01. This means HCE and SCE are significantly correlated at the 0.01 level.

CEE is positively correlated to IPE, while the correlation coefficient is 0.293

and p-value is 0.117. Moreover, the result shows that CEE is significantly correlated to HCE and SCE (correlation coefficient = 0.584 and 0.422, respectively) and that the correlation between CEE and CCE is not significant. Since HCE, SCE and CCE are components of IPE, they are all significantly correlated to IPE at the 0.01 level. (Correlation coefficient = 0.739, 0.584, and 0.824, respectively)

| Spearman Analysis | | CEE | HCE | SCE | CCE | IPE |
|---|---|---|---|---|---|---|
| CEE | Correlation coefficient | 1.000 | .480** | .391* | 0.075 | 0.293 |
| | Sig.（two-tailed） | . | 0.007 | 0.033 | 0.695 | 0.117 |
| HCE | Correlation coefficient | .480** | 1.000 | .584** | .422* | .739** |
| | Sig.（two-tailed） | 0.007 | . | 0.001 | 0.020 | 0.000 |
| SCE | Correlation coefficient | .391* | .584** | 1.000 | .417* | .584** |
| | Sig.（two-tailed） | 0.033 | 0.001 | . | 0.022 | 0.001 |
| CCE | Correlation coefficient | 0.075 | .422* | .417* | 1.000 | .824** |
| | Sig.（two-tailed） | 0.695 | 0.020 | 0.022 | . | 0.000 |
| IPE | Correlation coefficient | 0.293 | .739** | .584** | .824** | 1.000 |
| | Sig.（two-tailed） | 0.117 | 0.000 | 0.001 | 0.000 | . |
| **. Correlation is significant at the 0.01 level. | | | | | | |
| *. Correlation is significant at the 0.05 level. | | | | | | |

Table 9: Bivariate correlation analysis on components of intellectual capital

2. Bivariate correlation analysis on intellectual capital and enterprise performance

| Spearman Analysis | | F | VAIC |
|---|---|---|---|
| F | Correlation coefficient | 1.000 | .654** |
| | Sig.（two-tailed） | . | 0.000 |
| VAIC | Correlation coefficient | .654** | 1.000 |
| | Sig.（two-tailed） | 0.000 | . |
| **. Correlation is significant at the 0.01 level. | | | |

Table 10: Bivariate correlation analysis on F and VAIC

From Table 10, enterprise performance index F and VAIC has positive

correlation (Correlation coefficient = 0.654, p-value = 0.000<0.01); and the correlation is significant at the 0.01 level. This result supports the H1, namely without considering other situation, intellectual capital has positive influence on enterprise performance.

Meanwhile, simple bivariate correlation analysis cannot truly show the correlation between two variables when there are more variables, since the correlation could be affected by other variables. Therefore, partial correlation analysis is used to analyze correlation between two variables by controlling other variables. From Table 9 and 10, it is showed that variables in the model are correlated to each other. Therefore, this paper used partial correlation analysis to eliminate effect from other variables.

| Control Variable: IPE | | | |
|---|---|---|---|
| | | F | CEE |
| F | Correlation coefficient | 1.000 | 0.162 |
| | Sig.（two-tailed） | . | 0.400 |
| | df | 0 | 27 |
| CEE | Correlation coefficient | 0.162 | 1.000 |
| | Sig.（two-tailed） | 0.400 | . |
| | df | 27 | 0 |

Table 11: Partial correlation analysis on CEE and F

| Control Variable: CEE | | | |
|---|---|---|---|
| | | F | IPE |
| F | Correlation coefficient | 1.000 | 0.488 |
| | Sig.（two-tailed） | . | 0.007 |
| | Df | 0 | 27 |
| IPE | Correlation coefficient | 0.488 | 1.000 |
| | Sig.（two-tailed） | 0.007 | . |
| | Df | 27 | 0 |

Table 12: Partial correlation analysis on IPE and F

By controlling IPE and CEE respectively, enterprise performance index F has positive correlation with CEE and IPE (Correlation coefficient = 0.162 and

0.488, respectively). The p-value shows that the correlation between F and IPE is significant at the 0.01 level and that F and IPE are correlated to a certain extant but not significantly. This result supports the H2 and H6, namely without considering other situation, capital employed and intellectual potential have positive influence on enterprise performance.

