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Measuring Social Capital and Proximimty

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Measuring Social Capital and Proximity¹

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Abstract. Presumably, a question how to position and measure the value of social capital (SC) of a company, country or region has come to predominate the debate over society and governance. We argue that social capital is of static (*e.g.* SC value of Microsoft at the end of a quarter, say, Sept. 30, 2008) or dynamic nature (*e.g.* change of SC of Poland over the present economic slowdown, that is between, say, 1 July 2008 and now). We provide a tool to suitably measure it under both concepts. Also, we demonstrate that it is proximity that plays an inestimable role in the analysis of social capital, be it at a company or country level. Although based on our previous papers, published in Proceedings of ERSA 2008 and 2009, the following pages are meant to be a self-contained piece.

We first briefly introduce the concept of orthogonality in social sciences (static approach), known as the Orthogonality Principle: Two forms A and B are orthogonal or disjoint if and only if there exists a simple, one-dimensional decision rule of yes-no type by which we can decide whether an object from an analysed universe X belongs to A or B . In this paper we find that such a decision rule exists in relation to tangibles and intangibles of a given firm or country and demonstrate that they are mutually orthogonal, which means that both categories of assets can be added regardless of the measure (money, points scores, etc.). This will not be the case of formal and informal relations, important components of social capital. They are not orthogonal (Li, 2007), so we cannot add their values. In an inductive way, we describe four forms of capital as financial, physical, human and social and prove that they are mutually orthogonal. We postulate that the value of a firm/country (the value of its entire capital) is an aggregate value of the four components above. We introduce the concept of new GDP and describe how to evaluate it and compare with the GDP model used today.

Further, we argue (dynamic approach) that the Virtual Production Line, defined by us in 2006, is a good tool to study proximity, a concept introduced by the French proximity school (Torre and Gilly, 2000; Torre and Rallet, 2005; Torre, 2006; Rallet and Gilly, 1999), and most recently studied by Menzel, 2006. Like capital, proximity is complex and multidimensional, and depends on time. We propose that there are four forms of proximity: cognitive, emotive, spatial and organizational. By the Orthogonality Principle, we prove that they are mutually orthogonal. We also suggest methods to evaluate them based on that Principle. By an example in Section 8 we show how to measure trust on the country level, the main component of emotive proximity. Finally, we recommend ways to design relevant questionnaires in social sciences.

Key words: Social capital; Human capital; Proximity; Orthogonality Principle; Fundamental Equation.

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1. Introduction

Despite growing popularity, social capital suffers from two main points:

- i) **Conceptual confusion about the level of analysis.** Many scholars analyse social capital at a broad level (region/country) viewing it as an attribute of an individual that cannot be evaluated/assessed without the knowledge of the society in which the individual operates. A short paper by Robert Putnam published in 1995 sparked off a fiery debate about the concept of social capital and its appraisal. His perceptions shocked as they called into question whether the US social capital was growing. In a book “Bowling alone”, published 5 years later, he argued even more strongly that the decline was not only in place but went rapidly on and threatened the quality of democracy and life. Roughly, half debaters support his view (see reviews of Sobel, 2002; Powar, 2006; Li, 2007). A book “Intellectual Capital. The Proven Way to Establish your Company Real Value by Measuring its Hidden Brainpower” by Leif Edvinsson and Michael S. Malone, published in 1997, represents a powerful and popular approach to the analysis of social capital at a firm level. We quote the full title as it delineates their ambit to promote an alternative philosophy about accounting which, unlike classic accounting, will allow to assess and register the value of social capital (see point 9.2 in Section 9). There are also works which combine the two approaches above (see e.g. Westlund, 2006; Westlund and Nilsson, 2005; Westlund and Bolton, 2003).
- ii) **Lack of methodology for social capital evaluation.** It is a common belief, that like intangible assets, social capital is informal in nature and thus extremely difficult to analyse and evaluate (see e.g. Sobel, 2002; Quibria, 2005; Arrow, 1999; Chow, 2006; Sabatini, 2005; Young, 2007).

The two above points are of great relevance to our study, the second being paramount. The main objective of this paper is to describe a methodology for the assessment of social capital value of **firm F** , a broadly defined economic entity where people combine their efforts to achieve more or less defined objective(s) and certain accounting system is used to more or less precisely evaluate and register such efforts. A production/service company, school/university, sports club, political party/organization, family etc. are examples of our firm F , whereas e.g. Linux - a social movement for free and open software – is not. Programmers who contribute their work under Linux label are not paid for their software, nor is there anybody who takes legal responsibility for errors and mistakes such software may produce. So the difference between firm F and Linux is exactly the same as between a political party and a civic movement.

We generalise our considerations to the country/region level and view a national economy as one big company, a **megafirm MF** , where people make products (increase physical capital) and money (financial capital), learn/study (human capital) and cooperate or fight, e.g. in parliament (increase or reduce/decrease social capital). A very basic result of our methodology for social capital evaluation, the so called Orthogonality Principle is presented in Section 3. We further prove that the (market) value of firm F at time t , denoted as $V(F,t)$ equals the aggregate of the four forms of capital: financial, physical, human and social, and generalise our findings to the level of national economics (Section 5).

So far, we take a static approach in which we consider social capital as a **static resource**. In the following pages, however, we study how social capital works, how gets changed with time, etc., which is a **dynamic process**. In Section 6 we describe Virtual Production Line as a tool for an analysis of creative processes and study proximity between actors involved in such processes (Section 7 and 8). We finally formulate recommendations how to built questionnaires in social sciences based on the Orthogonality Principle. Although based on our works published in Proceedings of ERSA 2008 and 2009, this paper is done as a self-contained piece.

2. Basic assumptions

“How much does it cost?” or “What is the value of it?” are types of questions which have lived for almost as long as the humankind has, but the meaning, of course, has become more complex with time. In market economy, when demand equals supply – in this paper we will consider such equilibrium case only – the reply is obvious considering simple things like an apple or a service, say, a train service from London to Birmingham. The reply gets complicated if we seek to value a company/firm, say, Microsoft, or an institution like Systems Research Institute. It gets yet more complicated when we seek to measure the (entire) wealth of a given country or region.

In the case of Microsoft, a listed company, the answer to the above question - we will call it further Question A - seems easy at first: The **(market) value** of a firm F (Microsoft) at a given time t is equal to product of the number of stocks issued and the stock price. Then, e.g. on 31st March 2008 we had 9,566,808,000 stocks for the closing price \$28.38 each, so $V(\text{Microsoft}, 31.03.2008) = \$271,506,011,040$. Fig. 1, the left scale, shows how the market value of Microsoft fluctuated at the New York Stock Exchange over 2008, or from 31st December 2007 to 31st December 2008 to be exact. We define the **book value** of F for a given t , denoted by $BV(F, t)$, as the difference between its total assets and its total liabilities, calculated at the end of a reporting period - in case of Microsoft it is always a quarter - when balance sheets are prepared. So the book value is a stepwise function of time. Microsoft's book value for the above mentioned period is shown against the right scale (Fig. 1) and represented by the dotted line. Company book value is commonly regarded as the value of F calculated by accounting principles. For almost all stock market companies, the market value is higher - in knowledge-intensive sectors much higher - than the corresponding book value. Then, naturally, the Question A can be rephrased as: Why were investors ready on the 31st March 2008 to pay more than 6 times the book value of Microsoft? What did they pay for?

The aim of this paper is to provide our answer to this and suchlike questions.

We call the above way of establishing $V(F, t)$ **indirect purchasing** because a typical investor in, say, Microsoft case usually buys a few hundreds of stocks from almost 10 billion stocks issued. **Direct purchasing** happens when firm F is sold direct or merged with another. In that event, its $V(F, t)$ is a result of negotiations between the seller and the buyer. To analyse investors' decisions in both types of purchase above, we need an **investment model** allowing for three phases: “**past**” (always put in quotation marks), “**present**” and “**future**”. Investors, having information from the “past,” take decisions at the “present” to succeed (financially) in the “future”. By three examples below we will demonstrate how the investment model should be used in practice.

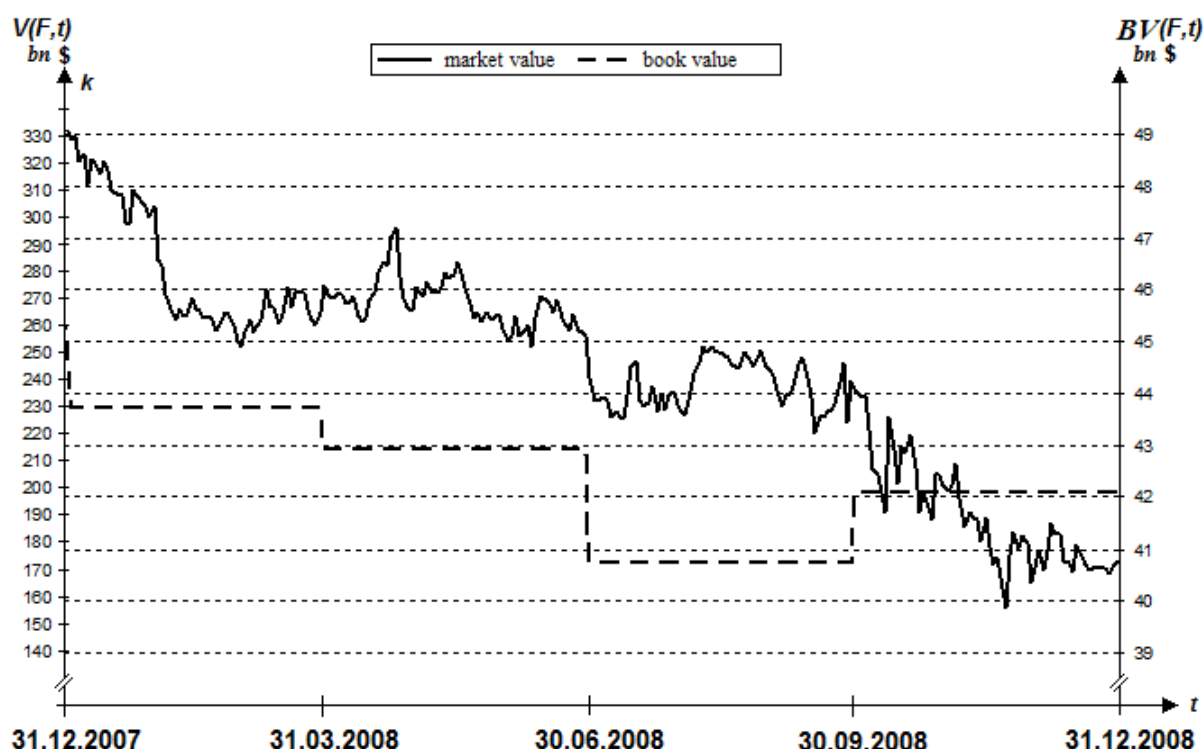


Fig. 1. The market value and the book value of Microsoft in 2008

When I buy an apple, I take a decision in, say, 10 seconds (“present”) based on my life experience (“past”) to eat it in minutes or days to come (“future”). Similarly, an investor buys Microsoft stocks after an analysis which can last seconds or days (“present”), based on information about the company, both official and unofficial, e.g. rumours, from the “past” to achieve a financial success in the “future”. The budget support for the Systems Research Institute in the next year 2010 (“future”) is established in 2009 (“present”) by the Polish Ministry of Science and Higher Education after an analysis of our achievements, mostly publications, in the last two years (“past”). In this example, the “present” and the “future” last one year, while the “past” – two years. We note that the “present” may be an infinitely short border (an instant) between maybe practically infinitely long “past” and “future”, but these three phases always exist. We obviously assume that, while taking decisions at the “present,” we have some model(s) of rational economy for “future” in mind and this rational economy is a branch of science based on reason. For instance, we assume that the wealth/progress/development is made by more or less organized productive work and not by e.g. gambling in Las Vegas.

