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Winning virtuous strategy creation by interlocking interconnecting directors in boards of directors in firms in information century

Dimitri O. Ledenyov and Viktor O. Ledenyov

Abstract – The article presents an original research on 1) the information theory of the board of directors and 2) the strategy creation by the interlocking interconnecting directors in the boards of directors in the firms in an information century. We review the possible structures of the board of directors, and show that there are the interlocking directors networks in the boards of directors in a big number of firms. Researching the strategic governance of firms, we highlight a fact that the director makes the information sensing, filtering, processing, resonant absorption, analysis, decision making, hence it can be empirically represented as a digital signal processor with the Harvard or von Neumann director's mindset architectures. We think that the board of directors can be theoretically represented as the electronically-scanned electronically-steered phased array radar with a certain number of active antenna elements, filters banks, digital signal processors, memory chipsets in agreement with the digital signal processing and business administration sciences. Using the theoretical assumptions, we formulate the Ledenyov theory on the winning virtuous strategies creation by the interlocking interconnecting directors in the boards of directors in the firms. We suggest that 1) the transmitted information data-stream measurements, 2) the information bit error rate measurements have to be used to accurately characterize the interlocking interlinking interconnecting directors networks in addition to the well known parameters such as the director's boards seats accumulation number, centrality, Freeman degree, Betweenness. We believe that the positive and negative feedback loops can quite possibly lead to the destructive coordination among the directors by eliminating the randomness element and by introducing the greater uniformity in the pursuing business strategies. We developed the MicroID software program to compute the probability number of the additional directorship mandates issues.

JEL code: C0, G21, G24, G30, G34, L1, L4, M2 .

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Keywords: theory of firm, firm valuation, firm strategy creation, board of directors composition, interlocking directors networks, boards seats accumulation number, centrality, Freeman degree, Betweenness, information flows measurements, destructive coordination, microeconomics, Harvard/von Neumann director's mindset architectures, digital signal processing, electromagnetic signals absorption, chemical elements absorption, information absorption.

Introduction

The *foundational principles in the economics and finances* in Joseph Penso de la Vega (1668, 1996), Mortimer (1765), Bagehot (1873, 1897), von Böhm-Bawerk (1884, 1889, 1921), Hirsch (1896), Bachelier (1900), Schumpeter (1906, 1911, 1933, 1939, 1961, 1939, 1947), Slutsky (1910, 1915 1923), von Mises (1912), Hayek (1945), Ellis, Metzler (1949), Friedman (1953), Baumol (1957), Debreu (1959), Dodd (2014) created an *essential theoretical framework* for a better understanding of *environmental opportunities and limitations* towards the economic and financial agents business activities, making it possible to formulate the *modern evolutionary theory of firm* in Babbage (1832), Ueda (1904, 1937), Marshall (1923), Berle, Means (1932a, b), Ohlin (1933), Coase (1937), Barnard (1938, 1948, 1949, 1958), Solow (August 1957), Modigliani, Miller (June 1958), Baumol (1959, 1962), Penrose (1959), Marris (May 1963), Telser (1963), Williamson (1964, 1975, 1988), Cyert, March (1963, 1992), Fogel (1964), Manne (1965), Stigler (1968), Mano (1968-1969, 1970-1971, 1972-1973 1975-1976, 1978, 1980-1981, 1987, 1994, 1995), Black, Scholes (1973), Black, Cox (1976), Merton (1973, 1974), Lee (1975), Jensen, Meckling (1976), Jensen, Ruback (1983), Jensen (1986, September-October 1989, 1993, 2007), Jensen, Murphy (1990), Fama (1980), Fama, Jensen (1983, 1985), Demsetz (1983, 1997), Wernerfelt (1984, 1995), Lode Li (1986), Perrow (1986), Hart, Moore (1990), Hart (2011), Sberman (2000), Williamson (2002), Kantarelis (2007), Spulber (2009), Ledenyov D O, Ledenyov V O(2013b), where the *evolution of firm* includes the *three clearly identified stages* in Chandler (1962, 1977, 1993, 1994, 1998, 2001, 2005), Chandler, Daems (1980): 1) *Barriers to entry creation*; 2) *Strategic boundaries definition*, and 3) *Limits to growth evaluation*. The *director of firm*, who is a *Leader*, a *Catalyst*, a *Believer*, a *Visionary*, is elected or appointed to the *board of directors* to achieve the *firm's strategic business goals* during the *evolution of enterprise* in Armstrong (1977, 2006). As we know, there are the *two main conditional classifications of directors types*: 1) *Director-Leader*, who introduces the leadership attributes such as being inspirational and visionary in Covey (2004), De Vries (2006), Heyden (2006), Galunic (2006), Nicholson (2007), Rao (2007), Kirkbride (2007), Emmerik (2009), Wendt, Euwema, van Emmerik (2009), Kozłowski (2009), Eisen (2010), Pietersen (2010); 2) *Director-Manager*, who performs the management of enterprise in Dai (2007), Fryer (2009). In the *numerous founded firms* in the *competitive industrial clusters* in Porter (2008), there are the *one- and two-tier directors' boards systems* in Postma, van Ees (2001) with the *interlocking interlinking interconnecting directors' networks* in Dooley (1969), Mariolis (1975), Bunting (1976), Burt (1980), Pennings (1980), Mintz, Schwartz (1981), Schoorman, Bazerman, Atkin

(1981), Palmer (1983), Ornstein (1984), Meeusen, Cuyvers (1985), Stearns, Mizruchi (1986), Mizruchi, Stearns (1988), Mizruchi (1996), Postma, van Ees (2001) Rommens, Cuyvers, Deloof (November 2007), Santella, Drago, Polo, Gagliardi (2009), Uddin (2012). In this empirical condensed essay, the authors would like to do the following things: 1) to review the interconnecting interlocking directors networks configurations in the boards of directors of publicly traded and non-traded firms, and 2) to research the strategy creation problem by the interlocking interconnecting directors in the boards of directors of publicly traded and non-traded firms during the strategic governance of firms in the challenging time, when the innovation breakthrough processes originate an appearance of the creative innovative disruptions during the capitalism evolution in Schumpeter (1911, 1939, 1947), Christensen (Christensen (June 16, 1977; Fall, 1992a, b; 1997; 1998; December, 1998; April, 1999a, b, c; 1999a, b; Summer, 2001; June, 2002; 2003; March, April, 2003; January, 2006), Bower, Christensen (January, February, 1995; 1997; 1999), Christensen, Armstrong (Spring, 1998), Christensen, Cape (December, 1998), Christensen, Dann (June, 1999), Christensen, Tedlow (January, February, 2000), Christensen, Donovan (March, 2000; May, 2010), Christensen, Overdorf (March, April, 2000), Christensen, Bohmer, Kenagy (September, October, 2000), Christensen, Craig, Hart (March, April, 2001), Christensen, Milunovich (March, 2002), Bass, Christensen (April, 2002), Anthony, Roth, Christensen (April, 2002), Kenagy, Christensen (May, 2002; 2002), Christensen, Johnson, Rigby (Spring, 2002), Hart, Christensen (Fall, 2002), Christensen, Verlinden, Westerman (November, 2002), Shah, Brennan, Christensen (April, 2003), Christensen, Raynor (2003), Burgelman, Christensen, Wheelwright (2003), Christensen, Anthony (January, February, 2004), Christensen, Anthony, Roth (2004), Christensen, Baumann, Ruggles, Sadtler (December, 2006), Christensen, Horn, Johnson (2008), Christensen, Grossman, Hwang (2009), Dyer, Gregersen, Christensen (December, 2009; 2011), Christensen, Talukdar, Alton, Horn (Spring, 2011), Christensen, Wang, van Bever (October, 2013)). The authors will apply the sophisticated econometrical econophysical techniques with the purpose to accurately characterize the firm's financial economical performance, achieving the strategic research goals in Schumpeter (1906, 1933), Bowley (1924), Fogel (1964), Box, Jenkins (1970), Grangel, Newbold (1977), Van Horne (1984), Taylor S (1986), Tong (1986, 1990), Judge, Hill, Griffiths, Lee, Lutkepol (1988), Hardle (1990), Grangel, Teräsvirta (1993), Pesaran, Potter (1993), Banerjee, Dolado, Galbraith, Hendry (1993), Hamilton (1994), Karatzas, Shreve (1995), Campbell, Lo, MacKinlay (1997), Rogers, Talay (1997), Hayashi (2000), Durbin, Koopman (2000, 2002, 2012), Ilinski (2001), Greene (2003), Koop (2003), Davidson, MacKinnon (2004), Cameron, Trivedi (2005), Vialar, Goergen (2009).

Review on the structures of board of directors and the interlocking directors networks configurations in boards of directors in firms

The *authors* believe that *a group of elected appointed directors (institutional agents), who control all the business activities by the management team (corporate agents) toward the firm's business development, constitute a board of directors*. The standard board of directors in the firm can be represented as a matrix in Drago, Polo (November 11 2007), Cai, Garner, Walkling (2009), Whitehead (December 2014), hence the *authors* can write the following empirical expression

$$\mathbf{Board\ of\ Directors} = \begin{vmatrix} d_{1,1} & d_{1,2} & d_{1,j} \\ d_{2,1} & d_{2,2} & d_{2,j} \\ d_{i,1} & d_{i,2} & d_{i,j} \end{vmatrix},$$

where $d_{i,j}$ is the position of a director's seat in the matrix, which describes the standard board of directors in the firm.

The composition of the board of directors changes over the time. The *board of directors composition dynamics* over the time can be described by the generalized formula as in Santella, Drago, Polo (November 11 2007)

$$\mathbf{board}_{c,t} = \mathbf{board}_{c,t-1} + \int_t^{t+1} (\mathbf{en} - \mathbf{ex}) dt,$$

where

$$\mathbf{en}(t) = \frac{d}{dt} \mathbf{en} \cdot t = \mathbf{en},$$

$$\mathbf{ex}(t) = \frac{d}{dt} \mathbf{ex} \cdot t = \mathbf{ex},$$

$\mathbf{en}(t)$ is the number of directors entrants at time t_i ,

$\mathbf{ex}(t)$ is the number of directors exits at time t_i ,

$\mathbf{board}_{c,t}$ is the board of directors size at time t_i ,

c is the company,

i is the director.

In general, the three *main functional tasks by the board of directors* are

1. Corporate governance;
2. Human capital management;
3. Accounting standards compliance revision.

The *broad functional tasks by the boards of directors* may also include in Wikipedia (2015)

1. “Governing the organization by establishing broad policies and objectives;
2. Selecting, appointing, supporting and reviewing the performance of the chief executive;
3. Ensuring the availability of adequate financial resources;
4. Approving annual budgets;
5. Accounting to the stakeholders for the organization's performance;
6. Setting the salaries and compensation of company management.”

There are a *one-tier board type* and a *two-tier board type*, depending on the *board internal structure*, in Postma, van Ees (2001): “In corporate governance systems *boards* perform *three functions*: the *interlocking function* (from a resource-dependency and network perspective), a *monitoring function* (from an agency perspective), and a *strategic function* (from a strategic choice perspective). In a *one-tier board* the *board of directors* incorporates *non-executive directors* (outsiders, they sometimes represent the interests of key-stakeholders) and *executive directors* (top management) of the firm. In a *two-tier board* there is a clear distinction between the *directors* as members of a *supervisory board* and the *top management team*. The *board* serves in this respect as a *supervisory board* vis à vis the *management board*.”