| Control Variables: HCE, SCE, CCE | | | |
|---|---|---|---|
| | | F | CEE |
| F | Correlation coefficient | 1.000 | 0.488 |
| | Sig.（two-tailed） | . | 0.010 |
| | df | 0 | 25 |
| CEE | Correlation coefficient | 0.488 | 1.000 |
| | Sig.（two-tailed） | 0.010 | . |
| | df | 25 | 0 |

| Control Variables: CEE, SCE, CCE | | | |
|---|---|---|---|
| | | F | HCE |
| F | Correlation coefficient | 1.000 | 0.955 |
| | Sig.（two-tailed） | . | 0.000 |
| | df | 0 | 25 |
| HCE | Correlation coefficient | 0.955 | 1.000 |
| | Sig.（two-tailed） | 0.000 | . |
| | df | 25 | 0 |

| Control Variables: CEE, HCE, CCE | | | |
|---|---|---|---|
| | | F | SCE |
| F | Correlation coefficient | 1.000 | -0.862 |
| | Sig.（two-tailed） | . | 0.000 |
| | df | 0 | 25 |
| SCE | Correlation coefficient | -0.862 | 1.000 |
| | Sig.（two-tailed） | 0.000 | . |
| | df | 25 | 0 |

| Control Variables: CEE, HCE, SCE | | | |
|---|---|---|---|
| | | F | CCE |
| F | Correlation coefficient | 1.000 | 0.481 |
| | Sig.（two-tailed） | . | 0.011 |
| | df | 0 | 25 |
| CCE | Correlation coefficient | 0.481 | 1.000 |
| | Sig.（two-tailed） | 0.011 | . |
| | df | 25 | 0 |

Table 13: Partial correlation analysis on F and components of VAIC

First of all, by controlling HCE, SCE and CCE, F and CEE have positive correlation which is significant at the 0.01 level. Along with result from Table 4.11, this supports the H2. Moreover, it is showed that HCE and CCE are positively correlated to F (Correlation coefficient = 0.955 and 0.481, respectively). The correlation between HCE and F is significant at the 0.01 level, while the correlation between CCE and F is significant at the 0.02 level. This result supports the H3 and H5, namely human capital and customer capital have positive influence on enterprise performance without considering other situations. However, the correlation between F and SCE is negative (correlation coefficient = -0.862), which is significant at the 0.01 level. Thus, the H4 is rejected.

### 4.3.3 Multiple linear regressions

In statistics, linear regression is a method for modeling the relationship between a dependent variable and one or more explanatory variables. Regression with more than one explanatory variable is called multiple linear regressions. This paper conducted multiple linear regression on enterprise performance index F and components of intellectual capital, result of which is

showed as following:

$$F = 2.688 + 3.489CEE + 1.218HCE - 1.503SCE + 0.158CCE$$

| R | $R^2$ |
|---|---|
| 0.959 | 0.920 |

Table 14: Model analysis

Coefficient of determination ($R^2$) measures how close the data are to the fitted regression line. R square of the model is 0.920, which shows that the regression function could explain 92.0% of information of dependent variable. Therefore, the data fits regression model excellently.

| | Sum of squares | df | Mean square | F | Sig. |
|---|---|---|---|---|---|
| Regression | 1106.466 | 4 | 276.617 | 71.623 | 0.000 |
| Residual | 96.553 | 25 | 3.862 | | |
| Total | 1203.019 | 29 | | | |

Table 15: Analysis of variance

The result from Table 4.15 shows that the F-value of regression is 71.623 and that p-value is 0.000<0.01, which means that the regression model is appropriate statistically.

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. error | Beta | | |
| 1 | (Constant) | 2.688 | .610 | | 4.409 | .000 |
| | CEE | 3.489 | 1.249 | .167 | 2.794 | .010 |
| | HCE | 1.218 | .075 | 1.052 | 16.194 | .000 |
| | SCE | -1.503 | .176 | -.576 | -8.519 | .000 |
| | CCE | .158 | .058 | .160 | 2.744 | .011 |

Table 16: Coefficients

The coefficient of CEE (=3.489) shows that capital employed efficiency has a strong influence on enterprise performance. The correlation is significant at the 0.01 level. This result supports the H2, that is capital employed efficiency has positive influence on enterprise performance without considering other situations. Moreover, the coefficient of CEE is the highest among these 4 components of VAIC, which show that financial capital is still play a key role in improving corporate performance in China.