To make the subject of this paper more definite, let us consider all, absolutely all assets of a given firm F at a time t from the “past”, “present” or “future” and denote its value as $V(F,t)$. The fact that we analyse all assets of a given firm or a piece of reality (set) X will be represented graphically as a (full) circle (see Fig. 2). Since we may find X too complex (difficult) to analyse, we will divide it into two parts (subsets) A and B . Then there are two alternatives: i) either subset A , marked with vertical lines, partially overlaps (covers) subset B ,

marked with horizontal lines (their overlapping is marked with check pattern), as shown in Fig. 2a - **division** of X , or ii) subsets A and B form a **partition** of X (see Fig. 2b). Any partition is then a division, but not the opposite.

Let us assume that we determine the value of A by summing up values of its elements 1, 2 and so on, marked by circles in Fig 2a and next determine the value of B by summing up its elements marked by crosses. The second element of B in Fig. 2a is exactly the same as the third element of A , so here we have violation of a very basic rule of accounting, which says that any item/element should be taken into account once and only once. This does not happen in Fig. 2b, where we have a partition of X into A and B . Since in social sciences like economics, management, sociology and political sciences a piece of reality X cannot be represented graphically as Fig. 2a or 2b, in the following Section we formulate the Orthogonality Principle which regulates when two forms (concepts, categories, processes, dimensions etc.) A and B are disjoint, as in Fig. 2b, or orthogonal.

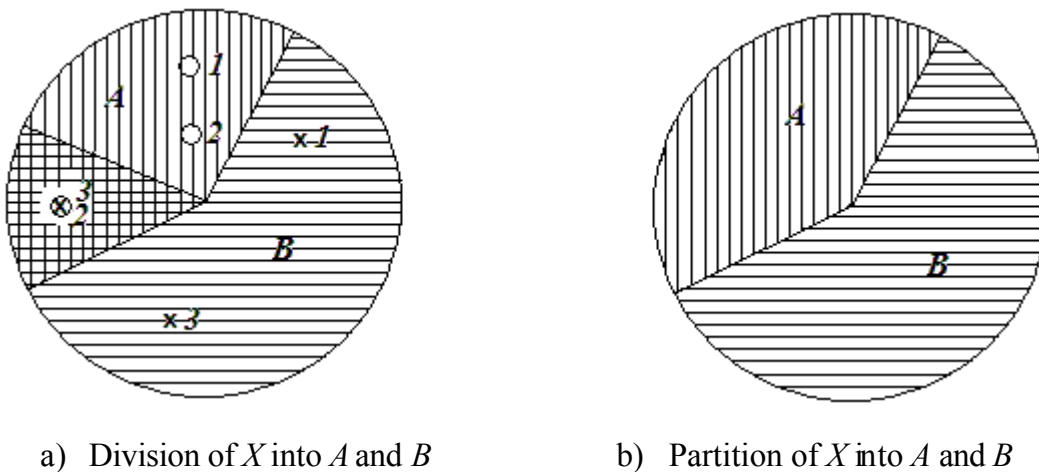


Fig.2 The difference between division and partition

3. The Orthogonality Principle and its applications

The axes t and k in Fig. 1 are orthogonal to each other. This means that no matter how precisely we measure time t (in seconds, days, months etc.) or capital k (e.g. in thousands or millions of dollars), the function $k=f(t)$ will stay the same, e.g. the book value function will always be a stepwise function. Unfortunately, in social sciences the relation between two variables (concepts, categories, forms etc.) can very rarely be represented in such a manner as in Fig. 1 or 2. The aim of the Orthogonality Principle formulated below is to provide a practical recommendation when two forms A and B are orthogonal or disjoint like in Fig. 2b, but not like in Fig. 2a.

Orthogonality Principle: Two forms (concepts, categories, processes, dimensions, etc.) A and B are **orthogonal** or **disjoint** if and only if there exists an objective, simple, one-dimensional **decision rule** of the yes-no type, by which we can always and everywhere decide whether an object from the considered part of reality X belongs either to A or to B .

Now we discuss four conditions we put on the decision rule in the Orthogonality Principle. The condition ‘**objective**’ means that the application of the decision rule does not depend on who applies it, where and when. A decision is ‘**simple**’ when it can be formulated in one-two plain language sentences. To illustrate, let X be a balance sheet of a given firm F , then a decision rule given in an academic lingo on, say, 10 pages, to understand what accountants study in academic books is obviously far from simple. For the same reason, we require a decision rule to be ‘**one-dimensional**’ and of the ‘**yes-no type**’ as it is impractical to assume that in a foreseeable future accountants will start using multicriteria decision making techniques or the fuzzy set theory in their everyday practice.

Since the Orthogonality Principle plays a key role in our considerations, we shall represent it in a mathematical (set theory) format. The Orthogonality Principle **partitions** a nonempty set X into two and only two nonempty sets A and B such that

$$X = A \cup B, A \cap B = \emptyset, A \neq \emptyset, B \neq \emptyset. \quad (1)$$

Consider a plate (our set X) dropped down on the floor. If it breaks, then we have a **partition** of X into at least two pieces. The graphical interpretation of the Orthogonality Principle is given in Walukiewicz, 2008b. Four examples below demonstrate practicality of this Principle.

Example 1. Classical mechanics. The concepts “static” (our set A) and “dynamic” (set B) from classical mechanics (set X) are obviously orthogonal or disjoint. The decision rule here is the absence or presence of motion. One can easily check that such a decision rule satisfies all four conditions of the Orthogonality Principle. So potential (static) energy E_p is disjoint with kinetic (dynamic) energy E_k , therefore by (1) we can add their values. In such a way we prove the energy conservation law, well known from classical mechanics

$$E = E_p + E_k. \quad (2)$$

It says that the entire energy of a given (closed) system E equals the sum of these two and only two kinds of energy.

Example 2. Tangible and intangible assets. Consider all, absolutely all assets (capitals) of a given firm F at a given time t from its “past”, “present” or “future”, denoted as $V(F,t)$. From the very beginning of accounting as a managerial science, the accountants used to divide all assets into two very broad forms (categories): tangible and intangible. Can we say that they are disjoint or orthogonal?

The answer is yes, they are disjoint or orthogonal. The decision rule here says that tangible assets (money, buildings, machines, energy, software, patents etc) can be touched, while intangible ones (competences, experiences, talent, trust, cooperation, but also distrust, personal fight etc.) cannot. One can easily check that such a decision rule satisfies all four conditions of the Orthogonality Principle. Reasoning why software and patents are counted as tangibles are given in Walukiewicz, 2008b. Relation between tangible and intangible assets as disjoint or orthogonal can be represented graphically in Fig. 2b. Therefore, if we denote by $v(TA,t)$ the value of tangible assets (capitals) of firm F at time t , and, similarly, by $v(ITA,t)$ intangible assets, then by (1) we can write

$$V(F,t) = v(TA,t) + v(ITA,t). \quad (3)$$

In a similar way (see Walukiewicz, 2008b) we prove that there exists a decision rule dividing tangible assets into two disjoint/orthogonal forms: financial capital with its value $v(FC, t)$ and physical capital – $v(PC, t)$. So, we arrive at

$$v(TA, t) = v(FC, t) + v(PC, t). \quad (4)$$

Example 3. Human and social capital. There is a common belief that intangible assets are extremely difficult to analyse and evaluate (see e.g. Sobel, 2002; Quibria, 2005; Arrow, 1999; Chow, 2006; Edvinsson, 2002; Edvinsson and Malone, 1997; Putnam, 1995 and 2000; Lin, 2001; Sabatini, 2005). For such complex objects we apply our Fig. 2 concept and divide all intangible assets of a given firm F into two forms: human capital and social capital. We prove (see Walukiewicz, 2008b and 2007) that these two forms are disjoint or orthogonal. The decision rule here says: one man – human capital, two or more – social capital. It is easy to see that such a decision rule satisfies all four conditions of the Orthogonal Principle. In other words, human capital is always associated with a single human, specifically with his/her competences, experiences, talent, health etc. while social capital is always connected with a group of at least two people, the way they cooperate, trust or distrust each other etc. Relation between two individuals is then a very basic component of social capital. Using obvious notation, we arrive at

$$v(ITA, t) = v(HC, t) + v(SC, t). \quad (5)$$

This means that whatever measure we use (money, points, etc.) to evaluate intangibles, we can add human capital to social capital. Obviously, we cannot add dollars to points; both human and social capital should be measured in the same units and on the same scale. At any rate, Fig 2b shows the relation between human and social capital.

Example 4. Formal and informal relations. All relations in the world, and in our firm F in particular, can be divided into two very broad forms of formal and informal relations between people. The analysis of social capital would be much, much easier if these two forms were orthogonal. Unfortunately, Li, 2007, p. 229, demonstrated that we need a 5-dimensional decision rule to distinguish formal relations from informal ones. So formal and informal relations are not disjoint or orthogonal to each other (see Fig. 2a) and we cannot add their values. In Section 7 we will study a much narrower concept of proximity and apply the Orthogonality Principle to that.