Fig. 1 shows the *one-tier board* and *two-tier board* schematic representation in Postma, van Ees (2001).

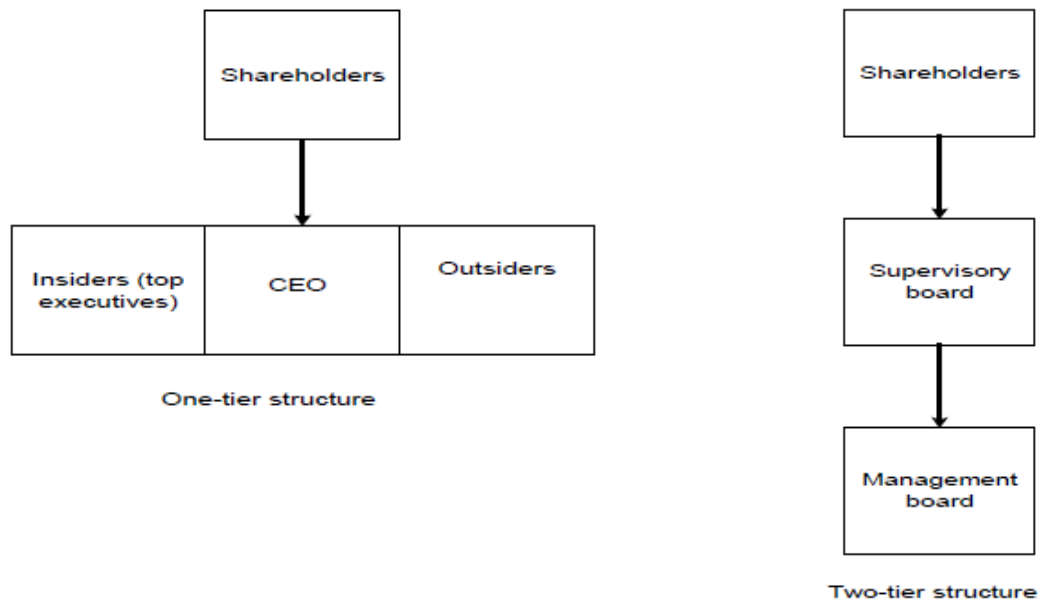


Fig. 1. One-tier board and two-tier board schematic representations (after Postma, van Ees (2001)).

Fig. 2 presents some information on the *operationalization of board functions* in Postma, van Ees (2001).

Board Functions: theoretical perspectives	Relevant aspects	Indicators
Interlocking function: - Resource dependency - Social networking	Interlocking Trust	Size of board Insiders/outside Background directors Reputation
Monitoring function: - Agency theory	Monitoring	Board compensation Board committees Insiders/outside CEO-duality
Strategic Function: - Strategic choice	Strategic discretion	Initiation of strategic dec. Evaluation/ratification

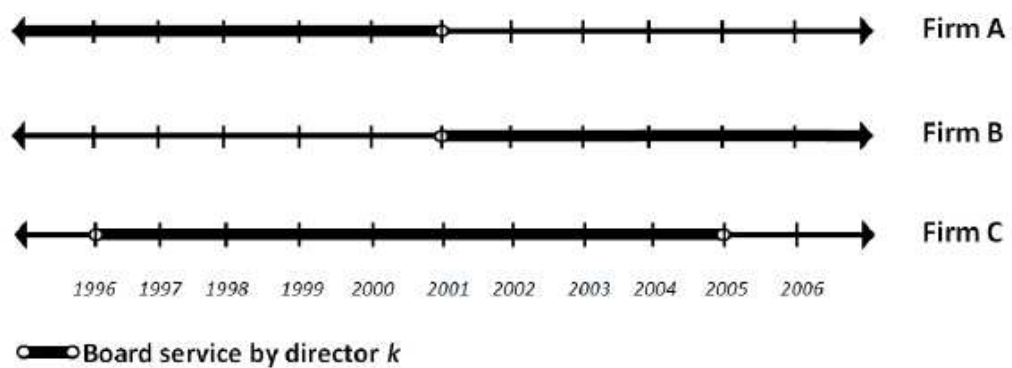
Fig. 2. Operationalization of board functions (after Postma, van Ees (2001)).

The *board of directors performs the governance of firm by formulating the business strategy to create, capture, deliver, sustain the value to the customers by designing the optimal business model and by linking the firm's business resources and capabilities to the competitive environment* in agreement with the research findings in Andrews (1971), Johnson, Scholes,

Whittington (1998, 2002, 2003), Fernandez (2007), Gavetti, Levinthal (2009), Sull (2007), Vermuelen (2007), Jacobides (2007), Alexander, Goold, Collis, Campbell, Lieberthal, Montgomery, Palepu, Prahalad, Stalk, Khanna, Hart, Shulman, Evans (1992, 1999).

The directors can be elected or appointed to a number of the boards of directors in the firms, creating the *interlocking interconnecting directors networks in the boards of directors in the firms*, which can be classified as a type of *social networks* in Malloy (2007), Ibara (2007), Ledenyov (2009), Gargiulo (2009).

Fig. 3 illustrates the *historical and contemporaneous directors interlocks* in the boards of directors in the firms in Rousseau, Stroup (2011).



Ordered pair	Historical Interlock	Contemporaneous Interlock
A to B	none	none
A to C	none	1997-2000
B to A	2003-	none
B to C	none	2002-2004
C to A	2003-2005	1997-2000
C to B	none	2002-2004

Fig. 3. *Historical and contemporaneous directors interlocks in boards of directors in firms (after Rousseau, Stroup (2011)).*

Let us review the *exact definitions* of the *interlocking interconnecting directors' networks in the boards of directors in the firms* as in the *academic literature*.

Postma, van Ees (2001) state: "The *interlocking function* of the *supervisory board* refers to the *institutional function of board structure*, indicating that *by increasing size and diversity of boards*, links to the external environment can be established and critical resources be secured, including prestige and legitimacy (Goodstein et al., 1994). Also from a *transaction cost*

economics point of view the board is reserved for those stakeholders who supply or finance firm specific assets (Williamson, 1996)."

Non, Franses (2007) state: "A director can hold several directorships in different firms. Such a director constitutes a link between the firms. Firms that are linked in this way are interlocked."

Rommens, Cuyvers, Deloof (November 2007) explain: "The resource dependence model sees interlocks as an organizational mechanism to co-opt other companies in an uncertain environment, so that each company depends on the other for resources. Information asymmetries and other uncertainties make corporate environments highly unpredictable, and interlocks may facilitate information flows between companies (e.g. Schoorman et al., 1981; Haunschild and Beckman, 1998, Gulati and Westphal, 1999). This information may include collusive information about competitors: interlocking directorates between competitors could therefore provide a means to distort competition, as competing firms may have common directors in order to strengthen collusive deals (e.g. Dooley, 1969; Schoorman et al., 1981; Gulati and Westphal, 1999). Interlocks may also be facilitators of information flows between companies and financial institutions and monitoring by financial institutions. Interlocks could thereby improve access to finance and lower the cost of finance (e.g. Richardson, 1987; Mizruchi and Stearns, 1994; Kroszner and Strahan, 2001; Santos and Rumble, 2006). However, financial institutions could abuse the control they exercise through interlocks by subordinating the interests of the company to their own interests (e.g. Richardson, 1987; Kroszner and Strahan, 2001)."

Santella, Drago, Polo, Gagliardi (2009) write: "There are several theories on the function of interlocking directorships. Mizruchi's (1997) comprehensive review on the topic illustrates three main reasons for the formation of interlocks: collusion, cooptation and monitoring, and legitimacy, career advancement, and social cohesion."

Pawlak M 2012 write: "Many executive (inside) directors and non-executive (outside) directors hold only one directorship, but others, particularly outside directors, hold more than one directorship. The situation in which one inside or outside director serves at the same time in two corporations is called an 'interlocking directorship', and this director is called an 'interlocking director'. Interlocking directorships (directorates) are more common in groups of outside directors, as they include a number of public and political figures who are recruited from other companies, and especially from the banking, insurance, and investment sectors (Scott John, 1991)."

Uddin (2012) writes: "Interlocking directorate is a loosely coupled inter-firm relationship. A direct interlock occurs when an executive or director of one firm sits on the

board of another firm, and an *indirect interlock* occurs when *two firms* have *directors* or *executives* who sit on the *board* of a *third firm*. Sharing innovation new idea, new approach, tacit knowledge, and overall cooperation are the motives behind joining in an *interlocking directorate*.”

Baccini, Marroni (September 2013): “An *interlocking directorates (ID)* occurs when a person sitting on the *board of directors* of a *firm* also sits on the *board of another firm*. According to Louis Brandeis (1933) “*the practice of interlocking directorates is the root of many evils. It offends laws human and divine. Applied to rival corporations, it tends to the suppression of competition*”. Others suggest that *ID* can be explained as the result of a strategic decision of *firms*, in view for example of monitoring sources of *environmental uncertainty*, and that the lack of direct evidence of *real anticompetitive effects* makes it difficult to elaborate a regulation (ABA, 1984; Schoorman et al., 1981). Indeed, the main trait of *ID* is ambiguity (Gerber, 2007). From a *competition policy perspective*, competing firms have to take their *business decisions* independently to avoid collusion and anticompetitive behaviour; *ID* may reduce or eliminate *competition* and facilitate collusion through the exchange of information (Gonzalez Diaz, 2012). Moreover, a same director sitting on the boards of competing firms may have an incentive to lessen competitive pressure amongst them (OFT, 2010; OECD, 2008). In contrast from a company perspective, *ID* can generate efficiencies, in terms of improving *business decisions* and, in some circumstances, *consumer and social welfare* (OFT, 2010; Mizruchi, 1996). In particular, *vertical interlocks* can facilitate *tying arrangements*, *vertical integration*, and *reciprocal* or *exclusive dealing* (OECD, 2008). As a consequence, *vertical ID* are considered benign for consumers, except in cases where *rivals* can be foreclosed, and therefore competition intervention scrutinizes *horizontal collusive ID* only (Gabrielsen et al. 2011).”

Let us provide the examples of *interlocking interconnecting directors' networks in the board of directors in the firms* in Europe, North America and Asia as in the academic literature. Investigating the ***composition of the boards of directors in European firms***, it makes sense to note the observation in Loderer, Peyer (September 5 2001, 2002): “It is possible that *board overlap* occurs in part as a means for banks to *obtain new business* or *consolidate the existing one*. There is also evidence that *board overlap* occurs unintentionally as a consequence of the fact that *good directors* attract many mandates.” The *board of directors overlap problem* in the *Swiss firms* has been researched in Loderer, Martin (1997), Loderer, Peyer (September 5 2001, 2002), Perry, Peyer (September 2002, January 2005).

Fig. 4 shows a schematic illustration of the boards of directors overlap between the two firms, which is a number of directors they have in common, in *Loderer, Peyer (September 5 2001, 2002)*.