Among the components of intellectual capital, human capital efficiency and customer capital efficiency have coefficient with F as 1.218 and 0.158, respectively. The p-values are 0.000<0.01 and 0.011<0.02, respectively. So that, it could be concluded that HCE and CCE have significantly positive influence on enterprise performance, which is accordance with H3 and H5. Structure capital efficiency (SCE) has a negative coefficient with F as -1.503, of which p-value is 0.000<0.01. Therefore, the H4 is rejected.

Overall, financial capital is still the most important element for improving corporate performance in China. With development of knowledge-intense economy, intellectual capital is playing more and more important role in corporate performance.

In summary, based on analysis, VAIC and its components, CEE, HCE and CCE, all have significantly positive correlation with enterprise performance F, which verifies hypothesis proposed in this paper, H1, H2, H3, H5, and H6. SCE has significantly negative correlation with enterprise performance F, which rejects H4.

# Chapter 5 Conclusion and recommendations

## 5.1 Research summary

The research analysis results above show that analysis consequence of this paper basically consistent with hypothetical that means intellectual capital and company performance has a positive relate, and each element of intellectual capital is related to company performance. Moreover, it has an important direct or indirect influence to company performance, the analysis details are given as following:

### 5.1.1 Relationship between IC components

After the descriptive analysis of sample's types and characteristic, this paper firstly analysis the relationship between human capital and structure capital. The analysis result shows that HCE and SCE have a positive relate. Thus, it can be seen, as elements of intellectual capital, they are not individual exists in improve company performance, but they are closely bound up. Human capital is the basic and core part of intellectual capital, it is the fountain of other elements and it is important to structure capital. Otherwise, structure capital promotes the development of human capital and creates suitable condition for its development. Structure capital and human capital are closely related, and together promote the development of intellectual capital, thus improving enterprise performance.

In order to further research the relationship between each variable index and company performance, this paper also conducts the Szpilman analysis for the relationship among others variables in model. The analysis results show that CEE has a prominent relation with intellectual capital and its elements. It means that no matter traditional financial capital or intangible intellectual capital, they are closely bound up in improving intersperse performance. Financial capital of organization can impact the capacity of intellectual capital improve company performance. Therefore, in today's knowledge economy ear, with the development of intangible intellectual capital's effect in organization, it has to have a certain amount of financial capital in order to enhance company

performance.

### 5.1.2 Relationship between enterprise performance and IC and its components

The correlation analysis and regression analysis on enterprise performance index F and variables of intellectual capital proved their interrelation. Through the partial correlation analysis by controlling intellectual potential efficiency, it is concluded that capital employed is positively related with performance index F. Intellectual capital and its components is positively related with performance index F to some extent. This result shows that tangible assets and cash are still playing significant role in improving performance of IT companies. Although the status and effect of tangible capital are reducing with the development of knowledge-intense economy, it does not mean that tangible capital is unimportant or unnecessary. In the current area of rise and developmentof enterprise's intellectual capital, strong financial capital is still indispensable for development of enterprise. Moreover, human capital, structure capital and customer capital are also indispensable; otherwise, the effect of financial capital is not significant. Intellectual capital and its components, especially human capital and customer capital, have positive influence on enterprise performance. This shows that Chinese companies are paying more attention on the development of intellectual capital. Moreover, through the relationship between corporate performance and financial capital and intellectual capital, it is concluded that intellectual capital influences the corporate performance through tangible capital.

To sum up, through the empirical research on relationship between intellectual capital and enterprise performance, it is concluded that, without considering other situations, companies with more intellectual capital have better performance, that is intellectual capital has positive influence on enterprise capital.

## 5.2 Research recommendations

The research analysis result shows that the development of intellectual capital of China is standing at the first step, most organizations has already seen this issue and starting at pay attention on its development. However, the not enough degree of concern makes the effect of intellectual capital do not working in organizations. Therefore, under the condition of that knowledge is becoming an important capital; enhancing intellectual capital management is increasingly becoming the core issue of business operation.