According to Li, 2007, p. 229 we need five dimensions to separate formal relations from informal ones. They are as follows:

- i. **Codification.** Formal relations are explicitly prescribed in constitutions, codes, regulations etc., while informal are not.
- ii. **Formation.** Formal relations are exogenously imposed by history, experiences, tradition etc. while informal ones are endogenously embraced.
- iii. **Enforcement.** Formal relations are or should be enforced rigidly by law with its vertical structure, while informal relations are flexibly adopted via horizontal peer pressures.
- iv. **Power.** Formal relations are executed/realised by vertical authority powers, while in informal relations all people are equal, on the same level.

- v. **Personalization.** Formal relations are between depersonalised posts/ranks etc., while informal ones are between people with all their merits and faults.

In other words, the world of relations is much more complicated than the world of assets, although in both cases we have two forms (categories): tangible and intangible assets form a partition of such world (see Fig. 2b), while formal and informal relations are overlapping each other, as shown in Fig. 2a.

Examples 2 and 3 demonstrate that our concept has a level structure. On level zero ($2^0=1$), all capital of F is one entity, on level one ($2^1=2$) the Orthogonality Principle is applied and the capital of F is partitioned into two categories: tangible and intangible assets. Among tangibles we then distinguish financial capital as a set of elements of direct monetary (financial) nature and call the rest physical capital. Since financial capital is measured in monetary units, we apply the same measure to physical capital using techniques known as amortisation methods. Among intangible assets we distinguish human capital, that is discrete individuals (workers) with their ability to think, cooperate, express emotions, etc., and social capital which is the rest.

Let us then summarise as follows:

Lemma 1. Financial capital, physical capital, human capital and social capital of firm F are mutually disjoint or orthogonal. The division of the entire capital of firm F into the above four forms is its partition.

A graphical representation of this statement is given in Fig. 3 below.

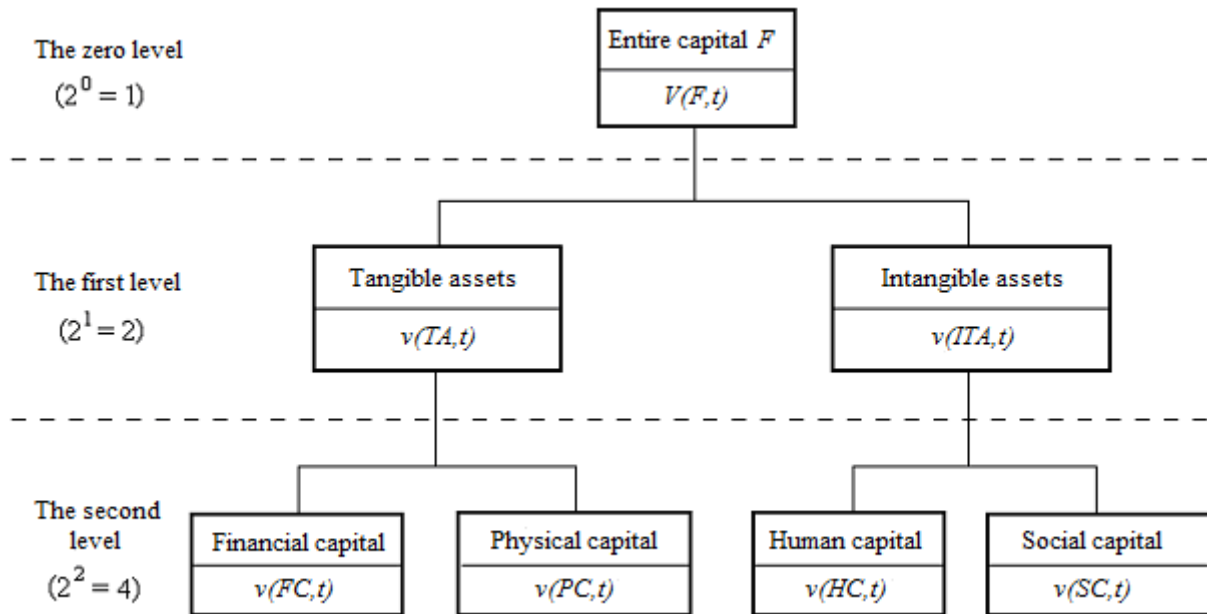


Fig. 3 The graphic representation of Lemma 1

Each form of capital of F may be considered either as a **static concept (a stock)** or as a **dynamic process (a flow)**. Obviously, they are tightly connected to each other and closely

cooperate in a given firm. In the next Section we will demonstrate how Lemma 1 can be used in evolutionary modifications of (classical) accounting.

4. The Fundamental Equation

Since the entire capital of firm F is partitioned into four forms (see Lemma 1), we can add their values and propose the following formula

$$V(F,t) = v(FC,t) + v(PC,t) + v(HC,t) + v(SC,t) \quad (6)$$

for any moment t in the “past”, “present” or “future” of firm F .

We will call it **Fundamental Equation** as it forms a base of the **accounting model** for social capital analysis. The formula says that in a market economy, under the equilibrium conditions, when demand equals supply, the value of a firm F equals the aggregate sum of four component values of its capital: financial, physical, human and social at any moment t of the firm’s “past”, “present” and “future”. The equilibrium conditions are important, as, for instance, the Fundamental Equation is inapplicable in the well known Enron case, where the equilibrium conditions were disturbed by crime. We will also call (6) the accounting model since we use accounting methods and techniques to calculate or assess the four values concerned.

The Fundamental Equation says that the future balance sheets will be divided into four main chapters, or be based on four big pillars, reflecting the above forms of capital. Obviously, it will take time to introduce such changes in (classical) accounting, but Example 6 in Walukiewicz, 2008b demonstrates that even now (Spring 2009) balance sheets contain some elements of social capital. Interestingly, our logic shows that further analysis of firm F capital will presumably go deeper but never wider: on the third level we will have eight subforms of capital, on the fourth level 16 and so on, but on the second level one should not expect the fifth, the sixth, etc. element like intellectual capital, organizational capital, relational capital, cultural capital, etc. All such forms, if necessary, should find their place at deeper levels, following the regular pattern of nodes and subnodes. Incidentally, almost all authors use the term “intellectual capital” as an equivalent to intangible assets which are too complex for our analysis (see also Young, 2007). We note at this point that while describing 8 subforms of capital on the third level for so generally defined firm F is difficult, it should be substantially easier to do that for a specific firm or sector.

The Fundamental Equation also says that both the values of a firm and the four forms of its capital are **cumulative**, i.e. their values (stocks) change gradually in the “past”, “present” and “future”. Consider once more the Fundamental Equation and observe that the values of its right hand side change, in general, at a very different rate/frequency. Due to modern computer banking systems we can register whatever changes of $v(FC)$ almost every other second or nanosecond, but with most commonly used amortisation techniques, changes in the value of physical capital, whatever their number, are usually recorded only once a year. Similarly, research projects are evaluated on a yearly basis (social capital), whereas contracts with top experts (human capital) are usually signed for years. Such irregularity means that while applying the Fundamental Equation to a particular sector or company, one should use certain smoothing techniques. The same is true when it comes to the application of our investment

model: we always should define the meaning of the “past”, “present” and “future”. Finally, the Fundamental Equation gives a general answer to Question A: investors in such transactions, real or artificial (theoretical), pay for the four forms of capital as above and nothing else.

Below we present a very important result of the foregoing partition of intangible assets.

Lemma 2. In a one-person enterprise $v(SC) = 0$, i.e. there is no social capital.

It takes at least two experts, two staff members, two organizational units, etc. to build any relation, a basic element in evaluation of $v(SC)$ of a firm. We observe that the **synergy effect**, the basic concept in management science, appears only when there is cooperation of at least two people, that is when $v(SC) > 0$. Lemma 2 was published for the first time in 2006 (see Walukiewicz, 2006a and also 2006b, 2007) and was considered by some researchers as a wrong concept. Their reasoning was that success of a one-person shop depends, among others, on relations between its owner and his/her clients, i.e. how social he/she is with them. To evaluate human capital of a one-person company, one should consider external relations of that business in the way exactly the same as exports and imports are considered in evaluation of GDP of a country or region. For that reason, there is no social capital in a one-person company (see Example 3), all its intangible assets consist of human capital only and the value of its human capital depends largely on the size and amount of external relations. The above reasoning should not be considered as a simple move from one ‘chapter’ (social capital) to another (human capital).

A one-person business with its $v(SC) = 0$ plays the same role in economics and management science as temperature $0^\circ K$ - the absolute zero - in physics. We conclude that $v(SC) \geq 0$ at all times. Similarly, we hold that $v(HC) \geq 0$ (Walukiewicz, 2006b). The value of financial capital can be negative, as in case of debts, loans, etc. The same can happen to the value of physical capital when, e.g., the cost of utilisation/recycling of used machines, computers, etc. needs to be accounted for. We conclude as follows:

Lemma 3.

- a) Since $v(HC) \geq 0$ and $v(SC) \geq 0$, then $v(ITA) = v(HC) + v(SC) \geq 0$.
- b) Since $v(FC) \geq 0$ and $v(PC) \geq 0$, then $v(TA) = v(FC) + v(PC) \geq 0$.

Lemma 2 demonstrates how important role in social capital analysis a one-person company plays. In an example below we look upon a (classical) marriage - a union of a man and a woman - as a two person company named John&Mary (J&M) to show usefulness of our methodology.

Example 5. Marriage as a two-person firm. To simplify our consideration, we assume that the main aim of the existence/activity of J&M is its happiness and that in this particular example the happiness is the main component of social capital of J&M. We also assume that the main component of human capital in this example is the ability to love the partner. We will study the relationship/interdependence of these two main components only. We consider J&M as a closed system with its four inputs corresponding to the four forms of capital involved: financial (FC), physical (PC), human (HC) and social (SC), which are combined to produce the output (social capital, or otherwise said, happiness of J&M). We assume that God



Fig. 4 Marriage as a two-person shop

The history of J&M starts at day W (wedding) and is presented in Fig. 5, where we show how the value of social capital (output variable) $v(SC,t)$ depends on the value of human capital of J&M (input variable) $v(HC,t)$, defined as

$$v(HC, t) = v(HC, J\&M, t) = v(HC, John, t) + v(HC, Mary, t).$$

We can do that, because human capital of John is orthogonal or disjoint with human capital of Mary.