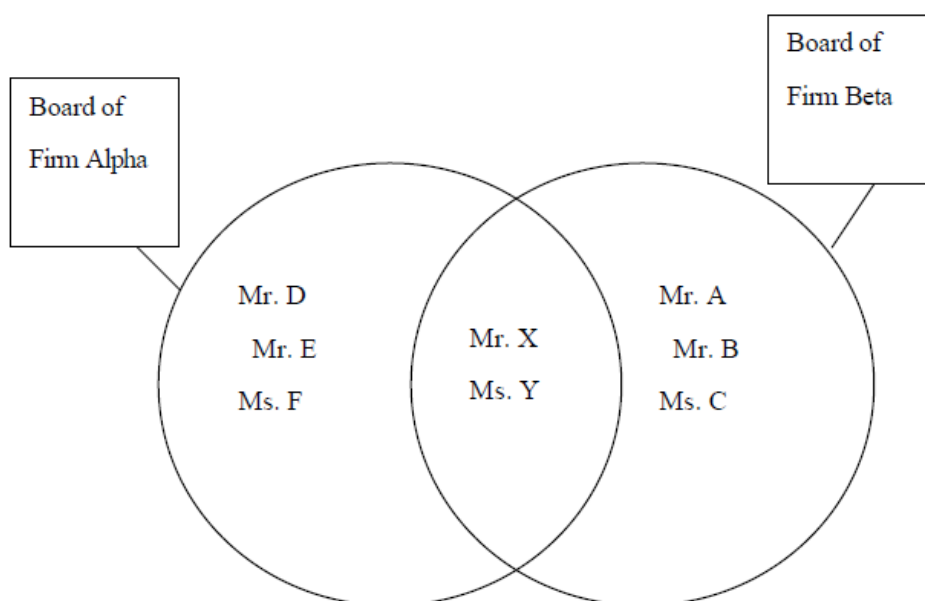


Fig. 4. Schematic illustration of boards of directors overlap (after *Loderer, Peyer (September 5 2001, 2002)*).

Tab. 1 Provides the examples of boards of directors overlaps in Switzerland in *Loderer, Peyer (September 5 2001, 2002)*.

	Rainer E. Gut COB of Credit Suisse Holding	Helmut Maucher COB of Nestlé	Pierre Borgeaud COB of Sulzer AG	Nikolaus Senn COB of Union Bank of Switzerland	Peter Spälti COB of Winterthur Versicherungen
Credit Suisse Holding	*	*			
Nestlé	*	*			
Sulzer AG			*		*
Union Bank of Switzerland				*	*
Winterthur Versicherungen			*	*	*

Tab. 1. Examples of boards of directors overlaps in Switzerland (after *Loderer, Peyer (September 5 2001, 2002)*).

Tab. 2 demonstrates the descriptive statistics of *Swiss* firms listed on the *Zurich Stock Exchange* in *Loderer, Peyer (September 5 2001, 2002)*.

	1980	1985	1990	1995
Panel A: All sample firms				
Number of firms	92	102	162	169
Median market value of equity (millions of Swiss francs)	121	285	326	439
Median board size	9	8	8	7
Average board size	10.5	10.1	9.5	8.5
Mean comparison test, t-statistics		-0.49	-0.95	-1.94
Average board overlap	9.7	9.6	9.2	6.4
Mean comparison test, t-statistics		-0.03	-0.31	-2.90
Average fraction of outside directors per firm	79.4%	78.6%	73.6%	76.5%
Panel B: Surviving firms (66)				
Median market value of equity (millions of Swiss francs)	181	267	529	632
Average board size	10.1	9.9	10.2	9.3
Mean comparison test, t-statistics		-0.2	0.27	-0.97
Average board overlap	11.2	11.5	13.4	9.5
Mean comparison test, t-statistics		0.14	0.92	-2.07
Average fraction of outside directors per firm	77.5%	76.9%	74.6%	76.1%

Tab. 2. Descriptive statistics of *Swiss* firms listed on the *Zurich Stock Exchange*. Panel A displays statistics for all sample firms. Panel B contains only the 66 firms that are listed in all four sample years (surviving firms) (after *Loderer, Peyer (September 5 2001, 2002)*).

Tab. 3 depicts the board of directors overlap in the 25 largest and the 25 smallest firms in *Loderer, Peyer (September 5 2001, 2002)*.

	1980	1985	1990	1995
Panel A: Largest firms (25)				
Median market value of equity (millions of Swiss francs)	1,292	1,871	4,150	5,803
Average board size	14.2	14.1	13.1	11.3
Average board overlap with other large firms	14.5	12.6	10.8	4.7
Average board overlap with sample firms in general	23.5	23.0	25.6	18.5
Panel B: Smallest firms (25)				
Median market value of equity (millions of Swiss francs)	36	41	53	44
Average board size	8.0	7.7	6.6	6.2
Average board overlap with other small firms	0.92	0.32	0.56	0.08
Average board overlap with sample firms in general	4.48	3.68	4.76	2.84

Tab. 3. Board overlap in the 25 largest and the 25 smallest firms. Panel A contains statistics on the 25 largest firms listed on the *Zurich Stock exchange* in each of the four sample years. Panel B contains statistics on the 25 smallest firms listed on the *Zurich Stock exchange* in each of the four sample years (after *Loderer, Peyer (September 5 2001, 2002)*).

Tab. 4 reports the board overlap statistics in the internationally vs. domestically oriented firms in Loderer, Peyer (September 5 2001, 2002)).

	1990	1995
Panel A: Internationally oriented firms		
Number of firms	88	98
Median market value of equity (millions of SFr.)	513	677
Average board size	9.6	8.6
Average board overlap	11.7	7.8
Panel B: Domestically oriented firms		
Number of firms	74	71
Median market value of equity (millions of SFr.)	130	153
Average board size	9.3	8.3
Average board overlap	6.3	4.4
Comparison tests internationally oriented vs. domestically oriented: t-statistics		
Board size	0.30	0.39
Board overlap	3.36	3.02

Tab. 4. Board overlap in internationally vs. domestically oriented firms. Internationally oriented firms have sales outside Switzerland that exceed 20% of total sales.
(after Loderer, Peyer (September 5 2001, 2002)).

Tab. 5 provides the information on the banks and the boards of directors overlap for the firms listed on the Zurich Stock Exchange in Switzerland.

	Banks	Total sample	
	(1)	(2)	(1)/(2)
1980			
Directors	203	714	28.4%
Board overlap	300	445	67.4%
1985			
Directors	214	761	28.1%
Board overlap	328	491	66.8%
1990			
Directors	321	1,111	28.9%
Board overlap	424	747	56.8%
1995			
Directors	227	1,093	20.1%
Board overlap	208	539	38.6%

Tab. 5. Banks and board overlap. Descriptive statistics for firms listed on the Zurich Stock Exchange. Columns (1) and (2) show number of directors and board overlap observed in the subsample of banks and in the total sample, respectively. The last column shows the ratio of the numbers in columns (1) and (2) (after Loderer, Peyer (September 5 2001, 2002)).

It is necessary to mention that there are multiple evidences of presence of the *board of directors overlaps* in the *Swiss firms*. For example, discussing the *Swatch Group* in the *Swiss watch industry*, Donzé (2011) writes: “In 1983, the various companies were grouped together into three sub-holdings, depending on their type of activity (complete watches; movements and parts; other), and initially characterized by rationalization. This policy was directed by a four-member *Executive Management Board*. Chaired by *Pierre Arnold*, CEO of the *Migros* chain store and a *member of several Boards of Directors (CFF, Swissair)*, it also included three division managers from both merged companies (*Ernest Thomke* for watch production, *Andor Helti* for high-tech and *Carl M. Meyer* for finances). This *board* worked under the supervision of *Nicolas G. Hayek*, who was engaged until 1986 as a special adviser to the *Board of Directors*, and went on to become the real seat of power within *SG*.” Therefore, it can be evidently seen that the practice, when the *directors take a number of seats in the boards of directors in the Swiss firms* is well spread.

The *interlocking directorships* in the *Italian listed companies in Italy in 1998 – 2006* have been researched in *Santella, Drago, Polo (November 11 2007)*, where it was shown that a high percentage of the *Italian listed companies* are connected with each other through an *interlinking networks of directors*. The highest level of connectivity among the *interlocking directors* is observed in the *boards of directors* in the *Italian Blue Chips*. *Santella, Drago, Polo (November 11 2007)* demonstrate that all the financial *Italian Blue Chips* are continuously connected with each other through an *interlinking network of directors* in the researched period of time from 1998 to 2006.

Santella, Drago, Polo (November 11 2007) highlight the following reasons for the *interlocking directors networks* formation: *collusion, cooptation, monitoring, legitimacy, career advancement, and social cohesion*. *Santella, Drago, Polo (November 11 2007)* write: “The *idea* is that *firms* invite on their *board* representatives of the various resources they depend on to reduce environmental uncertainty and maintaining their position in the market. For this reason companies have on their boards bankers, suppliers, clients (*Pfeffer e Salancik, 1978*). As regards monitoring, information theories hold that there are *information asymmetries between creditors and debtors, since creditors*, that is banks, know less about the quality of debtors. *Interlocking* is one of those institutions that can help surmount *information asymmetry (Mariolis, 1975)*. Its function is to monitor debtors by offering access to internal information. Through membership in directorates and boards banks are able to keep the company management under their influence. *Dooley (1969)* finds that less solvent firms are likely to be interlocked with banks. Later studies also report that firms with high debt-to-equity ratios (*Pfeffer, 1972*) or organizations with an

increased demand for capital (*Mizruchi and Stearns, 1988*) have a higher tendency to interlock their boards. The quest for legitimacy is a further source of interlocking (*Selznick, 1957*). In order to better their reputation firms invite on their boards individuals with ties to important organizations.”

In addition, *Santella, Drago, Polo (November 11 2007)* explain: “Moving from a *firm perspective* to an *individual director perspective*, that is from a *demand perspective* to a *supply perspective*, *Zajac (1988)* states that one reason for *interlocks* is the fact that *individuals join boards for financial remuneration, prestige, and contacts that may prove useful in securing subsequent employment opportunities*. Furthermore, according to *Useem (1984)*, *interlocks* are a tool to promote upper-class cohesion creating a *business elite*. Such incentives for *directors* to assume *multiple directorships* might have negative consequences. According to *Ferris et al. (2003)* and *Fich and Shivdasani (2006)*, *multiple directorships place an excessive burden on directors with a negative impact on their ability to monitor and influence managers* (business hypothesis).”

As far as the interlocking directors networks in the firms in *Italy* is concerned, *Santella, Drago, Polo (November 11 2007)* make the following conclusions: “We find that about 94% of all sampled *directors* sit on *one or two boards* in every one of the nine years considered. We observe that it is difficult for such *directors* to move to *three or more directorships*. We then explore the features of those *directors* who have more than *two directorships* at any given year and therefore ensure the bulk of the connectivity among the *Italian listed companies*. We find a group of 75 directors out of a total of 4270 directors who over the nine years considered have at least 23 directorships (on average about 2.5 every year). We define them for brevity the *Lords of the Italian stock market*. They are overwhelmingly male (just three female directors among the 75 *Lords*) and in an important number of cases they are *Chairmen* or *CEOs*; one third of them are also significant *shareholders* in one or more listed companies. Starting from the observation that *Lords* tend to belong to *families of directors*, we find 53 *families* that add up at least to 23 *directorships* in nine years. The *first five families* have more than 100 *directorships* and the *first ten* have a *higher number of directorships* than the first *Lord*.”

Tab. 6 shows a review of literature on the *interlocking directors* in the *board of directors* in the *firms* in Santella, Drago, Polo (November 11 2007).