Firstly, organization has to attach importance to enhance human capital management. Human capital is basic of intellectual capital and it is important in process of operate intellectual capital. Intellectual capital could understand as a kind of knowledge of can be converted to the market value in some sense, and it can bring profits and skills for company. Moreover, intellectual capital's knowledge and skills are contained in people's brain, thus human capital decides the operation way of other elements.

Secondly, organization has to attach importance to enhance customer capital. In the operation of intellectual capital, customer capital and human capital are interaction. In the modern economy, competition among companies is more and more intense. Customer resource is becoming an important asset which is recognized by corporate. During merger and acquisition, some sorts of customer capital, like customer list, are recognized as identifiable intangible assets. With a solid foundation of human capital, customer capital could have better influence on enterprise performance.

Thirdly, organization has to attach importance to enhance its balanced development. According to the influence of intellectual capital to enterprise performance and the interaction of intellectual capital's every element, company has to attach importance to enhance its balanced development in

order to improve its performance. In addition, the result of financial capital has a obvious positive correlation shows that although the strategy of pay more attention on finical capital is not suit for current enterprise's development, that is not meaning the development of finical capital is completely unnecessary. Thus, organization should move its development focus to intellectual capital.

### 5.3 Research limitation

This research is discussing the relationship between intellectual capital and high-tech company performance. The elements of intellectual capital are correlated, that is not right to pay attention in one element's development and ignore other elements; organizations should considerate about every element to let the intellectual capital bring maximum advantages. Financial capital is indispensable part for organizations, and it is important to promote the development of intellectual capital. They must be seen as a whole, thus they can together promote the development of company performance.

Moreover, this research has some disadvantages. Because of the limitation of time and condition, this paper only picked up some related data of high-tech listed company in 2014. Samples of this paper are relatively onefold and lack of variable, so that this results lack of applicability as well. Therefore, this paper is an attempt to analysis the relationship between the intellectual capital and high-tech company performance, however, the more accurate consequence needs further research.

### 5.4 Summary

The research of intellectual capital is gradual increasing in research field; it is a process from knowledge angel to scan enhances value in organization. Intellectual capital emphasizes the effective of hidden value to corporate

performance. In addition, based on the previous research, this paper firstly discusses definition, characteristic and elements of intellectual capital. Then discuss some intellectual capital measurement methods to point out research structure, and intellectual capital measurement method and company performance indexes are selected. After put forward hypothesis, this paper builds a model according to research hypothesis and related literature. Finally conduct descriptive analysis, correlation analysis and regression analysis to analysis the relationship between intellectual capital and enterprise performance.

Knowledge assts are increasingly becoming the core of sustainable competitive advantages. Future development of intellectual capital has to face some uncertain factors. Human capital is basis of Intellectual capital and structure capital support it; intellectual capital combines traditional financial capital and through their interaction to promote company performance. Furthermore, intellectual capital management is a process of identifies and balance elements of intellectual capital, and gives full play to its potential of value creative, improving company performance, and becoming company's resource at the end. Hopefully, this paper can give a little bit suggestion in intellectual capital research area and let more and more people pay attention on intellectual capital in order to develop organization performance.