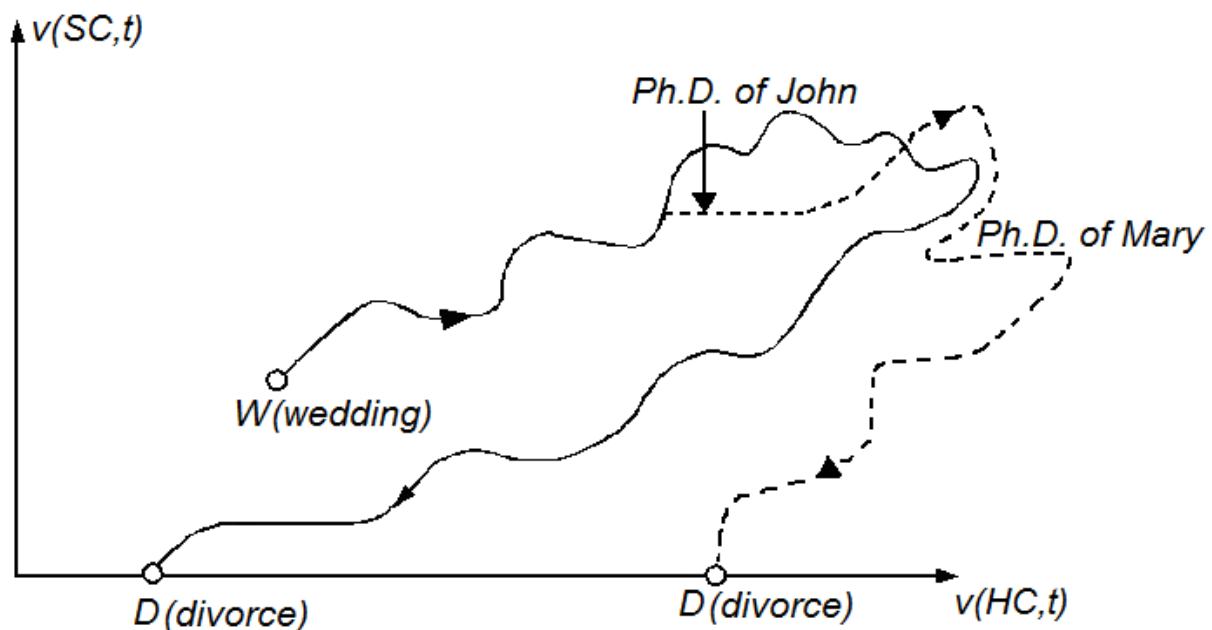


Fig. 5 The dependence of $v(SC,t)$ on $v(HC,t)$ in J&M firm

Since at the wedding they loved each other and were happy, both human and social capital were positive, specifically:

$$v(HC, t=W) > 0 \text{ and } v(SC, t=W) > 0.$$

At the beginning, when they had „an easy game to play”, the value of their human capital was up, as was the value of their social capital $v(SC,t)$ and the two other capitals. Nobody knew why they started to argue and it became harder and harder with time. As a result, their human capital as well as social capital declined. In arguments they broke dishes, furniture etc.

(destroyed their physical capital), while cost of medicine and medical or psychotherapeutic, if not psychiatric treatment, lawyers, etc. undermined their financial stability (financial capital). Finally, at day D they divorced, J&M broke into two separate one-person companies and, with Lemma 2 in mind, the value of social capital of J&M at that day went down to zero. It is interesting to note that the value of human capital at day D was still above zero, though possibly lower than at day W . Divorced people often remarry, e.g. Alla Pugacheva, a famous Russian pop-singer, presently married but divorced three times. Incidentally, her present husband, Maxim Galkin, is almost 30 years younger than her. So we can write (see Fig.5)

$$V(SC, J\&M, t=D) = 0, \text{ but } v(HC, John, t=D) > 0 \text{ and } v(HC, Mary, t=D) > 0.$$

Robert Gailey, a referee of the paper, noted that if one of them or both made a Ph. D., then their human capital at the divorce day may be higher the one at the wedding, as shown by a dotted line in Fig.5.

We draw three interesting conclusions from Example 5. First, even though we do not know yet how to measure happiness in marriage or love level of one's partner, we are able to study interdependence of such variables. Second, there is a right angle between $v(HC, t)$ and $v(SC, t)$. Third, it is probably not easy to provide a practical example of an economic entity with $v(HC, t) = 0$.

5. The concept of new GDP

First, we introduce the concept of new GDP as a sort of generalisation of the foregoing reasoning and compare it with the GDP conception used to date.

To this end, we will consider a national/regional economy as one big company, the **mega-firm MF**, where people put in their skills, competences, etc. (human capital) and work together, collaborate, etc. (social capital), using their tangible resources (physical capital and financial capital), to add to the growth of it and it has direct impact on their lives. The size of so-defined economy is then determined by the value of such a mega-firm. We can now say that an economy is worth the stock value of the **entire wealth** of the country or region it represents at a given moment of time t in its history ("past"), "present" or "future". We denote it as $V(MF, t)$. Now we may write the Fundamental Equation (6) in the form:

$$V(MF, t) = f(FC, PC, HC, SC, t) = v(FC, t) + v(PC, t) + v(HC, t) + v(SC, t). \quad (7)$$

for any t from the "past", "present" or "future".

The Fundamental Equation at the national level indicates that under stable economic conditions when demand equals supply, the entire wealth of a country or nation equates the aggregate value of its four categories (forms) of capital: financial, physical, human and social, calculated at any moment t of its "past", "present" or "future". We point out that the value of each form is estimated in the same monetary units for the same moment t , e.g. at the end of the (fiscal) year), and we have take into account the appreciation/depreciation of money in time in such calculations. The monetary crises in Russia and Argentina in 1990's may serve as examples of times t when the Fundamental Equation did not work. One simple reason was that economic conditions were not stable in those countries at that time.

Using (7) may be impractical as, in general, people are not familiar with the use of very big numbers (trillions of US \$ or €) in their everyday life. Therefore, we suggest that the entire

wealth of a country should be measured as a flow. We will call it the **new GDP** (in mathematical terms denoted as *newGDP*) and define as

$$newGDP(t) = \frac{V(MF, t) - V(MF, t-1)}{V(MF, t-1)} 100\% \quad (8)$$

where $V(MF, t)$ denotes the entire wealth of the country at the end of year t .

The *newGDP*(t) will now illustrate the percentage increase or decrease of the entire wealth of the country in year t against its value at year $t-1$. Using (7) we can write (8) as

$$\begin{aligned} newGDP(t) = & \frac{v(FC, t) - v(FC, t-1)}{V(MF, t-1)} 100\% + \frac{v(PC, t) - v(PC, t-1)}{V(MF, t-1)} 100\% + \\ & + \frac{v(HC, t) - v(HC, t-1)}{V(MF, t-1)} 100\% + \frac{v(SC, t) - v(SC, t-1)}{V(MF, t-1)} 100\% \end{aligned} \quad (9)$$

We will call the first term in (9) **financial capital contribution (to new GDP) in year t** and denote it as $R(FC, t)$. In a similar way, we define $R(PC, t)$, $R(HC, t)$ and $R(SC, t)$ as **physical capital contribution**, **human capital contribution** and **social capital contribution (to new GDP) in year t** , respectively.

Now then, let us write (9) as

$$new\ GDP(t) = R(FC, t) + R(PC, t) + R(HC, t) + R(SC, t). \quad (10)$$

We may now formulate

Definition 1. New GDP is the percentage increase or decrease of the monetary value of the entire wealth of a given country in a given year against the value of the entire wealth in the previous year. It is a sum of four contributions: financial capital, physical capital, human capital and social capital.

GDP is usually defined as “the value of the *aggregate* production of goods and services in a country in a given time period – usually a year” (Parkin (2000), p. 494). To eliminate the effects of inflation, the concept of real GDP is introduced as a GDP valued at base year prices. Finally, the economic growth rate is defined as

$$\frac{real\ GDP\ this\ year - real\ GDP\ last\ year}{real\ GDP\ last\ year} \cdot 100\% \quad (11)$$

(see Parkin (2000), p.506), which is similar to our definition of new GDP (see (8)). It is worthwhile to note that the economic growth rate is often confused with GDP.

There are three main advantages of a new GDP against (the old) GDP or the economic growth rate:

i) Methodological. New GDP describes the economy of a country in a more complete way. Firstly, it is not restricted solely to tangible assets (financial capital and physical

capital) but accommodates intangible assets represented by human capital of its citizens (their education, competencies, tacit knowledge, creativity, talents, etc.) and social capital (trust, openness, networking, stable political system and similar positive features as opposed to distrust, political/social tensions and mismanagement - examples of negative social capital). By Lemma 1, all four forms of capital are mutually disjoint or orthogonal to each other - this facilitates implementation of our methodology. Lastly, our approach provides an answer to question A and thus reduces the value gap in the valuation of firm F or an economy of a country. The value gap may be reduced to zero, thus bringing the theory (accounting) to practice (market) as close as anything could be (Walukiewicz, 2007).

ii) Technical. If we assess somehow the entire wealth of a given country $V(MF, T)$ in a basic year T , e.g. by the national census - in many countries every 10-15 years - and estimate $newGDP(t)$ in (10) e.g. using expertise and research results from selected firms, regions or social classes, then we can calculate the entire wealth of the country in any year $t > T$ by the following chain calculations:

$$V(MF, t) = V(MF, T) \left[1 + \frac{newGDP(t)}{100\%} \right] \quad \text{for } t = T+1, T+2, \dots$$

Our approach can be considered as an evolutionary modification of procedures used so far. For instance, we may estimate that the human capital contribution $R(HC, t)$ at a given year t will be the same as in the previous year while due to the parliamentary election, the contribution of social capital $R(SC, t)$ will be higher.

iii) Explanatory. We claim that a new GDP can offer better insights into the performance of economies than (the old) GDP or the economic growth rate. The reason is that it allows us to better understand the distinction between sustainable and unsustainable development (growth): **A sustainable development of a given country can only happen if and only if all four factors given in (10) have a strictly positive value for a couple of years, say, 5-10.** For instance, German or French economies have been growing in the last five years at a rate 1-2%, whereas the Polish economy has achieved a growth rate of 5-6%. Despite these figures, we argue that the Polish economy has recently been declining as the stocks of its social capital – incomparable smaller than the corresponding stocks of Germany or France – have shrunk at a rate much higher than this 5 or 6% per annum – see Fig. 6.