Authors	Results	Methodology
Elouaer 2006, Dooley 1969	"Financial Interlocks occurs for several reasons. First, companies that are in financial difficulty tend to form a close association with one or more financial houses. Second, banks find it advantageous to be connected with large firms through electing company officers to the bank's board of directors; this may attract large deposits as well as secure a reliable customer for bank loans. Third, these financial interlocks also arise from the trust operations of banks (Dooley [1969])"	
Koenig, Gogel, and Sonquist, 1979; Burt, 1983	Mechanism for interfirm collusion and cooperation	
Pfeffer and Salancik, 1978; Kotz, 1978; Mizruchi, 1982; Mizruchi and Stearns, 1994	They enable firms (especially banks) to reduce dependence or coopt, control, and/or monitor others	
Zeitlin, 1974; Palmer, 1983 Radcliff 1980	They promote upper-class cohesion and capital accumulation	
Zajac, 1988 Kramarz Thesmar, 2006	They are a mechanism for personal career advancement	
Selznick, 1957; DiMaggio and Powell, 1983	They are a source of legitimacy	
Useem, 1984; Davis, 1991; Haunschild, 1993) (for a review, see Mizruchi, 1996)	They are a source of information about business practices	
Barucci 2006	"Alleanze industriali, relazioni con fornitori \ clienti rapporto banca-impresa. Stabilizzazione del controllo tramite rapporti personali, controllo da parte della capogruppo, limitare la concorrenza, benefici privati del controllo e dell'amministratore, consolidamento di rendite di posizione"	

Tab. 6. *The function of interlocks. Review of the empirical evidence (after Santella, Drago, Polo (November 11 2007)).*

Tab. 7 informs on the positive and negative impacts of *interlocking directors* in the *board of directors* in the *firms* in Santella, Drago, Polo (November 11 2007).

Authors	Results	Methodology
Autori vari in Barucci 2006	Probabilità di cambiamento dell'amministratore delegato è legata negativamente alla performance della società	
Interlocking and shareholder value Varie ipotesi in Barucci 2006 Pag.52-55	Negative. Interlocks related to personal advantages of directors.	
Interlocking and shareholder value Varie ipotesi in Barucci 2006 Pag.52-55	Positive. Interlocks related to leverage of the firm (Bank director in board of a not financial high leveraged form)	

Tab. 7. *Positive and negative impacts of interlocking directors in the board of directors in the firms (after Santella, Drago, Polo (November 11 2007)).*

Tab. 8 shows the literature on *interlocking directors* in *Santella, Drago, Polo (Nov 2007)*.

Country/year	Author	Results	Methodology
Australia (1976/1996)	Malcolm (2003)	"The interpersonal network of 1996 is broader, more cohesive and more densely connected than that of 1976. However, there is only minimal change in the density of intercorporate linkages over these two decades."	Network analysis (directors)
Canada	Ornstein (2003)	"The Canadian network is neither unusually sparse nor fragmented; there is no pronounced cleavage between, or subordination of, non-financial corporations to financial corporations; nor do the foreign-controlled corporations constitute an alternative centre or fragment of the network. It resembles the networks of countries such as Germany and France"	
Europe (2000/2001/2002/2003)	Guieu Meschi (2006)	"La base de regroupement reste largement nationale, les liens internationaux n'ayant aucunement de caractère systématique. Si liens internationaux il y a, ces liens restent sporadiques, centrés sur quelques individus. Un administrateur peut être international (comme c'est le cas par exemple de B. Collomb, de M. Treschow ou d'A. Bertheim), les réseaux le sont peu"	Network analysis, Descriptives
Europe/Various countries	Rodriguez, Cárdenas, Oltra (2003)	"Existe claramente una Europa de poder económico multinacional y un espacio económico multinacional que son el resultado de la acción de un reducido grupo de propietarios internacionales."	
Europe/ Various countries	Rodriguez, Cárdenas, Oltra (2003)	"We can point to some different models of class and power"	
France (1996/2000)	Chabi, Maati (2005)	Existence of a Small world.	Matching Small World phenomenon
France (1996/2005)	Elouaer (2005)	Centrality of financial institutions. Big companies tend to be more central. "Less dense network in 2005"	Network analysis (directors and companies)
FTSE 100 (2005)	Maati (2007)	Existence of a Small world	Matching Small World phenomenon
Germany (1989/2001)	Hemze (2004)	"Qualitative dissolution of interlocking directorates"... This process of quantitative erosion did not yet affect considerably structural properties of the networks". Centrality of financial institutions.	Network analysis
Ireland	Mac Canna, Brennan, O'Higgins (1998)	"Network of interlocking directorates is in some way structured, and not the result of random processes. Irish boards were found to have a relatively loosely connected network structure which is sparser and less dense than those of other countries. This is reflected in the relatively low percentage of multiple directors and the relatively fewer number of directorships per multiple director. In general, indigenous Irish public companies tended to be central in the network, while a disproportionately large number of foreign and private companies were isolated on the periphery. However, a number of foreign-owned companies were central to the network"	Matching Small World phenomenon
Italy (1952/1960/1972)	Rinaldi Vasta (2005)	"In 1952 and 1960, the system, centred on the larger electrical companies, showed the highest degree of cohesion. This centre dissolved after the nationalisation of the electricity industry in 1962 and was replaced by a new and less cohesive one, hinged on financial intermediaries: banks, insurance and finance companies. More generally, contrary to conventional wisdom, we argue that banks maintained an important role throughout the period investigated"	Descriptives

Italy (1970/1990)	Aguilera (2006)	Overall static structure (1970-1990). Existence of a small world	Network analysis Matching Small World phenomenon.
Italy (1983/1998)	Barbi (2000)	"A decreasing trend in overlapping membership in order to support block-holders is given by a decrease in density as well as by an increase in the asymmetry of links distribution"	Network analysis/Concentration analysis
Italy (1990/2000)	Corrado Zollo (2006)	"Stability of Small World coefficients". Fragmentation of the system. Relative stability of the key players.	Network analysis (Ownership network)
Italy (2004)	Carbonai Di Bartolomeo (2006)	"The Italian insurance industry is characterized by a low degree of competition. This paper provides some evidence to the idea that the absence of competition is due to a violation of a basic assumption"	Graph Theory, Principal Component Analysis (interlocking directors Insurance companies)
Italy (1999/2000/2001/2002/2003/2004)	Bertoni Randone (2006)	Existence of a Small World	Matching Small World phenomenon (Company and Ownership networks)
Italy (2004)	Casaleggio (2004)	Existence of a Small World	
Italy (2006)	Murgia (2006)	Higher level of companies isolates. Higher percentages of multiple directorships.	Network analysis (IT directors companies in Lazio)
Netherlands (1960/1964/1969/1972/1976/1980)	Stokman et al (1990)	Reducing interlocks per multiple director. Increasing the density of the network.	Network descriptive statistics
New Zealand (2004)	Stablein et. al. (2004)	Existence of a Small World	Matching Small World phenomenon
Singapore (1997)	Ong, Chin Huat, Wan, David and Ong, Kee-Sing (2003)	Firm size correlated with interlocking directorships. Financial companies share an higher level of interlocks with not financial companies	Network explorative analysis
Singapore (2005)	Conyon Muldoon (2006)	Existence of a Small World	Matching Small World phenomenon
Spain (1970/1990)	Aguilera (2006)	Large changes over the time (1970-1990). Existence of a small world	Network analysis. Matching Small World phenomenon
USA	Davis Yoo et Baker (2002)		
USA (1982,1990,1999)	Davis Yoo et Baker (2003)	Stability of the aggregate connectivity. Existence of a small world	Network analysis. Matching Small World phenomenon
USA (1990,2001)	Davis Yoo et Vast (2003)	Existence of a small world in 1990 and 2001)	Matching Small World phenomenon

Tab. 8: Detailed information on published literature on interlocking directors in board of directors in firms in various countries (after Santella, Drago, Polo (November 11 2007)).

Tab. 9 gives some data on a *number of directorships* by a *director* in the *board of directors* in the *Italian listed firms* in 1998-2006 in Santella, Drago, Polo (November 11 2007).

1998				1999				2000			
boards	directors	perc.	cumul.	boards	directors	perc.	cumul.	boards	directors	perc.	cumul.
10	0	0	0	10	1	0.06	0.06	10	0	0	0
9	0	0	0	9	1	0.06	0.12	9	1	0.05	0.05
8	3	0.18	0.18	8	2	0.11	0.23	8	3	0.16	0.21
7	2	0.12	0.3	7	3	0.17	0.4	7	4	0.22	0.43
6	8	0.47	0.77	6	6	0.33	0.73	6	5	0.27	0.7
5	8	0.47	1.24	5	13	0.72	1.45	5	12	0.65	1.35
4	20	1.17	2.41	4	17	0.94	2.39	4	20	1.09	2.44
3	65	3.81	6.22	3	73	4.04	6.43	3	65	3.54	5.98
2	172	10.09	16.31	2	182	10.06	16.49	2	190	10.35	16.33
1	1427	83.7	100	1	1511	83.53	100	1	1535	83.65	100
Total	1705				1809				1835		
2001				2002				2003			
boards	directors	perc.	cumul.	boards	directors	perc.	cumul.	boards	directors	perc.	cumul.
9	1	0.05	0.05	9	3	0.16	0.16	9	0	0	0
8	3	0.16	0.21	8	0	0	0.16	8	2	0.11	0.11
7	0	0	0.21	7	2	0.11	0.27	7	3	0.16	0.27
6	5	0.27	0.48	6	8	0.43	0.7	6	6	0.33	0.6
5	16	0.86	1.34	5	12	0.64	1.34	5	10	0.55	1.15
4	17	0.91	2.25	4	16	0.86	2.2	4	24	1.32	2.47
3	60	3.23	5.48	3	49	2.62	4.82	3	52	2.86	5.33
2	197	10.6	16.08	2	211	11.28	16.1	2	198	10.89	16.22
1	1559	83.91	100	1	1569	83.9	100	1	1524	83.78	100
Total	1858				1870				1819		
2004				2005				2006			
boards	Directors	perc.	cumul.	boards	directors	perc.	cumul.	boards	directors	perc.	cumul.
8	1	0.06	0.06	8	0	0	0	8	0	0	0
7	3	0.17	0.23	7	0	0	0	7	1	0.05	0.05
6	5	0.28	0.51	6	13	0.62	0.62	6	3	0.14	0.19
5	13	0.72	1.23	5	14	0.67	1.29	5	13	0.62	0.81
4	28	1.54	2.77	4	21	1.01	2.3	4	33	1.57	2.38
3	47	2.59	5.36	3	76	3.64	5.94	3	63	3.01	5.39
2	205	11.29	16.65	2	229	10.96	16.9	2	214	10.21	15.6
1	1514	83.37	100	1	1736	83.1	100	1	1769	84.4	100
Total	1816				2089				2096		

Tab. 9. A number of directorships by director in board of directors in Italian listed firms in 1998-2006 (after Santella, Drago, Polo (November 11 2007)).

Tab. 10 shows the *directors* with more than 23 *directorships* in the *board of directors* in the *Italian listed firms* in nine years (1998-2006) in Santella, Drago, Polo (November 11 2007).