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# Appendix

## Appendix I: Original data of financial index for IT companies

| Stock Code | ROA | Gross margin | ROE | ROIC |
|---|---|---|---|---|
| 000021 | 0.025586625 | 0.031881045 | 0.031797604 | 0.022242686 |
| 000066 | 0.016584681 | 0.095699297 | -0.005724632 | 0.043719447 |
| 000555 | 0.056763291 | 0.041489755 | 0.096951949 | 0.068767085 |
| 000785 | 0.030080314 | 0.221195136 | 0.040649499 | 0.030854621 |
| 000839 | 0.054831128 | 0.160983055 | 0.029372869 | 0.045473109 |
| 000909 | 0.015417839 | 0.069727867 | 0.047539753 | 0.03005429 |
| 000977 | 0.08138228 | 0.141869445 | 0.145070625 | 0.081308588 |
| 002090 | 0.089655338 | 0.307407783 | 0.144406078 | 0.098802168 |
| 002115 | 0.019154389 | 0.290139373 | 0.015395399 | 0.021138755 |
| 002161 | 0.037319601 | 0.313272046 | 0.036067866 | 0.030846481 |
| 002195 | 0.027364212 | 0.513506309 | 0.027882442 | 0.021574366 |
| 600100 | 0.050533313 | 0.198664562 | 0.078977568 | 0.060054811 |
| 600198 | 0.025790948 | 0.200367692 | -0.001981812 | 0.026804229 |
| 600288 | 0.019122493 | 0.175044189 | 0.005119735 | 0.020288588 |
| 600410 | 0.030093639 | 0.187624033 | 0.039671394 | 0.033069121 |
| 600522 | 0.067674357 | 0.189670313 | 0.072782403 | 0.063476174 |
| 600601 | 0.048974997 | 0.149086541 | 0.089757313 | 0.059140022 |
| 600718 | 0.041186879 | 0.286497081 | 0.043828352 | 0.046411178 |
| 600775 | 0.049210443 | 0.150769999 | 0.058054762 | 0.049998051 |
| 600990 | 0.043531515 | 0.179584415 | 0.088828258 | 0.060306538 |
| 000035 | 0.072894519 | 0.517705107 | 0.107889182 | 0.072710314 |
| 000669 | 0.079629475 | 0.303375094 | 0.083492929 | 0.078680413 |
| 002052 | -0.109441662 | 0.161633929 | -0.49381056 | -0.122646885 |
| 002065 | 0.144313109 | 0.352871368 | 0.164991313 | 0.128870531 |
| 600130 | 0.065393474 | 0.108504862 | 0.082748766 | 0.062098473 |
| 600485 | 0.161533591 | 0.918545035 | 0.17803267 | 0.134752818 |
| 600658 | 0.151025305 | 0.689720295 | 0.160421939 | 0.161578551 |
| 600733 | 0.029271225 | 0.592251008 | 0.032429725 | 0.02883937 |
| 600850 | 0.093658329 | 0.167556212 | 0.182048985 | 0.140096483 |
| 600122 | 0.046463946 | 0.091563316 | 0.048362621 | 0.053533224 |
| **Stock Code** | **Total asset turnover** | **AR turnover** | **Current asset turnover** | **Ratio of working capital to total assets** |
| 000021 | 1.138865028 | 7.429361557 | 1.419469577 | 0.154073845 |

| | | | | |
|---|---|---|---|---|
| 000066 | 1.908635747 | 193.6858765 | 2.468053338 | 0.062648935 |
| 000555 | 1.024306685 | 2.928841666 | 1.333289421 | 0.273168706 |
| 000785 | 0.424341027 | 3.650163667 | 0.66051222 | 0.437768776 |
| 000839 | 0.213404137 | 5.483949778 | 0.39895749 | 0.27970449 |
| 000909 | 0.305900221 | 18.52298184 | 0.328803738 | 0.293681698 |
| 000977 | 1.228305027 | 6.84137684 | 1.511980179 | 0.205830344 |
| 002090 | 0.714853856 | 2.327023892 | 0.920777543 | 0.300884782 |
| 002115 | 0.444595186 | 1.607258755 | 0.560870683 | 0.474080167 |
| 002161 | 0.369982254 | 1.79004357 | 0.811260042 | 0.340829482 |
| 002195 | 0.152497938 | 7.483130417 | 0.397492279 | 0.333290933 |
| 600100 | 0.52274951 | 3.833453463 | 1.028784067 | -0.041332441 |
| 600198 | 0.571733185 | 2.078401719 | 0.868268185 | 0.230526354 |
| 600288 | 1.059100439 | 6.784078192 | 1.520156057 | 0.267733156 |
| 600410 | 0.647467877 | 2.594138543 | 0.896490663 | 0.340487151 |
| 600522 | 0.732368423 | 2.623882993 | 1.047051273 | 0.427397094 |
| 600601 | 0.747865396 | 5.134712186 | 1.498377184 | -0.080870818 |
| 600718 | 0.810249245 | 4.000201306 | 1.406905903 | 0.203423317 |
| 600775 | 0.7542273 | 4.741156055 | 1.125457201 | 0.405613685 |
| 600990 | 0.638932299 | 3.084263298 | 0.871347656 | 0.116510649 |
| 000035 | 0.168353376 | 5.303560777 | 0.637470844 | -0.019000063 |
| 000669 | 0.282506523 | 8.781253668 | 0.890951725 | -0.088494812 |
| 002052 | 0.536454566 | 1.446110069 | 0.779049312 | -0.023004952 |
| 002065 | 0.652583747 | 1.751658888 | 0.888264666 | 0.553438069 |
| 600130 | 1.334556956 | 14.20141768 | 1.732437609 | 0.526234841 |
| 600485 | 0.222068068 | 1.47927063 | 0.280234789 | 0.589703836 |
| 600658 | 0.320341154 | 24.17792964 | 0.400470209 | 0.506915327 |
| 600733 | 0.061219353 | 4.576995562 | 0.069944661 | 0.637143379 |
| 600850 | 1.491362099 | 4.920748283 | 1.5385174 | 0.369193037 |
| 600122 | 0.979732529 | 18.91903635 | 1.368631732 | 0.304897454 |