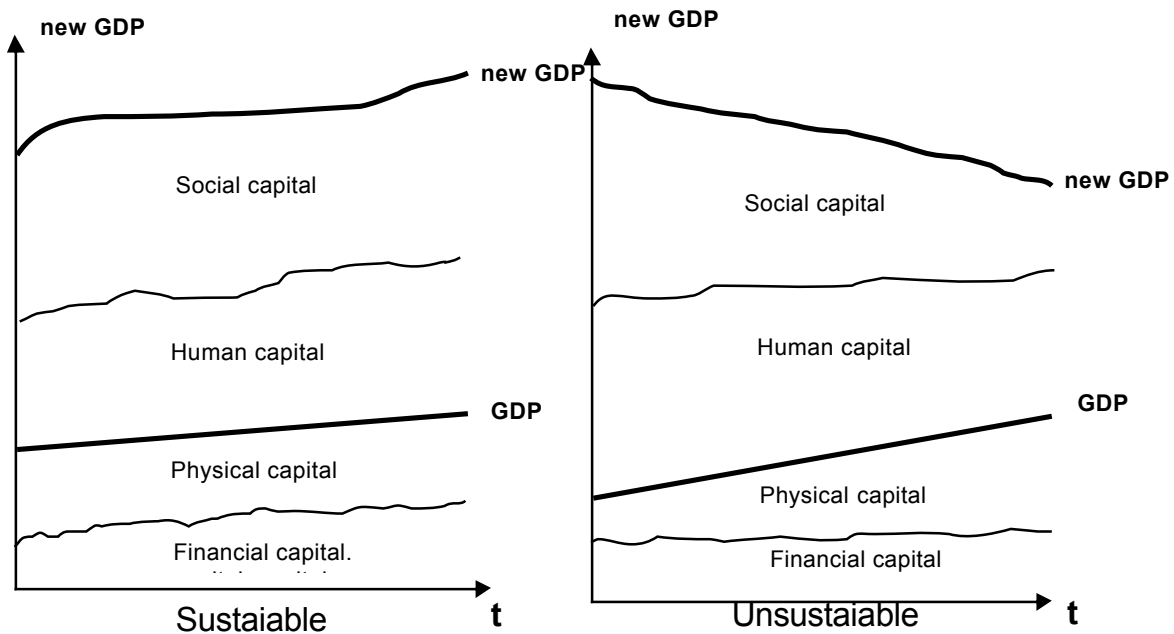


Fig. 6 The concept of sustainable and unsustainable development

We can also provide a more precise definition of a knowledge-based economy: **In knowledge-based economy the importance/value of intangible assets grows faster than that of tangibles, and within intangibles, the importance/value of social capital grows faster than that of human capital** (Walukiewicz and Dewalska-Opitek, 2008).

We observe that knowledge - taken as broadly as possible - is a unique resource whose volume/value will increase during its consumption (use, application, acquisition, etc.). Under such conditions, the volume/value of tangible assets in this world is finite while the volume/value of human capital - ability of every human to learn, study the surrounding world and improve his/her life, etc. - and social capital, that is human ability to organize into more and more efficient groups, teams, societies, etc., is infinite. Or in other words, there is no upper limit on self-organisation (organisation) of a given society. Although teamwork has been known ever since the beginning of humankind, only the Internet and ICT networks give the world a chance to boost the efficiency of its social capital use. We will study these questions in the next Section.

6. Virtual Production Line

Before we go on to the dynamic aspects of social capital, we need to provide an ‘allover’ definition of a creative process and problem. **Creative process** is any non-routine process, any response, successful or not, to a **creative problem**. Creativity depends very much on the “here and now” factor. With some exaggeration, we would say that turning out a million cars today is not a creative problem/process, it is a routine job, but making the first car in a series (prototype) definitely is. Lecturing on social capital is not creative for me, but for my students, I hope, is. Here, we will study creative processes involving at least two experts (people, actors etc.). By Lemma 2, it takes a minimum of two actors to create any social capital. Arguably, the concept of Virtual Production Line (VPL), first introduced by Walukiewicz in 2006, is a useful tool for the analysis of creative processes. To understand

VPL, one needs first to know about (classical) assembly/production line (CPL), its predecessor. We would like to explain it with an example from the automotive industry.

Before 1913 cars were manufactured in so-called production circles (see Fig.7), where a few highly skilled craftsmen produced a car from beginning to end using parts and raw materials. The division of labour in such a production process was very flexible, in fact, craftsmen could easily substitute for one another, and the obvious limit for productivity was the number of highly skilled craftsmen in a given society.

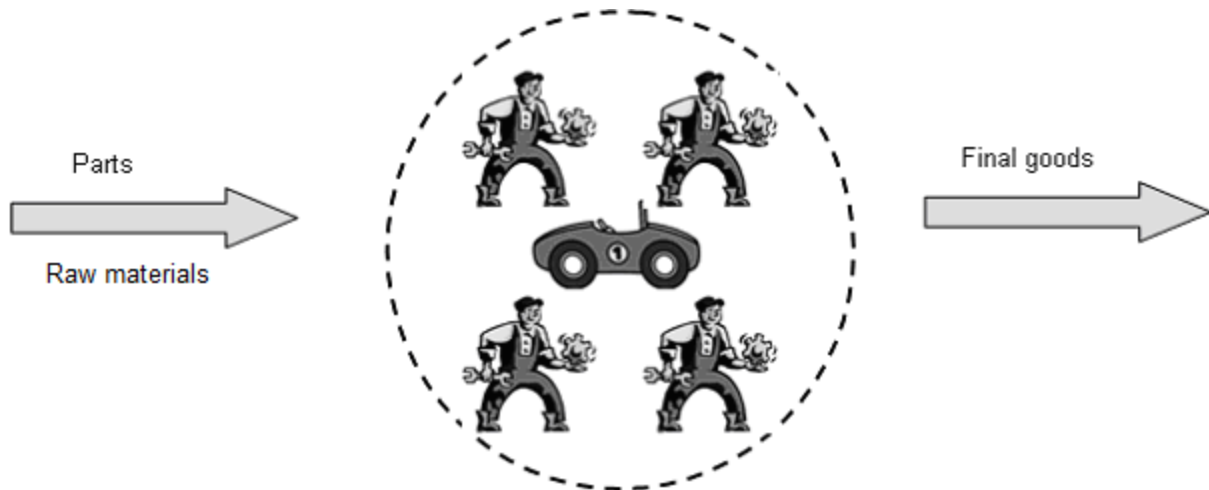


Fig. 7 Production circle

Henry Ford was the first who put into practice the following observation: if we partition a complex car manufacturing process into a fixed number of simple operations (jobs) done by simple workers (blue collars) on a line (belt) (see Fig.8), then its productivity will increase and the problem of limited number of highly skilled craftsmen should be solved. It is one of the greatest achievements in management science and economics, which completely changed our world. The idea of the assembly line was then applied in many production and service processes. If we have many production/service lines manned by people or robots, then for the purpose of our analysis, we combine them into one production/service line, which we will call the **Classical Production Line (CPL)**.

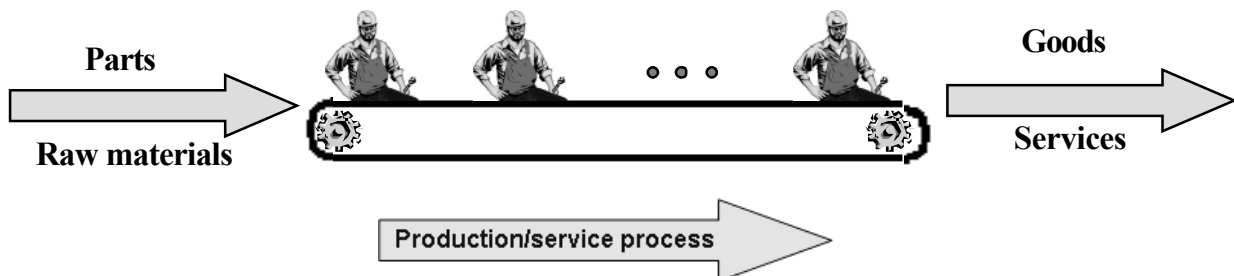


Fig. 8 Classical Production Line (CPL)

Let us assume that a given worker has increased his/her skills (his/her human capital) and now can do the job assigned in half the previous time. Does it have any impact on the organization/productivity of the production process concerned? The answer is no. His/her extra skills may be used in the design and implementation of another production process on

another CPL, but not on the one in hand as its organization is fixed. We conclude that CPL does not allow of any **self-organization** and workers are to work on it, not to think.

Definition 2. Classical Production/Service Line (CPL) is a partition of a complex production/service process into a fixed number of simple operations (jobs) described to the smallest detail. Such a partition is fixed for a time and does not allow of any **self-organization** (see Fig. 11).

So we can say, though a bit exaggeratedly, that high-skilled craftsmen are not needed in automotive industry, where organization is a priority. Due to excellent organization, very simple workers can produce very sophisticated cars.

Let us consider a **Virtual Production Line (VPL)**, pictured in Fig. 9, where a number of experts (teams of experts), scientists, specialists, etc. with their laptops, computers, data bases, etc. (in Fig. 9 we show their keypads and monitors), are connected via the Internet or any ICT network, solving a given more or less accurately defined creative problem of our firm F during a creative process. Since there is no material representation of the VPL (our experts can be located in different parts of the world), we denote it in Fig. 9 using a dotted line.

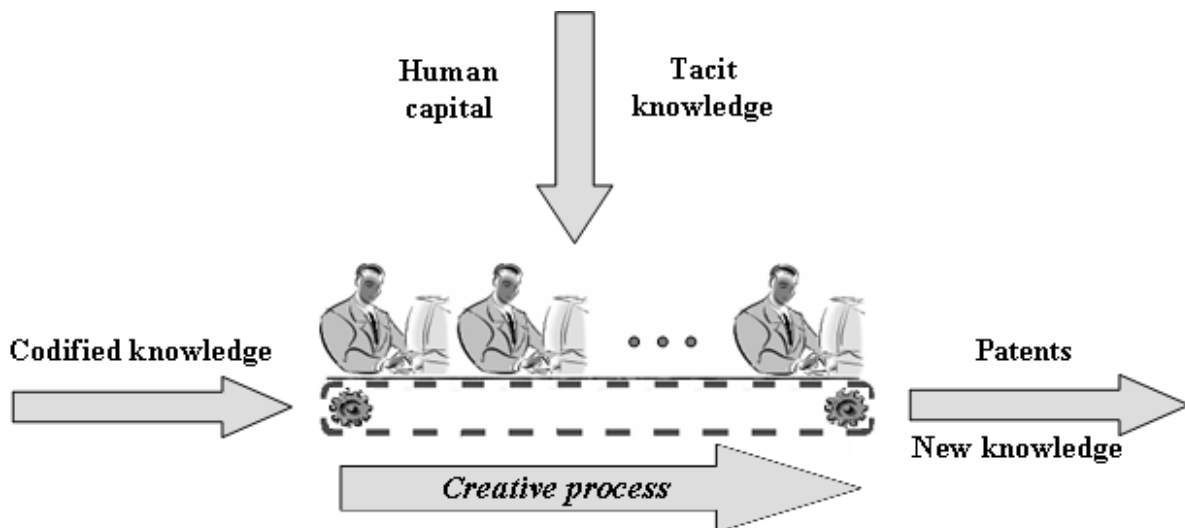


Fig. 9 The concept of Virtual Production Line (VPL)

On VPL, by definition, we have at least two experts and they combine their human capital, mostly their tacit knowledge with codified knowledge, to solve in a creative process a problem which may have at the beginning not been well defined or described in a murky way, but which, due to their efforts (**self organization**), gets more and more clear-cut and distinctive. In other words, experts on VPL not only work but also think. See Fig. 10 below.