COGNOME NOME	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total
GRANDE STEVENS FRANZO	7	8	8	8	7	8	7	6	4	63
EREDE SERGIO	8	10	9	5	5	5	5	6	7	60
PESENTI GIAMPIERO	8	7	7	6	6	6	6	5	4	55
BENETTON GILBERTO	3	3	4	8	9	8	7	6	6	54
DE BENEDETTI CARLO	5	7	7	6	6	6	6	6	4	53
TRONCHETTI PROVERA MARCO	6	9	8	9	6	4	4	4	3	53
MION GIANNI	3	3	3	8	9	7	8	5	5	51
PESENTI CARLO	3	5	6	4	6	6	6	6	6	48
GUATRI LUIGI	4	4	4	5	6	6	6	6	5	46
BUORA CARLO	2	3	3	6	9	7	7	6	2	45
CARLEVARIS CARLO	5	5	5	5	5	5	5	5	5	45
GALATERI DI GENOLA E SUNIGLIA GABRIELE	6	6	6	5	3	4	4	6	5	45
GIRARD FRANCO ROBERTO	5	5	5	5	5	5	5	5	4	44
DELFINI MARIO	4	3	5	5	5	5	5	5	5	42
PURI NEGRI CARLO ALESSANDRO	3	4	3	5	7	6	5	5	4	42
ROCCA GIANFELICE	4	4	5	4	5	5	5	5	4	41
DE BENEDETTI RODOLFO	4	5	4	4	4	4	5	5	4	39
PIRELLI ALBERTO	4	3	4	5	6	4	4	4	4	38
BAZOLI GIOVANNI	5	4	4	4	4	4	4	4	4	37
BENETTON ALESSANDRO	3	5	6	4	4	4	4	4	2	36
COLOMBO UMBERTO	4	5	5	5	5	5	4	3		36
FALCK ALBERTO	8	8	8	6	6					36
GRECO MARIO	1	1	3	5	6	6	5	3	5	35
SEGRE MASSIMO	2	3	3	3	4	4	4	6	6	35
LIGRESTI JONELLA	2	2	2	3	3	5	6	6	5	34
LUCCHINI GIUSEPPE	5	5	4	4	4	4	4	2	2	34
MOLINARI AMATO LUIGI	3	3	2	3	4	5	5	6	3	34
RUOZI ROBERTO	2	3	3	3	4	4	4	6	5	34
GUTTY GIANFRANCO	7	7	7	6	2	2		1	1	33
PECCI ALBERTO	5	6	5	4	2	2	3	3	3	33
VITALE MARCO	2	2	3	4	5	5	4	4	4	33
SAVIOTTI PIERFRANCESCO	4		3	5	5	4	4	3	4	32
COLANINNO ROBERTO	3	6	6	2	1	3	3	3	4	31
D'URSO CARLO	3	3	3	3	4	4	3	4	4	31
FERRERO PIERLUIGI	2	3	3	4	4	4	4	4	3	31
CEFIS GIORGIO CAMILLO MARCELLO	4	5	5	4	4	2	2	2	2	30
ORLANDO LUIGI	6	5	5	5	5	3	1			30
TAMBURINI MATTEO		2	4	3	3	4	4	5	5	30
ZANON DI VALGIURATA LUCIO IGINO	4	4	4	3	3	3	3	3	2	29
FABRIZI PIER LUIGI	2	3	3	5	5	3	3	3	1	28
LIGRESTI GIULIA MARIA	1	1	1	2	3	5	5	5	5	28
BERLUSCONI MARINA ELVIRA	3	3	3	3	3	3	3	3	3	27
CATTANEO MARIO	2	3	3	3	3	4	4	3	2	27
CLO' ALBERTO	1	2	2	2	2	3	5	5	5	27
DALLOCCIO MAURIZIO	1	1	2	3	3	4	5	6	2	27
MARZOTTO PIETRO	6	5	4	4	4	3	1			27
ACUTIS CARLO	2	2	2	2	2	3	4	4	5	26
BERNHEIM ANTOINE	2	2	2	2	2	3	3	4	4	26
CALTAGIRONE FRANCESCO	4	3	2	2	2	3	3	3	4	26
LIGRESTI GIOACCHINO PAOLO	1	1	1	2	2	7	4	4	4	26
PERISSINOTTO GIOVANNI		1	1	2	3	4	5	5	5	26
SOZZANI VINCENZO	6	4	3	2	3	3	3	2		26
GAZZONI FRASCARA GIUSEPPE	6	5	4	3	1	1	2	2	1	25
MAJORE ALBINO	2	2	3	3	3	3	3	3	3	25
MINUCCI ALDO	1	2	3	3	3	3	3	3	4	25
NATTINO GIAMPIETRO	3	2	1	3	4	3	3	3	3	25
REBOA MARCO	1	2	2	2	2	4	4	4	4	25
BIANCHI TANCREDI	3	4	5	5	2	2	1	1	1	24
BONDI ENRICO	5	6	4	4	3			1	1	24
CIPOLLETTA INNOCENZO	3	3	2	4	3	2	3	2	2	24
FAVRIN ANTONIO	1	1	1	2	3	4	4	5	3	24
GERONZI CESARE	2	3	3	3	3	2	3	3	2	24
MARTINELLI FELICE	1	2	3	3	3	3	3	3	3	24
RIPA DI MEANA VITTORIO	3	3	3	3	5	2	2	2	1	24
ROSA UMBERTO	3	3	1	1	2	2	4	4	4	24
SCIUME' PAOLO	3	3	3	3	3	3	2	2	2	24
TEODORANI FABBRI PIO	2	2	2	3	3	3	3	3	3	24
ARCELLI MARIO	4	4	4	4	4	3				23
BRUNETTI GIORGIO	2	2	2	3	3	3	2	3	3	23
CALTAGIRONE FRANCESCO GAETANO	1	1	2	3	3	4	3	3	3	23
FERRERO CESARE	1	1	1	4	4	4	3	3	2	23
MARAMOTTI ACHILLE	3	3	3	5	3	3	3			23
MARCHIO' ANGELO	6	6	7	2	1	1				23
PININFARINA ANDREA	3	3	2	2	3	2	3	3	2	23
RONDELLI LUCIO	4	4	5	2	2	1	1	2	2	23

Tab. 10. Directors with more than 23 directorships in board of directors in Italian listed firms in nine years (1998-2006) (after Santella, Drago, Polo (November 11 2007)).

Tab. 11 displays the characteristics of *interlocking directorship network of top 100 companies in Italy in 2010 in Baccini, Marroni (September 2013)*.

Label	Company	Degree	All Closeness centrality	Normalized all degree	Betweenness centrality
1	A2A	6	0,350	0,061	0,015
2	Acea	4	0,345	0,040	0,003
3	Amplifon	5	0,327	0,051	0,015
4	Ansaldo Sts	4	0,337	0,040	0,023
5	Ascopiave	4	0,291	0,040	0,004
6	Astaldi	1	0,249	0,010	-
7	Atlantia	19	0,458	0,192	0,062
8	Autogrill	11	0,412	0,111	0,015
9	Autostrada TO-MI	7	0,345	0,071	0,010
10	Azimut Holding	2	0,292	0,020	-
11	Banca Carige	4	0,346	0,040	0,004
12	Banca Generali	8	0,387	0,081	0,010
13	Banca Intermobiliare	2	0,284	0,020	0,002
14	Banca MPS	3	0,336	0,030	0,001
15	Banca Popolare di Sondrio	3	0,319	0,030	0,002
16	Banca Popolare Emilia Romagna	3	0,257	0,030	0,003
17	Banca Popolare Milano	9	0,356	0,091	0,025
18	Banco di Desio e Brianza	1	0,289	0,010	-
19	Banco Popolare	7	0,346	0,071	0,024
20	Benetton Group	8	0,395	0,081	0,003
21	Beni stabili	6	0,375	0,061	0,008
22	Buzzi Unicem	3	0,313	0,030	0,002
23	Cairo Communication	0	-	-	-
24	Campari	3	0,299	0,030	0,003
25	Cattolica Assicurazioni	2	0,304	0,020	0,000
26	Cementir Holding	3	0,312	0,030	0,001
27	Cir	10	0,383	0,101	0,025
28	Cofide	8	0,380	0,081	0,014
29	Credito Artigiano	5	0,360	0,051	0,020
30	Credito Bergamasco	1	0,254	0,010	-
31	Credito Emiliano	2	0,287	0,020	0,001
32	Credito Valtellinese	5	0,313	0,051	0,006
33	Danieli & Co.	3	0,326	0,030	0,003
34	Datalogic	5	0,312	0,051	0,032
35	De' Longhi	11	0,390	0,111	0,062
36	Dea Capital	8	0,390	0,081	0,021
37	Diasorin	2	0,263	0,020	-
38	Edison	4	0,307	0,040	0,004
39	Enel	2	0,290	0,020	0,001
40	Enel Green Power	1	0,312	0,010	-
41	Engineering	2	0,316	0,020	0,000
42	Eni	12	0,421	0,121	0,020
43	Erg	0	-	-	-
44	Exor	7	0,369	0,071	0,023
45	Falck Renewables	5	0,324	0,051	0,012
46	Fiat	10	0,399	0,101	0,043
47	Fiat Industrial	9	0,406	0,091	0,010
48	Fondiana-Sai	12	0,417	0,121	0,021
49	Gas Plus	3	0,319	0,030	0,005
50	Gemina	9	0,392	0,091	0,027
51	Generali	19	0,451	0,192	0,064
52	GEOX	1	0,312	0,010	-
53	Gruppo Ed. L'Espresso	13	0,408	0,131	0,034
54	Hera	3	0,249	0,030	0,000
55	IGD	3	0,276	0,030	0,005
56	IMA	2	0,251	0,020	0,002
57	Impregilo	8	0,372	0,081	0,024
58	Indesit Company	5	0,353	0,051	0,001
59	Interpump Group	10	0,393	0,101	0,033
60	Intesa San Paolo	11	0,415	0,111	0,032
61	Iren	6	0,333	0,061	0,007
62	Italcementi	14	0,440	0,141	0,051
63	Italmobiliare	12	0,413	0,121	0,028
64	Lottomatica	4	0,331	0,040	0,005
65	Luxottica Group	19	0,453	0,192	0,097
66	Maire Tecnimont	2	0,312	0,020	-
67	Marcolin	5	0,356	0,051	0,003
68	Marr	3	0,297	0,030	0,009
69	Mediaset	9	0,402	0,091	0,011
70	Mediobanca	22	0,483	0,222	0,103
71	Mediolanum	7	0,382	0,071	0,035
72	Milano Assicurazioni	8	0,397	0,081	0,012
73	Mondadori Editore	12	0,408	0,121	0,030
74	Nice	2	0,281	0,020	-
75	Parmalat	13	0,431	0,131	0,053
76	Piaggio & Co.	9	0,369	0,091	0,016
77	Pirelli & Co.	25	0,463	0,253	0,116
78	Prysmian	7	0,393	0,071	0,011
79	RCS Mediagroup	19	0,458	0,192	0,058
80	Recordati	0	-	-	-
81	Safilo Group	0	-	-	-
82	Saipem	5	0,343	0,051	0,023
83	Salvatore Ferragamo	1	0,298	0,010	-
84	Saras	6	0,378	0,061	0,003
85	Save	0	-	-	-
86	Sias	2	0,286	0,020	-
87	Snam rete gas	1	0,253	0,010	-
88	Sogefi	3	0,311	0,030	-
89	Sol	2	0,271	0,020	-
90	Sorin	6	0,360	0,061	0,022
91	Telecom	17	0,456	0,172	0,071
92	Telecom Italia Media	4	0,326	0,040	0,003
93	Terna	6	0,359	0,061	0,008
94	Tod's	7	0,364	0,071	0,012
95	Trevi Fin Industriale	3	0,285	0,030	0,007
96	UBI Banca	8	0,393	0,081	0,017
97	Unicredit	8	0,397	0,081	0,032
98	Unipol	4	0,318	0,040	0,029
99	Yoox	1	0,236	0,010	-
100	Zignago Vetro	5	0,330	0,051	0,008

Tab. 11. The characteristics of *interlocking directorship network of top 100 companies in Italy in 2010 (after Baccini, Marroni (September 2013))*.