| **Stock Code** | **Current ratio** | **Quick ratio** | **Reciprocal of Debt-to-asset ratio** | **Ratio of current assets to total assets** |
|---|---|---|---|---|
| 000021 | 1.237678975 | 1.115308575 | 1.537746893 | 0.802317321 |
| 000066 | 1.088152569 | 0.134978377 | 1.272502739 | 0.773336507 |
| 000555 | 1.551759431 | 1.25128478 | 1.8604431 | 0.768255315 |
| 000785 | 3.13886313 | 2.911839357 | 2.493141829 | 0.642442357 |
| 000839 | 2.096020902 | 1.001898835 | 2.379761599 | 0.53490445 |
| 000909 | 1.461284117 | 0.126847331 | 1.210790683 | 0.930342894 |
| 000977 | 1.339345287 | 0.560811574 | 1.646361425 | 0.812381699 |
| 002090 | 1.63280999 | 1.152366483 | 1.941799 | 0.776358917 |
| 002115 | 2.487976265 | 1.457064889 | 1.893445457 | 0.792687511 |
| 002161 | 3.957837365 | 2.851837712 | 8.120017133 | 0.456058766 |

| | | | | |
|---|---|---|---|---|
| 002195 | 7.618281993 | 2.220328852 | 19.79237383 | 0.383650064 |
| 600100 | 0.924775715 | 0.539510304 | 1.447134363 | 0.508123645 |
| 600198 | 1.538677187 | 0.948082728 | 1.440592637 | 0.658475336 |
| 600288 | 1.624127467 | 0.907000831 | 2.300924004 | 0.696705074 |
| 600410 | 1.89193996 | 1.343098451 | 1.673123626 | 0.722224898 |
| 600522 | 2.570960883 | 1.668255847 | 3.21172565 | 0.699458033 |
| 600601 | 0.860564605 | 0.556945328 | 1.626404831 | 0.499116914 |
| 600718 | 1.546124402 | 1.057505752 | 2.377342471 | 0.575908625 |
| 600775 | 2.533289476 | 1.278220314 | 3.727139164 | 0.670151916 |
| 600990 | 1.188908075 | 0.796662209 | 1.542569081 | 0.733269086 |
| 000035 | 0.932884704 | 0.51023134 | 1.983078729 | 0.264095805 |
| 000669 | 0.781806118 | 0.705551188 | 1.8359096 | 0.317083984 |
| 002052 | 0.967671808 | 0.701368798 | 1.394005908 | 0.688601553 |
| 002065 | 4.053711369 | 3.08381392 | 4.864409893 | 0.73467264 |
| 600130 | 3.155817111 | 1.431004601 | 3.970809493 | 0.770334787 |
| 600485 | 3.908786252 | 2.685971449 | 4.07599198 | 0.792435762 |
| 600658 | 2.730102728 | 1.685210787 | 3.344648797 | 0.799912569 |
| 600733 | 3.675827954 | 1.932548522 | 4.188145711 | 0.875254121 |
| 600850 | 1.615160628 | 0.884380828 | 1.657523268 | 0.969350167 |
| 600122 | 1.74193191 | 1.292590098 | 1.871280494 | 0.715848176 |