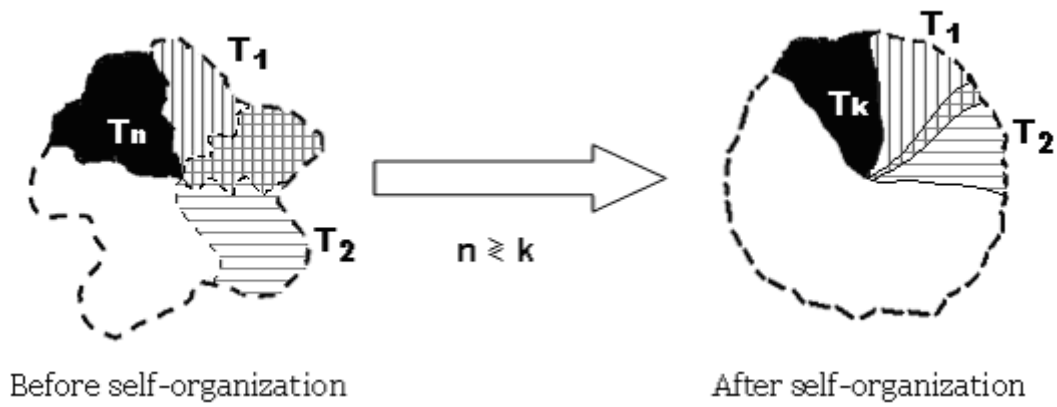


Fig. 10 VPL as a flexible division of labour and self-organization

In Fig. 10 we see that at the beginning of creative process, the problem is not well defined - we mark it with a dotted line along the perimeter. Tasks often overlap and their limits are not well delineated - we denote it with a waved line. After self-organization the problem is much better defined (it is almost a circle), the overlappings of tasks are substantially smaller and their limits are almost straight lines. If the problem is initially divided into n tasks, T_1, T_2, \dots, T_n , then after self-organization, it is divided into k tasks, T_1, T_2, \dots, T_k , where k can be equal, bigger or smaller than n . We conclude that VPL allows a **flexible division of labour** while CPL is based on a **rigid (stiff) partition of labour** (see Fig. 11) where production/servicing process is well defined - it is a circle - the jobs J_1, J_2, \dots, J_n do not overlap and the limits between them are straight lines.

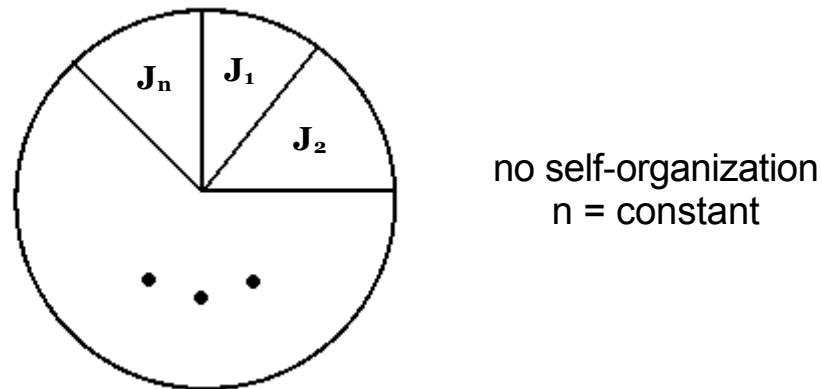


Fig. 11 CPL as a rigid partition of labour

Definition 3. Virtual Production Line (VPL) is a division in general, not a partition, of a complex creative process into more or less precisely described tasks (jobs) combined with modern ICT. The division of the creative process into tasks, as well as the number of tasks, may be changed throughout the process by actions of experts involved in it. Such a modification is called **self-organization of virtual production line**. Self-organization may recur over the creative process.

We note that unlike CPL, VPL is not a division of labour alone but combination of labour division and self-organization with modern ICT. Therefore, we can make two conclusions:

Conclusion 1. The Past. Modern ICT increases substantially the efficiency and value of social capital.

This is true insofar as we realize that social capital became a subject of serious studies only in the 90's, when we began to be able to send information electronically to virtually every corner of the world at almost zero cost. John Chambers, chairman and chief executive of Cisco, world's biggest maker of data networking equipment, gives a good example of the importance of ICT in solving business problems (by our standards, running VPL). Cisco's acquisition in 2005 of Scientific Atlanta, a maker of set-top cable boxes for US \$ 6.9 billion took 45 days. The popular feeling was that the contract was signed, or VPL run, at a break-neck speed. 18 months later, in 2007, Cisco paid US \$ 3.2 billion for Webex, a web conferencing and on line collaboration company. With a new high-end videoconferencing system, the entire process, including the signing of the final contract, took only 8 days. "There was no data room, it was virtual" – says Mr. Chambers (for details see FT of July 16, 2007). The problem was solved, or the VPL run, in only 8 days.

Conclusion 2. The Future. The history of improvement/development of CPL delineates directions for research on VPL. In fact, VPL is a natural development (phase) of CPL.

We may say that VPL is an instrument (a virtual conveyor belt) that experts use to combine codified knowledge with their tacit knowledge, competence, experience etc., to produce improvements in products, services, technology and management, and contribute to the world's stock of knowledge, both codified and tacit (see Fig 9). Otherwise stated, it is a device on which social capital of firm *F* makes money (financial capital) for the firm using human capital of its experts and its physical capital (computers with software, data bases, communication networks, patents, licenses, books, buildings, furniture, etc.) acquired with a view to creative process. VPL is a heart of the **managerial model** for social capital analysis, in particular the dynamic aspects of it.

7. Four forms of proximity

For obvious reasons, workers (blue collars) are physically located and work on CPL as close as possible to each other. Experts (white collars, actors, etc.) may be located apart from each other, but they collaborate (work) on VPL because their competences, knowledge (both tacit and codified), experiences, etc. are close or complementary, they work in the same or similar organization, within the same or close organizational culture, etc. In short, actors cooperating on VPL are close to each other on a multitude of levels but not necessarily spatially near. To analyze cooperation on VPL, we will use the concept of **proximity** introduced and developed by the French proximity school (Torre and Gilly, 2000; Torre and Rallet, 2005; Rallet and Gilly, 1999), and recently studied by Menzel, 2006.

Proximity literally means nearness, closeness, contiguity and propinquity. We will use this proposition to describe relations between different experts working on VPL, a central concept in our analysis of social capital. Like capital, proximity is complex and multidimensional and depends on time. Moreover, proximity, as we demonstrate below, is a subjective concept. Menzel, 2006 demonstrated in a deductive way that there are four forms or dimensions of proximity. As with capital (see Walukiewicz, 2008b), we will provide an indicative description of each, employ the Orthogonality Principle and show that they are mutually orthogonal or disjointed. We will define them in a standard way, always referring a creative problem to VPL. The order of presentation matters.

The four forms of proximity are as follows:

1. **Technological proximity (TP)** or **cognitive proximity** - describes the so-called cognitive distance (Nooteboom, 1999) between two experts E and H , differences and similarities in the shared knowledge (both codified and tacit) relevant to problem solving, technological distance between them, etc. Technological proximity between experts E and H exists, or they are technologically close, if technology-related collaboration between them is possible for a given moment/period of time t in the “past”, “present” or “future” on a given VPL or in solving a given problem. This is the most complex form of proximity and it depends on VPL (problem).
2. **Emotive proximity (EP)** is related to personal relations, emotions, common experiences, trust, etc. between two particular experts as human beings. Emotive proximity forms a social environment which always surrounds any such cooperation. Emotive proximity between two experts E and H exists if such cooperation between them as two human beings is possible for a period of time t in the “past”, “present” or “future”. This form of proximity does not depend on VPL (problem).
3. **Spatial proximity (SP)** describes the geographical (spatial) context of cooperation, the ability and possibility of experts to engage in face-to-face contacts. We note that in the Internet era spatial proximity is not a permanent thing, but generated temporarily, whenever necessary (Torre, 2006). Scientific conferences, kick-off meetings, industrial fairs, working lunches/dinners, etc. are examples of spatial proximity. Spatial proximity exists between two experts E and H when it is possible for them to engage in face-to-face contacts, whenever necessary, for a period of time t in the “past”, “present” or “future” on a given VPL (problem).
4. **Organizational proximity (OP)** describes the organizational context of a relationship, a structure or framework (like firm, network, cluster, etc.) that defines contacts between experts. Menzel, 2006 calls it structural proximity. Organizational proximity between two experts E and H exists if it is possible for them to cooperate within a given organizational structure at any time t in the “past”, “present” or “future”. It does not depend on VPL (problem). It is the simplest form of proximity.

The first two proximities describe direct interactions (relationships) between experts, teams, etc., therefore we call them **direct proximities (DP)**. We hardly imagine robots working on a given VPL, i.e. solving a given problem, although the work of experts on VPL will be changing alongside the improvement of ICT – see Cisco case in Section 6. Once again, direct proximities are always connected directly with human beings. The other two proximities describe indirect factors that influence contacts between humans, so we call them **indirect proximities (IDP)**. All in all, proximity is a subjective description of a given relationship, done by an expert or experts involved.

We have defined the above four forms of proximity in a very specific way to facilitate introduction of **the utility measure u of a given proximity**, called in short **proximity u** . It is a binary function defined in the following way:

Definition 4. **Technological proximity** between experts E and H equals

$$u(TP, E, H, t) = \begin{cases} 1, & \text{if } E \text{ has a technology-related collaboration with } H \\ 0 & \text{otherwise} \end{cases}$$

for any time t of their mutual relation in the “past”, “present” or “future” on a given VPL.

In a similar way, we can define **emotive proximity** $u(EP,E,H,t)$, **spatial proximity** $u(SP,E,H,t)$ and **organizational proximity** $u(OP,E,H,t)$.