Fig. 5 shows the *interlocking directorship network* of the *top 100 companies in Italy* in 2010 in *Baccini, Marroni (September 2013)*.

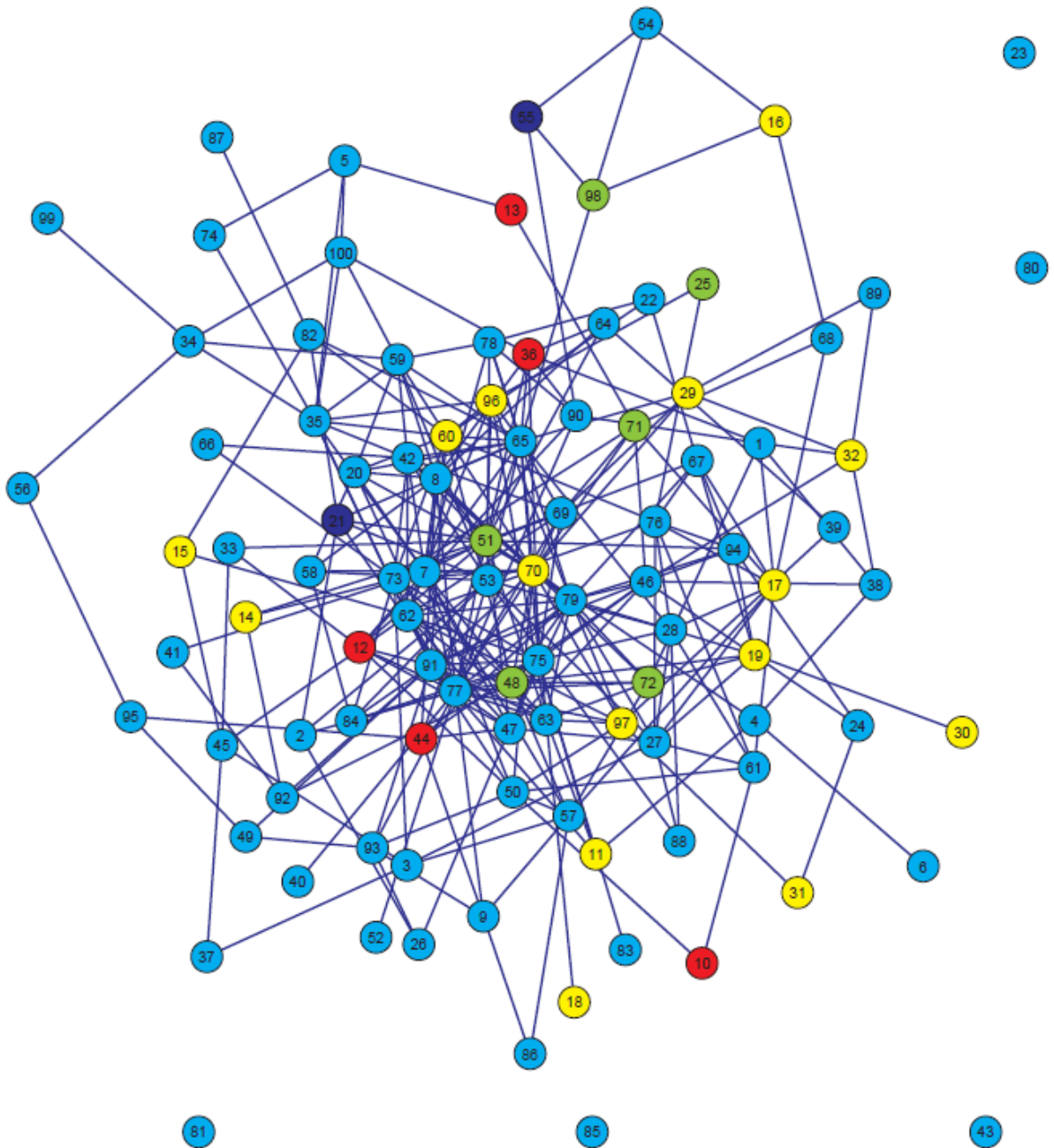


Fig. 5. *The interlocking directorship network of the top 100 companies in Italy in 2010. Yellow color denotes the directorships from financial industry (after Baccini, Marroni (September 2013)).*

Analyzing the *composition of the boards of directors in the North American firms*, we would like to attract an attention to the research on the *interlocking directorship network of the top 100 companies in the USA in Baccini, Marroni (September 2013)*.

Baccini, Marroni (September 2013) explain: “Concerns regarding *monopoly* and *big companies* were widespread at the beginning of the twentieth of century in the *U.S.* and as a consequence *ID* became a hot political issue. In *1908* the *Democratic Party platform* proposed a law to prohibit it, and in *1912* the platforms of all three national parties called for *ID legislation* to supplement the *Sherman Act*. In the build-up of the legislation, two committees investigated and documented the extent of *interlocking directorates*. *Brandeis*, an influential advisor to *President Woodrow Wilson*, published articles highly critical of the practice (*1915*). The issues raised by these committees and commentators were broader: they concerned *collusion*, *information exchange* and *conflicts of interest*. Policy proposals were directed toward the prohibition of almost any kind of interlock (*Travers, 1968*). Congress approached the problem of *ID* selectively, limiting both the classes of corporations and the kinds of *ID* subject to regulation (*ABA, 1984*); and in fact *Section 8* of the *Clayton Act*, enacted in *1914* and still effective today, prohibits *ID* for competing corporations larger than a certain size (*Waller, 2011*). *Congress* also decided to leave the regulation of conflict of interest of the *boards of directors* and other concerns to state fiduciary duty laws, the securities laws of the *1930s*, and to other legislation. Revisions to *Section 8* followed quickly upon the statute's *1914* passage, but the most significant changes took place in the last quarter of the *XXth* century. In *1978* *Congress* enacted the *Depository Institution Management Interlocks Act (1978)* to discipline *bank interlocks* and expanded the role of agencies to grant exemption. The exclusion of *banks* represented a significant break in the history of *Section 8*: substantial portions of earlier versions of *Section 8* had dealt with *banking interlocks*, and many of the early amendments to the *Section* focused exclusively on modifying the banking provisions of the act. In *1990* a modification excluded relatively small companies from coverage under the law. Current wording of this rule prohibits any person from serving as a director and officer “*in any two corporations (...) that are (...) by virtue of their business and location of operation, competitors, so that the elimination of competition by agreement between them would constitute a violation of any of the antitrust law*” (*United States Code, 2013*).”

Tab. 12 demonstrates the characteristics of *interlocking directorship network* of *top 100 companies* in the *USA* in *2011* in *Baccini, Marroni (September 2013)*.

Label	Company	Degree	All Closeness centrality	Normalized all degree	Betweenness centrality
1	3M Co.	8	0,324	0,081	0,054
2	Abbott Laboratories	6	0,273	0,061	0,041
3	Altria Group Inc.	0	-	-	-
4	Amazon.com Inc.	1	0,193	0,010	-
5	American Express Company	6	0,302	0,061	0,039
6	American International Group, Inc.	3	0,239	0,030	0,004
7	Amgen Inc.	4	0,273	0,040	0,004
8	Anadarko Petroleum Corporation	1	0,163	0,010	-
9	Apache Corp.	0	-	-	-
10	Apple Inc.	4	0,268	0,040	0,005
11	AT&T, Inc.	4	0,255	0,040	0,072
12	Baker Hughes Incorporated	3	0,234	0,030	0,052
13	Bank of America Corporation	2	0,240	0,020	0,001
14	Baxter International Inc.	0	-	-	-
15	Berkshire Hathaway Inc.	5	0,255	0,051	0,029
16	BlackRock Inc.	3	0,221	0,030	0,019
17	Boeing Co.	10	0,337	0,101	0,091
18	Bristol-Myers Squibb Company	0	-	-	-
19	Carnival Corporation	0	-	-	-
20	Caterpillar Inc.	4	0,283	0,040	0,014
21	Chevron Corporation	8	0,296	0,081	0,051
22	Cisco Systems, Inc.	2	0,213	0,020	0,004
23	Citigroup Inc.	4	0,265	0,040	0,031
24	Colgate-Palmolive Co.	2	0,221	0,020	0,007
25	Comcast Corporation	2	0,223	0,020	0,005
26	ConocoPhillips	5	0,279	0,051	0,031
27	Coming Inc.	4	0,248	0,040	0,029
28	Costco Wholesale Corporation	2	0,216	0,020	-
29	CVS Caremark Corporation	0	-	-	-
30	Danaher Corp.	0	-	-	-
31	Deere & Company	5	0,289	0,051	0,028
32	Dell Inc.	4	0,252	0,040	0,009
33	Devon Energy Corporation	1	0,185	0,010	-
34	DIRECTV	2	0,241	0,020	-
35	eBay Inc.	4	0,249	0,040	0,012
36	El DuPont de Nemours & Co.	4	0,247	0,040	0,011
37	Eli Lilly & Co.	7	0,290	0,071	0,040
38	EMC Corporation	1	0,186	0,010	-
39	Emerson Electric Co.	1	0,198	0,010	-
40	Express Scripts Inc.	1	0,215	0,010	-
41	Exxon Mobil Corporation	6	0,298	0,061	0,042
42	Ford Motor Co.	4	0,251	0,040	0,025
43	Freeport-McMoRan Copper & Gold Inc.	3	0,200	0,030	0,035
44	General Electric Co.	7	0,302	0,071	0,056
45	Gilead Sciences Inc.	2	0,250	0,020	0,004
46	Google Inc.	2	0,198	0,020	0,001
47	Halliburton Company	1	0,153	0,010	-
48	Hewlett-Packard Company	3	0,249	0,030	0,004
49	Honeywell International Inc.	6	0,284	0,061	0,063
50	Intel Corporation	5	0,249	0,051	0,032
51	International Business Machines Corp.	12	0,351	0,121	0,142
52	Johnson & Johnson	4	0,259	0,040	0,005
53	JPMorgan Chase & Co.	7	0,277	0,071	0,038
54	Kraft Foods Inc.	5	0,255	0,051	0,027
55	Lowe's Companies Inc.	1	0,212	0,010	-
56	Marathon Oil Corporation	9	0,310	0,091	0,125
57	Mastercard Incorporated	1	0,198	0,010	-
58	McDonald's Corp.	6	0,278	0,061	0,030
59	Medtronic Inc.	4	0,297	0,040	0,026
60	Merck & Co. Inc.	5	0,282	0,051	0,041
61	MetLife, Inc.	3	0,253	0,030	0,011
62	Microsoft Corporation	2	0,232	0,020	0,006
63	Monsanto Co.	0	-	-	-
64	Morgan Stanley	5	0,295	0,051	0,072
65	News Corp.	1	0,195	0,010	-
66	Nike Inc.	3	0,256	0,030	0,008
67	Occidental Petroleum Corporation	1	0,204	0,010	-
68	Oracle Corp.	1	0,223	0,010	-
69	Pepsico, Inc.	6	0,271	0,061	0,041
70	Pfizer Inc.	8	0,279	0,081	0,034
71	Philip Morris International, Inc.	1	0,177	0,010	-
72	PNC Financial Services Group Inc.	2	0,232	0,020	0,007
73	Praxair Inc.	2	0,186	0,020	0,018
74	Procter & Gamble Co.	8	0,292	0,081	0,047
75	Prudential Financial Inc.	5	0,253	0,051	0,006
76	QUALCOMM Incorporated	0	-	-	-
77	Schlumberger Limited	0	-	-	-
78	Simon Property Group Inc.	1	0,218	0,010	-
79	Southern Company	1	0,217	0,010	-
80	Target Corp.	7	0,302	0,071	0,038
81	Texas Instruments Inc.	1	0,207	0,010	-
82	The Bank of New York Mellon Corporation	5	0,235	0,051	0,031
83	The Coca-Cola Company	3	0,260	0,030	0,009
84	The Dow Chemical Company	3	0,277	0,030	0,010
85	The Goldman Sachs Group, Inc.	5	0,273	0,051	0,022
86	The Home Depot, Inc.	1	0,221	0,010	-
87	Time Warner Inc.	0	-	-	-
88	U.S. Bancorp	1	0,244	0,010	-
89	Union Pacific Corporation	1	0,163	0,010	-
90	United Parcel Service, Inc.	5	0,296	0,051	0,035
91	United Technologies Corp.	6	0,271	0,061	0,037
92	Unitedhealth Group, Inc.	0	-	-	-
93	Verizon Communications Inc.	5	0,291	0,051	0,060
94	Viacom	0	-	-	-
95	Visa, Inc.	3	0,246	0,030	0,004
96	Walgreen Co.	1	0,211	0,010	-
97	Wal-Mart Stores Inc.	5	0,272	0,051	0,032
98	Walt Disney Co.	7	0,293	0,071	0,043
99	Well Point Inc.	1	0,219	0,010	-
100	Wells Fargo & Company	8	0,288	0,081	0,051