| Stock Code | Sales growth rate | Capital maintenance and increment ratio | Net income growth rate | Total assets growth rate |
|---|---|---|---|---|
| 000021 | 0.093396059 | 1.017772337 | 0.010584843 | 1.051908867 |
| 000066 | -0.026418286 | 0.978917254 | 0.936178726 | 1.012482134 |
| 000555 | -0.149664806 | 1.53948668 | 0.184973961 | 1.061420495 |
| 000785 | 0.031623672 | 1.702581339 | 0.120880148 | 1.416171679 |
| 000839 | 0.147179114 | 1.123413762 | 0.446695544 | 0.957838496 |
| 000909 | 0.117674983 | 1.048666139 | 0.20566768 | 1.070690575 |
| 000977 | 0.729895871 | 2.192390352 | 1.342700101 | 1.683887835 |
| 002090 | 0.120365027 | 1.214770326 | 0.863824193 | 1.070949206 |
| 002115 | 0.142959321 | 1.015735287 | 1.101808114 | 1.024367827 |
| 002161 | 0.186586859 | 1.055277476 | 0.151465601 | 1.101490697 |
| 002195 | 0.641391569 | 8.732456072 | 2.887096185 | 8.786752829 |
| 600100 | 0.147618483 | 1.123574541 | 0.125573666 | 1.166749499 |
| 600198 | 0.008699546 | 1.702336343 | -1.058220213 | 1.252493187 |
| 600288 | -0.056135978 | 1.003971565 | -0.720492476 | 0.946700509 |
| 600410 | -0.111600948 | 1.089914883 | 1.083893627 | 1.157823111 |
| 600522 | 0.276165227 | 1.46976927 | 0.068142508 | 1.311710082 |
| 600601 | -0.066530139 | 0.897851762 | 14.05962912 | 1.013337686 |
| 600718 | 0.046100822 | 1.010630855 | -0.364603002 | 1.026202743 |
| 600775 | -0.156803692 | 1.015772796 | -0.11784306 | 1.031934212 |

| | | | | |
|---|---|---|---|---|
| 600990 | 0.508531291 | 1.089803976 | 0.572033183 | 1.263846788 |
| 000035 | 1.205232332 | 1.827231008 | 1.143358321 | 1.608382113 |
| 000669 | 0.616551453 | 1.891564839 | 0.121253995 | 1.667268226 |
| 002052 | -0.181101963 | 0.668088003 | -13.20140207 | 0.902744175 |
| 002065 | 0.169149602 | 1.694733837 | 0.347391751 | 1.318545408 |
| 600130 | 0.199008466 | 1.090194987 | 0.093953924 | 1.109582231 |
| 600485 | 0.338531509 | 2.381963893 | 0.115773005 | 2.248511563 |
| 600658 | -0.060099825 | 1.125625451 | -0.02297027 | 1.062199871 |
| 600733 | -0.832199895 | 1.003005611 | -0.716870174 | 0.952245165 |
| 600850 | 0.031043654 | 1.129800757 | 0.01440581 | 1.011433942 |
| 600122 | 0.097862743 | 1.371598249 | 0.300697872 | 1.232582459 |