We observe that - in general - emotive proximity is **asymmetric (ASP)** - the fact that e.g. expert E trusts expert H at a given moment t on a given VPL does not imply that H trusts E at the same moment t on the same VPL. So, in general

$$u(EP,E,H,t) \neq u(EP,H,E,t).$$

The same reasoning shows that technological proximity is asymmetric too, but spatial and organizational proximities are **symmetric (SSP)**. Thus we formulate

Lemma 4. Both technological proximity and emotive proximity are asymmetric, therefore direct proximities are asymmetric. Both spatial proximity and organizational proximity are symmetric, therefore indirect proximities are symmetric.

In practical terms, to gauge symmetric proximity we can choose to ask only one expert, E or H , but to gauge direct or asymmetric proximity we will have to ask both experts E and H at a time. A somewhat more elaborated approach to measuring technological proximity is studied in Walukiewicz, 2008b.

One may easily observe a striking likeness between the four forms of capital and the four forms of proximity. Since each form of proximity may be considered as a two argument relation or a binary function of two variables, we can now employ the Orthogonality Principle to analysis their relationships.

Clearly, asymmetric and symmetric proximities are mutually disjoint/orthogonal. Here the decision rule is whether

$$u(.,E,H,t) = u(.,H,E,t),$$

where the dot stands for any of the above four forms of proximity.

Consider an instance of technological cooperation (technological proximity) between two experts E and H on a given VPL looking for a solution to a given problem. Since such cooperation may or may not be going on another VPL and emotive proximity is always surrounding any contact between E and H , then technological proximity is disjoint or orthogonal to emotive proximity. Since spatial proximity is defined by face-to face contacts (geography) and organizational proximity concerns organizational structures, then they are disjoint or orthogonal to each other. That way we prove

Lemma 5. Technological proximity, emotive proximity, spatial proximity and organizational proximity are mutually disjoint or orthogonal and form a partition of proximity as entirety.

Fig. 12 gives a graphic interpretation of Lemma 5. It most resembles Fig. 3 above which illustrates Lemma 1.

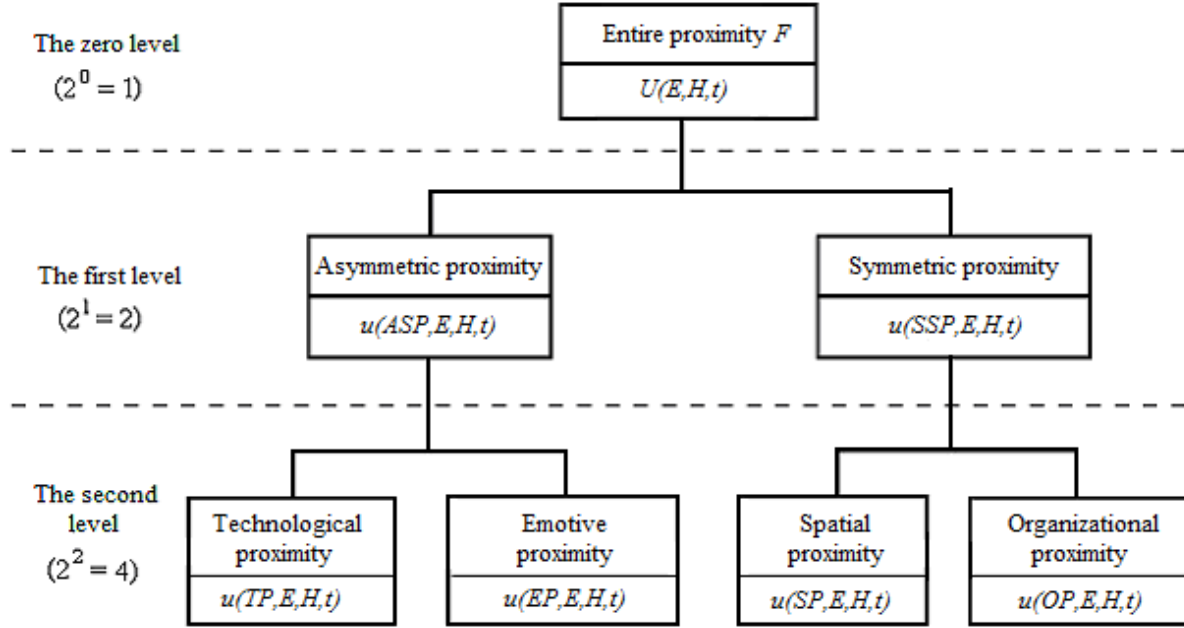


Fig. 12 Graphic interpretation of Lemma 5

Now we can provide an answer to the question posed in the introductory part of Walukiewicz, 2008b concerning capital and, additionally, include proximity in it.

Lemma 6 The minimal dimension of space describing all complexity of capital and proximity is four.

In our paper for ERSA 2009 (see also Walukiewicz, 2008b), we study the structure of both capital and proximity and demonstrate that number four has its particular beauty in social science.

8. Measuring trust

In Section 7 we studied proximity mostly at the level of a firm and now, with an example of Barack Obama, the new US president, we would like to demonstrate how our methodology works on a national level. Let us consider Obama's declaration "Yes, we can" as a name of one, very big (national) Virtual Production Line (VPL) where Americans combine their efforts to improve/change their country. Let us assume that the VPL is in progress already or has just started - it is, at the "present" stage, which we assume will last one year, the first year of Obama's term. So the situation is that Americans are now making their way through at the "present", base their actions on (bad) experiences from the "past" (two terms of J.W. Bush) and hope to have a better country in the "future" (the remaining three years of Obama in the office). Emotive proximity, trust in particular, seems to take predominance in this example. How can we measure it?

First of all, trust as the main component of the emotive proximity, can be treated as a binary variable, similar to technological proximity in Definition 4, but in Fig. 13 we propose a more developed measure.

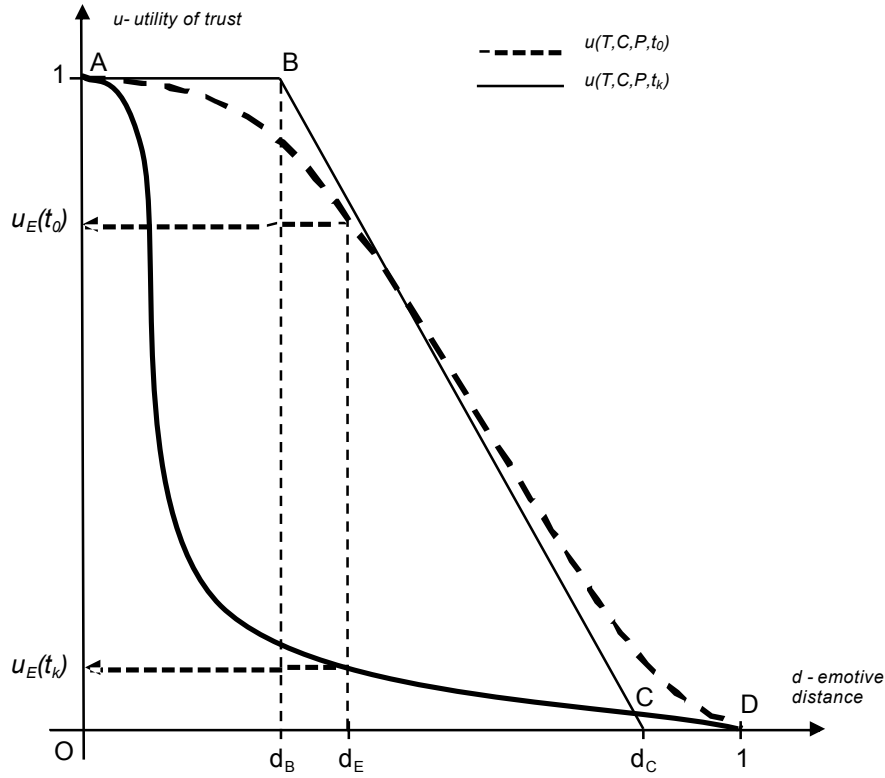


Fig. 13 New measure of trust

Let $u(T, C, P, t)$ be the **utility (measure) of trust** between a typical (average) citizen (C) and the president (P) at time t . Without loss of generality we may assume that $0 \leq u(T, C, P, t) \leq 1$. The utility of trust depends on the **emotive distance** d between C and P , which in this example can be interpreted as a measure of discord over the administration policy issues. Again, without loss of generality we may assume that $0 \leq d \leq 1$. If $d=1$ (a maximum of disaccord between C and P), then the output of their cooperation is zero ($u(T, C, P, t)=0$). At the other extreme point, if $d=0$ (C fully agrees with P on all policy issues), their cooperation is most productive and the utility takes its maximum ($u(T, C, P, t)=1$). In Fig. 13 we present our proposition how utility of trust as a function of emotive distance varies with time. In this example we will assume that trust is equivalent to support for president. Usually support for president at the beginning of the term ($t=t_0$) is much bigger than at the end of the fourth year in office (the “past”, $t=t_k$) – see Fig.13.

As we do not know yet the function $u(T, C, P, t)=f(d)$, we have to work with its approximations. A pretty good approximation of the utility of trust is a surface under the curve $u(T, C, P, t)=f(d)$. As a first trial, for instructive purpose only, we approximate the curve in Fig. 13 by broken line ABCD with coordinates of points B and C calculated on the base of the public opinion research, assuming that:

$$\begin{aligned} d_B &= \% \text{ of population supporting the president} \\ 1-d_C &= \% \text{ of population opposing him} \\ d_C - d_B &= \% \text{ of population without opinion.} \end{aligned}$$

In Fig. 13 trapezium ABCO is an approximation of the surface under the curve $u(T, C, P, t_0)=f(d)$. As its height equals 1, then the surface of trapezium ABCO equals $(d_B + d_C)/2$.

Let d_E be a given emotive distance between the average citizen and the president (e.g. the emotive distance established by experts for a fixed moment of time t). In fig. 13 we show how to calculate the utility of trust for $t=t_0$ and $t=t_k$. In this particular example we assume that the three remaining forms of proximity are not important and have zero value each. Thus, by Lemma 5 the total utility $U(\text{"Yes, we can"}, t)$ equals

$$0 \leq U(\text{"Yes, we can"}, t) = u(T, C, P, t) = u_E(t) \leq 1.$$

Finally, let $K_p(t)$ be projected cost of a given scheme (VPL, e.g. cost of a health reform as assessed by experts) at time t , and let K_r be real cost of that scheme. Then we propose that

$$K_r(t) = K_p(t)/U(\text{"yes, we can"}, t),$$

which exemplifies a well-known fact from political practice that any big reform should start at the beginning of a term, otherwise its real cost may be enormous.