Tab. 12. the characteristics of *interlocking directorship network* of *top 100 companies* in the *USA* in *2011* (after *Baccini, Marroni (September 2013)*).

Fig. 6 displays the *interlocking directorship network* of the *top 100 companies in the USA in 2011* in *Baccini, Marroni (September 2013)*.

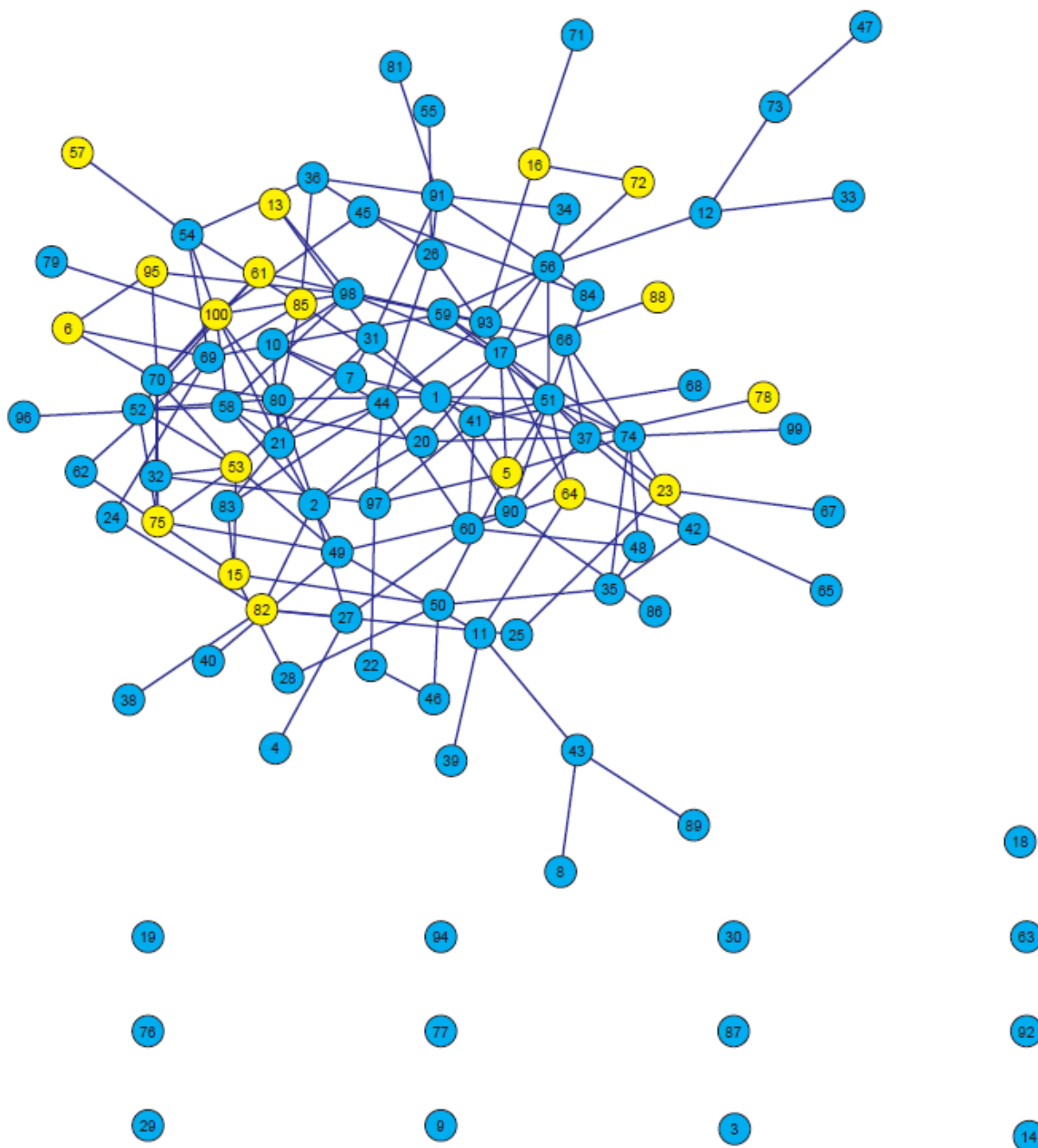


Fig. 6. *The interlocking directorship network of the top 100 companies in the USA in 2011. Yellow color denotes the directorships from financial industry (after Baccini, Marroni (September 2013)).*

The *interlocking interconnecting directors networks in the Canadian firms* have been described in *Ornstein (1984), Rowley (1997, 1998, 2000), Elms, Berman, Rowley (2000), Rowley (June 3, 2005), Rowley, Baum (2008), Carroll, Malcolm (August 1999)*. The *second author* had a wonderful opportunity to discuss the *research problem on the board' of directors overlap in the Canadian firms* in *Rowley (June 3, 2005)*. The *Canadian boards of directors*, which have the strong influences on the *public opinion* or the *business and political processes* in *Canada*, are mainly governed / chaired by the *elected (appointed) directors* from the *USA*. For example, the *board of director* at the *Torstar Corporation* in *Toronto, Canada* is governed by a *professor* from *Fuqua Business School* at *Duke University, North Carolina, USA*, because the *Torstar Corporation* is frequently used by the *US authorities* to control the *Canadian officials* in the *Canada*.

Researching the *composition of the boards of directors in Asian firms*, *Humphry Hung (July 2003)* writes: “The *model* proposes that a *board of directors* can be regarded as a *strategic device of a corporation* to influence and obtain resources through the *business and interpersonal networks of directors*. The choice of networks is therefore critical for the interlocking to be effective. The selection of *inbound directors* and *external corporations for outbound directors* can be used to achieve the *strategic goals of the organizations*.”

Humphry Hung (July 2003) continues to explain: “A *board of directors* can be a powerful tool in the *strategic management process*. *Hung (1998)* identified *six roles of board of directors: link, coordinate, control, strategize, maintain and support*. These roles serve to assist the organizations to achieve their corporate objectives. *Directors' resource endowment* will be imperative for their *governing boards* to fulfill their roles effectively (*Burt, 1997; Stuart, 1998; Gulati & Garguilo, 1999*). With an appropriate mix of *directors*, an organization can maximize the utilization of the *networks* it embeds or intends to penetrate. *Board composition* can be used as a device to enhance *competitive advantages* through acquiring *comparative advantages of resource endowment by interlocking directorates*. A *board of director* is actually a low-cost reservoir of resources and also channels for the corporation to gain access to relevant *organizational networks* and senior executives of the organization to reach appropriate *corporate elites' networks*.”

Humphry Hung (July 2003) concludes: “The need for strategic analysis of the resource endowment of the incumbent organization is a prerequisite condition for a *strategic use of boards*. A careful selection of both *organizational and corporate elites' interpersonal networks* may pave the way for an appropriate choice of *inbound directors*. Based on the model, *board effectiveness* should be measured by the *extent the governing board has contributed toward the*

response of the organization in meeting the challenge of the environment. An appropriate board composition can provide considerable contributions to the performance of the organization.”

The measurements on the extent and implications of director interlocking in the pre-war Japanese banking industry in Asia have been conducted in *Okazaki, Yokoyama (October 2001)*.

The *interlocking interconnecting directors networks* in the boards of directors in the publicly traded and non-traded firms and the related scientific topics have been researched (in a chronological order) in Brandeis (1915, 1933), Luce, Perry (1949), Selznick (1949, 1957), Ford, Fulkerson (1956), Hopkins (1964), Milgram (1967), Travers (1968), Vance (1968), Dooley (1969), Harary (1969), Bunting, Barbour (Autumn 1971), Bunting (1976), Mace (1971), Pfeffer (1972, 1973, 1983), Pfeffer, Salancik (1978), Pfeffer, Salancik (1978), Blumberg (1973), Bron, Kerbosch (1973), Granovetter (1973), Doreian (1974), Zeitlin (1974), Mariolis (1975), Buchmann (1976), Burt (1976, 1983), Cuyvers, Meeusen (1976, 1985), Wilson (1976), Hughes, John, Mackenzie (1977), Tukey (1977), Pfeffer, Salancik (1978), Freeman (1979a, b), Koenig, Gogel, Sonquist (1979), Mokken (1979), Burt (1980, 1997), Pennings (1980), Radcliff (1980), Schoorman, Bazerman, Atkin (1981), Mintz, Schwartz (1981, 1985), Mizruchi, Bunting (1981), Mizruchi (1982, 1992, 1996), Stearns, Mizruchi (1986), Mizruchi, Stearns (1988, 1994), Byrd, Mizruchi (2005), Mariolis, Jones (1982), Barnes (1983), Burt (1983), Dodd, Warner (1983), Palmer (1983), Roy (1983), Vance (1983), American Bar Association (1984, 2011), Lease, McConnell, Mikkelson (1984), Ornstein (1984), Scott, Griff (1984), Useem (1984), Ziegler (1984), Baysinger, Butler (1985), Bearden, Mintz (1985), Galaskiewicz, Wasserman, Rauschenbach, Bielefeld, Mullaney (1985), Demsetz, Lehn (1985), Meeusen, Cuyvers (1985), Stokman, Wasseur (1985), Stokman, van der Knoop, Wasseur (1990), Mace (1986), Glatthard (1987), Richardson (1987), Hermalin, Weisbach (1988, 1998), Kesner (1988), Weisbach (1988), Hill C W L, Snell (1988), Zajac (1988, 1996), Fosberg (1989), Lorsch, MacIver (1989), Nelson (1989), Singh, Harianto (1989), Zahra, Pearce (1989), Pearce, Zahra (1992), Baysinger, Hoskisson (1990), Gilson (1990), Glaus (1990), Kaplan, Reishus (1990), Kaplan, Minton (1994), Powell (1990), Rosenstein, Wyatt (1990, 1994, 1997), Burris (1991), Davis (1991), Davis, Greve (1997), Davis, Yoo, Baker (2002, 2003), Davis, Yoo, Vast (2003), Goodstein, Boeker (1991), Hermalin, Weisbach (1991, 2001), Byrd, Hickman (1992), Demb, Neubauer (1992), Fligstein, Brantley (1992), Gerlach (1992), Judge, Zeithaml (1992), Lee, Rosenstein, Rangan, Davidson (1992), Lincoln, Gerlach, Takahashi (1992), Lipton, Lorsch (1992), Mallette, Fowler (1992), Milgrom, Roberts (1992), Smith, Watts (1992), Daily, Dalton (1993), Haunschild (1993), Haunschild, Beckman (1998), Jensen (1993), Johnson, Hoskisson, Hitt (1993), Kester (1993), Millstein (1993), Shivdasani (1993), Shivdasani, Yermack (1999), Barnhart, Marr, Rosenstein