## Appendix II: VAIC and its components for IT companies

| Stock Code | F | CEE | HCE | SCE |
|---|---|---|---|---|
| 000066 | 36.81606135 | 0.591397251 | 23.45661292 | 0.630445187 |
| 002195 | 14.34074116 | 0.345899368 | 12.47846351 | 0.954070853 |
| 600658 | 7.408757565 | 0.324639975 | 19.22062949 | 12.56304223 |
| 600130 | 6.211859059 | 0.320634196 | 1.002288069 | 0.913264524 |
| 600122 | 5.968297922 | 0.199338928 | 2.524770476 | 3.4981101 |
| 600601 | 5.4267153 | 0.504288745 | 1.183234429 | 2.861319591 |
| 002161 | 5.169980905 | 0.485646633 | 1.610713661 | 0.936734097 |
| 000909 | 4.979577437 | 0.279870593 | 1.113980016 | 1.494032263 |
| 002065 | 4.874095361 | 1.163823948 | 2.228480634 | 2.551393944 |
| 600485 | 4.720149966 | 0.416619241 | 2.618780157 | 5.523067835 |
| 000977 | 4.114046093 | 0.605859091 | 1.608534973 | 1.554569742 |
| 600733 | 4.101147026 | 0.069544883 | 2.28281633 | 1.318929663 |
| 000785 | 4.03226651 | 0.093162025 | 0.803283579 | 0.776131922 |
| 600775 | 3.889377028 | 0.353209234 | 0.583115917 | 0.729726755 |
| 600522 | 3.688144283 | 0.512002363 | 2.321863126 | 2.202852593 |
| 000669 | 3.610983871 | 0.395689883 | 0.879660892 | 1.184374475 |
| 600288 | 3.456243664 | 0.114166227 | 0.245345821 | 0.252329058 |
| 000021 | 3.451016153 | 0.076341731 | 0.456884153 | 1.874666159 |
| 600850 | 3.389742953 | 0.443049148 | 0.954938101 | 1.196999071 |
| 000839 | 3.318014951 | 0.583004852 | 0.818734988 | 3.824805223 |
| 000035 | 3.181082551 | 0.793656317 | 6.59523148 | 5.865761629 |
| 000555 | 3.04256199 | 0.244269532 | 0.536492376 | 0.900027788 |
| 600718 | 3.006240157 | 0.339350976 | 0.224258259 | 0.455788308 |
| 600410 | 2.987152475 | 0.150481372 | 0.331780451 | 1.01510154 |
| 002115 | 2.972358384 | 0.209127569 | 0.349061639 | 0.4783232 |
| 002090 | 2.948653813 | 0.56629805 | 1.094572873 | 1.064529816 |

| | | | | |
|---|---|---|---|---|
| 600990 | 2.61323174 | 0.196663321 | 0.918843059 | 1.269749189 |
| 600100 | 2.416576937 | 0.515734121 | 1.3226751 | 1.833877734 |
| 600198 | 2.33221886 | 0.047842507 | 1.278954545 | 1.07393059 |
| 002052 | -1.020851496 | -0.682581293 | -1.116524552 | -0.881942096 |
| **Stock Code** | **CCE** | **IPE** | **VAIC** | |
| 000066 | 5.607486703 | 29.69454481 | 30.28594206 | |
| 002195 | 1.564862332 | 14.99739669 | 15.34329606 | |
| 600658 | 7.265892738 | 39.04956445 | 39.37420443 | |
| 600130 | 24.88245358 | 26.79800618 | 27.11864037 | |
| 600122 | 1.959344225 | 7.982224802 | 8.18156373 | |
| 600601 | 2.582179817 | 6.626733836 | 7.131022581 | |
| 002161 | 1.452154188 | 3.999601945 | 4.485248578 | |
| 000909 | 3.192028877 | 5.800041157 | 6.07991175 | |
| 002065 | 6.533968285 | 11.31384286 | 12.47766681 | |
| 600485 | 20.85657944 | 28.99842743 | 29.41504667 | |
| 000977 | 1.397827437 | 4.560932152 | 5.166791243 | |
| 600733 | 10.81428453 | 14.41603053 | 14.48557541 | |
| 000785 | 1.122846612 | 2.702262114 | 2.795424139 | |
| 600775 | 6.118492289 | 7.431334961 | 7.784544195 | |
| 600522 | 2.570878624 | 7.095594342 | 7.607596705 | |
| 000669 | 1.11064558 | 3.174680947 | 3.57037083 | |
| 600288 | 0.382202232 | 0.87987711 | 0.994043336 | |
| 000021 | 20.78011782 | 23.11166813 | 23.18800986 | |
| 600850 | 1.611301678 | 3.76323885 | 4.206287999 | |
| 000839 | 4.433238451 | 9.076778662 | 9.659783514 | |
| 000035 | 0.905797189 | 13.3667903 | 14.16044662 | |
| 000555 | 0.989908826 | 2.42642899 | 2.670698522 | |
| 600718 | 0.941269191 | 1.621315757 | 1.960666734 | |
| 600410 | 0.691133557 | 2.038015548 | 2.18849692 | |
| 002115 | 1.02729373 | 1.854678569 | 2.063806138 | |
| 002090 | 1.822703108 | 3.981805797 | 4.548103847 | |
| 600990 | 2.198249944 | 4.386842191 | 4.583505512 | |
| 600100 | 0.258921185 | 3.415474019 | 3.93120814 | |
| 600198 | 2.604690216 | 4.957575351 | 5.005417858 | |
| 002052 | -1.119792812 | -3.11825946 | -3.800840753 | |