9. Summary

9.1. Measure the non-measurable. The strategic aim of this research study is to develop a methodology for the measurement/evaluation of social and human capital of a given firm F or country MF , i.e. of all, absolutely all, intangible assets which are commonly considered as non-measurable today. We claim that the Orthogonality Principle and the Fundamental Equation form a firm base for our methodology. In Walukiewicz, 2008b we estimate the value of social and human capital of Microsoft under a very few realistic assumptions. Grabowska and Wojnar, 2009 study in a similar way the activities of three ICT companies: Microsoft, Nokia and Google in the last three years 2006 – 2008. The main conclusion from the studies is that intangibles account for a massive portion of a firm's market value, usually over 50% of it. In the case of Google, 2007 it was as much as 90%. For details see relevant reports.

9.2. Revolutionary versus evolutionary approach to accounting. We would like to call the approach to accounting by Edvinsson and Malone, 1997 **revolutionary**, as they ask for a totally new philosophy of accounting. Their concept not only acknowledges the existence but gives absolute priority to "intellectual capital" (almost intangibles, though not exactly) of a company. They propose a suite of questionnaires to assess the value of "intellectual capital" in a form of a **multiplicative function**. In our **evolutionary approach**, we suggest a stepwise mode to introducing elements/components of social and human capital to balance sheets until all main components of all four forms of capital are included (see Section 4). We note that balance sheets and the Fundamental Equation are **additive functions, not multiplicative**, and emphasise the fact that subtraction is addition with the opposite sign and multiplication is equivalent to multiple addition (of the same element). What they propose is violation of a very basic accounting principle that an accounting entry should be recorded once and only once. We seem to avoid this obvious mistake. Finally, even now, when our methodology is unknown, we can find e.g. in Microsoft's balance sheets two items ("Goodwill" and "Intangible assets, net") that can be understood as components of its social capital. Their aggregate value accounts for 5% of Microsoft's market value (see Walukiewicz, 2008b). So accountants have already begun to take into balance sheets some components of social capital.

9.3. Recommendations for questionnaires. Applying the Orthogonality Principle to the analysis of capital and proximity gives some notion of how to design a suitable questionnaire. It should be done top down, following the rule "from general to particular," with distinctive

analysis levels. On each level, questions are put in such a way that makes them maximally disjoint/orthogonal to each other, that is the answers to such questions should be maximally disjoint. The easiest way to do so is to have only one (well defined) group of questions or simply one question for a given set of answers on each level.

9.4. Different levels, different forms, unity at the end of the day. In our analysis of social capital we look upon a company in exactly the same way as a country. We mark the difference between the respective levels, though (firm F vs. megafirm MF). We demonstrate that there are four forms of capital, mutually disjoint or orthogonal, and use one analytical method to study them, pointing out numerous similarities. We demonstrate the same for proximity (see also Walukiewicz, 2008b). Clearly then, the number four has some meaning in social sciences, or in other words, has its beauty. Also, we claim that at some point down the road balance sheet in firm F and new GDP in a country (megafirm MF) will be ‘cast in the same mould’.

Importantly, our research is done under the assumption that everything, absolutely everything, in market economy has its price defined by an investment model in which the value achieved at “present” is based on the “past” and aimed at success in the “future”. So calculated $V(F,t)$ or $V(MF,t)$ will provide a more precise explanation of facts which for many are cloudy and fraught with uncertainties (unsustainable development of certain countries, growing importance of social capital in the Internet era, new GDP, concept of VPL and its relation to proximity).

9.5. Sequential assignment to task. A good (optimal) assignment of workers (blue collars) to operations (jobs) determines the efficiency of CPL. There are thousands of academic textbooks and papers on that, offering theory or providing practical guidance. No wonder the emphasis should also be on optimal assignment of expert to tasks on VPL. We believe this will be a major concern in social capital analysis in the years to come. We assume that there already is a “core” team of experts ready to complete a (creative) task of firm F and we would like to hire a few new experts to maximise F ’s social capital in the coming years. Thus we propose

Sequential assignment to task (on VPL). For a given “core” team of experts on VPL, assign new experts in the “present”, one by one, from a given set of candidates E_1, E_2, \dots, E_n , taking into account their technological (cognitive) and emotive proximity to optimise the value of social capital of “extended” VPL in the “future”.

9.6. “Human capitalists” unite. We would like to finish the paper with this paraphrase of a well-known ideological slogan, which we believe may have a strong bearing on global economy. Although human capital build-up is a lifelong process, it is the school education from kindergarten to Ph. D. for many that plays a key role in it (see Walukiewicz and Wiktorzak, 2009; Wiktorzak, 2009). We may say that scholarship is not the only type of knowledge that matters: well-paid CEO’s and journalists on the one hand, but also top models, top sport figures, musicians, etc. are among successful “human capitalists”. Unfortunately, top scientist are not in the club yet, but the situation is improving... A bit exaggeratedly perhaps, we can say that in a knowledge-based economy each community member is a capitalist with his/her own human capital and communities/regions/countries where such ‘human capitalists’ unite will be the most successful in global economy. With this statement we are not biased toward any ‘one-person capitalism’ or anything, but promote organised teams of experts, *i.e.* VPLs, with their self-organisation, proximity, sequential assignment problems etc. Today, in the Internet era, as we are surrounded by VPLs, we think

that most of them are badly organised. Taking Henry Ford's concept further, we agree that organisation matters a lot, but claim that self-organization matters even more. We believe that our methodology will be of help in solving self-organisation problems on VPLs.

10. References

Arrow, K.J. (1999) *Observations on Social Capital*, in Dasgupta and Serageldin, eds.

Chou, Y. K. (2006) *Three simple models of social capital and economic growth*, The Journal of Socio-Economics, **35**, 889-912.

Dasgupta, P. and Serageldin, I. (1999) *Social Capital: Multifaceted Perspective*, Wold Bank, Washington, DC.

Edvinsson, L. (2002) *Corporate Longitude*, Pearson Education, London.

Edvinsson, L. and Malone, M. S. (1997) *Intellectual Capital. The Proven Way to Establish your Company's Real Value by Measuring its Hidden Brainpower*, HarperBusiness, London.

Grabowska, G. and Wojnar, J. (2009) *Social Capital and Proximity in ICT Companies*, Proceedings of ERSA 2009, Łódź, August 25-29, 2009.

Lin, N. (2001) *Social capital: A theory of social structure and action*, Cambridge University Press, New York.

Li, P. P. (2007) *Social tie, social capital, and social behavior: Toward an integrative model of informal exchange*, "Asia Pacific J. Management", 24, s.227-246.

Menzel, M.-P. (2006) *Dynamic Proximities. Towards a Concept of Changing Relations*, presented at 5th Proximity Congress, Bordeaux, 2006.

Nooteboom, B. (1999) *Innovation, Learning and Industrial Organization*, Cambridge Journal of Economics **23**, 127-150.

Parkin, M. (2000), "Economics", 5th edition, Addison-Wesley.

Powar, M. (2006) 'Social' 'capital', The Social Science Journal, **43**, 211-226.

Putnam, R. (1995) *Bowling Alone: America's Declining Social Capital*, Journal of Democracy 6, 65-78.

Putnam, R. (2000) *Bowling Alone: The Collapse and Revival of American Community*, Simon and Schuster, New York.

Quibria, M. G. (2005) *The Puzzle of Social Capital: Critical Review*, MPRA Paper No. 2640, <http://mpra.ub.uni-muenchen.de/2640/>

Rallet, A. and Torre, A. (1999) *Is Geographical Proximity Necessary in the Innovation Networks in the Era of Global Economy?*, GeoJournal, **49**, 373-380.

Sabatini, F. (2005) *An Inquiry into the Empirics of Social Capital and Economic Development*, PhD Programme in Political Economy, Department of Public Economics, University of Roma La Sapienza.

- Sobel, J. (2002) *Can We Trust Social Capital?*, Journal of Economic Literature, XL, pp139-154.
- Solow, R.M. (1999) *Notes on Social Capital and Economic Performance*, in Dasgupta and Serageldin eds.
- Torre, A. (2006) *Clusters and Temporary Geographical Proximity*, presented at ERSA Conference in Volos (Greece).
- Torre, A. and Gilly J. P. (2000) *On the Analytical Dimension of Proximity Dynamics*, Regional Studies, **34**, 169-180.
- Torre, A. and Rallet, A. (2005) *Proximity and Location*, Regional Studies, **39**, 47-59.
- Walukiewicz, S. (2006a) *Systems Analysis of Social Capital at the Firm Level*, Working Paper WP-1-2006, Systems Research Institute, Warsaw.
- Walukiewicz, S. (2006b) *Trzy modele do analizy kapitału społecznego*, (in Polish), w "BOS 2006 Wiedza systemowa" pod red. Stachowicz J., Straszak A., Walukiewicz S., 25-40.
- Walukiewicz, S. (2007) *Four Forms of Capital and Proximity*, Working Paper WP-3-2007, Systems Research Institute, Warsaw.
- Walukiewicz, S. (2008a) *Piękno liczby cztery (w naukach społecznych)*, (in Polish), Working Paper WP-2-2008, Instytut Badań Systemowych PAN, Warszawa.
- Walukiewicz, S. (2008b) *The Dimensionality of Capital and Proximity*, Proceedings of ERSA 2008, Liverpool, August 27-30, 2008.
- Walukiewicz, S. (2009) *The Orthogonality Principle*, Proceedings of ERSA 2009, Łódź, August 25-29, 2009.
- Walukiewicz, S. and Dewalska-Opitek, A., (2008) *WP5: Regional Case Studies – SILESIA*, Working Paper WP-1-2008, Systems Research Institute, Warsaw.
- Walukiewicz, S. and Wiktorzak A.A., (2009) *Human and Social Capital in Education*, Proceedings of ERSA 2009, Łódź, August 25-29, 2009.
- Wiktorzak, A. A. (2009) *Analiza systemowa i obliczenia inteligentne w modelowaniu kapitału ludzkiego i społecznego na przykładzie szkoły ponadgimnazjalnej*, (in Polish), Rozprawa doktorska, Instytut Badań Systemowych PAN, Warszawa.
- Westlund, H. and Bolton, R. (2003) *Local Social Capital and Entrepreneurship*, Small Business Economics, **21**, 77-113.
- Westlund, H. and Nilsson, E. (2005) *Measuring Enterprises' Investments in Social Capital: A Pilot Study*, Regional Studies, **39**, 1079-1094.
- Westlund, H. (2006) *Social Capital in the Knowledge Economy. Theory and Empirics*, Springer, Berlin, Heidelberg.
- Young, G. K., [2007]: *A Survey on Intangible Capital*, CEI Working Paper Series, No.2007 10, Hitotsubashi University, Tokyo, Japan