(1994), Brickley, Coles, Terry (1994), Brickley, Coles, Linck (1999), Daily, Dalton (1994, 1997), Dalton, Daily, Ellstrand, Johnson (1998), Dalton, Daily, Johnson, Ellstrand (1999), Goodstein, Gautam, Boeker (1994), Huse (1994), Krackhardt (1994), Tricker (1994), Wasserman, Faust (1994), Wassermann, Faust, Iacobucci (1994), Wasserman, Galaskiewicz (1994), Benassi (1995), Fligstein (1995), Hallock (January 1995), Hill S (1995), Kini, Kracaw, Mian (1995), Klein (1995), Lorsch (January - February 1995), Moerland (1995, 1997, 1999), Monks, Minow (1995), O'Neal, Thomas (1995), Pfannschmidt (1995), Wunderer (1995), Agrawal, Knoeber (1996), Beasley (1996), Bhagat, Black (May 10-11 1996, 1998), Booth, Deli (1996, 1999), Borokhovich, Parrino, Trapani (1996), De Cecco, Ferri (1996), Doz (1996), Park, Rozeff (1996), Sundaramurthy (1996), Sundaramurthy, Mahoney, Mahoney (1997), Miller (March 26 1997), Yermack (1996), West (1996), Williamson (1996), Bianco, Pagnoni (1997), Cotter, Shivdasani, Zenner (1997), Davies, Gower (1997), Hallock (1997), John, Senbet (1997), Loderer, Martin (1997), Uzzi (1997), Loderer, Peyer (September 5 2001, 2002, June 3, 2005), Podolny, Baron (1997), Rosenstein, Wyatt (1997), Rowley (1997, 1998), Elms, Berman, Rowley (2000), Rowley, Behrens, Krackhardt (2000), Rowley, Baum (2008), Shleifer, Vishny (1997), Tufano, Sevick (1997), Bollobas (1998), Charan (1998), Collin (1998), Denis, Sarin (1998), Eisenberg, Sundgren, Wells (1998), Everett, Borgatti (1998), Fried, Bruton, Hisrich (1998), Gulati (1998, 1999), Gulati, Singh (1998), Khanna, Gulati, Nohria (1998), Gulati, Gargiulo (1999), Gulati, Westphal (1999), Gargiulo, Gulati (January 2000), Haunschild, Beckman (1998), Hermalin, Weisbach (1998, 2003), Hopt (1998), Hopt, Kanada, Roe, Wymeersch, Prigge (editors) (1998), Hopt, Leyens (2004), Hung (1998), Klein (1998a, b), La Porta, Lopez de Silanes, Shleifer, Vishny (1998), Mac Canna, Brennan, O'Higgins (1998), Sanders, Carpenter (1998), Stuart (1998), Spencer (1998), Watts, Strogatz (1998), Watts (1999a, b, c), Barabasi, Albert (1999), Barabasi (2002), Bhagat, Black (1999, 2002), Borgatti, Everett (1999), Borgatti, Everett, Freeman (2002), Borgatti (2002, 2005, 2006), Borgatti, Foster (2003), Carroll, Malcolm (August 1999), Core, Holthausen, Larcker (1999), Davies A (1999), Fohlin (1999), Maassen (1999), MacAvoy, Millstein (1999), Maman (1999, 2001), Postma, van Ees, Garretsen, Sterken (1999), Shivdasani, Yermack (1999), Vafeas (1999), Van Manen, Hooghiemstra (1999), Adams (2000), Barbi (2000), Blackhurst (2000), Dyer, Noboeka (2000), Fich (2000), Gulik, Gedajlovic, Maassen, van den Bosch, Volberda (July 8-11 2000), Kracaw, Zenner (2000), Miwa, Ramseyer (2000), Robert III, Evans, Honemann, Balch (October 1 2000), Scott (2000), Sterman (2000), Ward (2000), Ferris, Masciandaro, Messori (2001), Ferris, Jagannathan (2001), Ferris, Jagannathan, Pritchard (2002, 2003), Kroszner, Strahan (2001a, b), Newman, Strogatz, Okazaki, Yokoyama (October 2001), Watts (2001), Newman (2003, 2007), Snijders (2001, 2003),

Tomka (2001), Bainbridge (2002), Becht, Bolton, Roell (October 2002), Bianchi, Bianco, Enriques (2002), Bianchi, Bianco, Giacomelli, Paccos, Trento (2005), Bianchi, Bianco (2006), Carver (2002), Everard, Henry (2002), Faccio, Lang (2002), Perry, Peyer (September 2002, August 12 2005), Volpin (2002), Dann, Del Guercio, Partch (2003), De (2003), Gillette, Noe, Rebello (2003), Fich, White (2003, 2005), Fich, Shivdasani (2006), Hermalin, Weisbach (2003), Humphry Hung (July 2003), Malcolm (2003), Ong, Wan, Ong (October 2003), Ornstein (2003), Phan, Lee, Lau (2003), Rodriguez, Cardenas, Oltra (2003), Bebchuk, Cohen, Ferrell (2004), Bebchuk, Cohen (2005), Bebchuk, Grinstein, Peyer (2006a, b), Bebchuk, Cremers, Peyer (2007), Battiston, Catanzaro (2004), Caldarelli, Catanzaro (2004), Hakansson, Lind (2004), Heinze (2004), Hopt (2004), Levine (April 2004), OECD (2004), O'Hagan, Green (2004), Rinaldi (June 25-26 2004), Rinaldi, Vasta (2005), Robins, Alexander (2004), Stablein, Cleland, Mackie, Reid (2004), Attig, Morck (2005), Carrington, Scott, Wasserman (2005), Chabi, Maati (2005), Charan (2005), De Nooy, Mrvar, Batagelj (2005), Hanneman, Riddle (2005), Raheja (2005), Rinaldi, Vasta (2005), Aguilera (2006), Batagelj, Mrvar (2006), Barucci (2006), Bertoni, Randone (2006), Bizjak, Lemmon, Whitby (2006), Carbonai, Di Bartolomeo (2006), Chhaochharia, Grinstein (2006a, b, 2007), Conyon, Muldoon (2006a, b), Corrado, Zollo (2006), Elouaer (2006), Ferrarini (2006), Guieu, Meschi (2006), Kramarz, Thesmar (2006), Kiel, Nicholson (2006), Morresi (2006), Murgia (2006), Prinz (2006), Silva, Majluf, Paredes (2006), Soon Moon Kang (May 23 2006), Adams, Ferreira (2007), Adams, Hermalin, Weisbach (2010), Ciocca (2007), Deloof, Vermoesen (December 2011), Enriques, Volpin (Winter 2007), Gerber (2007), Murray (2007), Non, Franses (2007), Provan, Fish, Sydow (2007), Rommens, Cuyvers, Deloof (November 2007), Santella, Drago, Polo (November 11 2007), Uzzi, Amaral, Reed-Tsochas (2007), Bowen (2008), Harris, Raviv (2008), Milakovíc, Alfarano, Lux (2008), Milakovíc, Raddant, Birg (2009), Alfarano, Milakovíc (2009), Tutelman (2008), Alvarez, Marin, Fonfria (2009), Bizjak, Lemmon, Whitby (2009), Cai, Garner, Walkling (2009, 2010), Santella, Drago, Polo, Gagliardi (2009), Rosch (2009), Schonlau, Singh (2009), Baccini, Barabesi (2010), Baccini, Marroni (September 2013), Stuart, Yim (2010), Donzé (2011), Gabrielsen, Hjelmeng, Sorgard (2011), Rousseau, Stroup (2011), Chu (2012), Ghezzi (2012), Gonzalez Diaz (2012), Pawlak (2012), Schifeling, Mizruchi (August 27 - 28 2012), Uddin (2012), Anderson, Sawyer (2014), Whitehead (December 2014), Wikipedia (January 15 2015).

Winning virtuous strategies creation by interlocking interconnecting directors in boards of directors during strategic governance of firms

Going from the *information theory* and *information communication theory* in Shannon (1948), Yaglom A M, Yaglom I M (1983), we know that the *information* can be transmitted in the *analogue and digital formats* in the *XI century*. Therefore, the *authors* would like to formulate the *theory of the board of directors* as well as the *interlocking interconnecting directors' networks in the boards of directors in the firms*, going from the *information theory* and *information communication theory perspectives* in Shannon (1948), Yaglom A M, Yaglom I M (1983). The *authors* make a *logical assumption* that the **director works with the information in the firm**, performing various kinds of manipulations with the *information* to form his *opinions* and make his decisions on the *business related issues* in the *firm*.

Let us focus on a possible representation of the **director** in terms of the *information communication theory*. In the *proposed theoretical framework*, the *authors* come up with a *research idea* that the **director** works to make the *decisions* on the a *number of different business related tasks in the firm* by doing the following things

1. the *information sensing and detection*,
2. the *information filtering*,
3. the *information processing*,
4. the *information resonant absorption*,
5. the *information analysis*,
6. the *decision making, using the available information*.

Speaking about the **information sensing**, we can conditionally imagine that the *director* is a *sensing and detecting device* with the *embedded optical, sound, chemical sensors and detectors*, which can gather the *information data streams* in the *information fields*.

Considering the **information filtering**, it would be interesting to say that every *director* has the *accumulated knowledge base, subject oriented skills developed during his education at university, professional experiences obtained in the process of work*, can allow the *director* to *tune into the selected information data streams at certain frequencies* and to *filter out the undesired information streams*, working at the *board of directors* in the *firm*. The *filtered information* by every *director* is different, but some correlations may occur. Moreover, the *filtered information* can be distorted during the *information filtering process*, because of various factors such as the *existing imperfections* in the *director's professional education, professional experiences*, and problems with the *data communication channels*.

Discussing the **information processing**, we would like to make a *theoretical proposition* that the ***director can be represented as an information processing element*** with the ***Harvard director's mindset architecture*** or the ***von Neumann director's mindset architecture*** or some other possible director's mindset architectures in agreement with the *digital signal processing* and *business administration sciences*. Let us suppose that the classical *von Neumann director's mindset architecture* has a *single memory* to store the *data* and *program instructions*; and the *Harvard director's mindset architecture* has the *two separate memories* to keep the *data* and *program instructions*, achieving a *high degree of concurrency* in Hwang, Briggs (1984), Anceau (1986), Fountain (1987), Chen (editor) (1988), Van de Goor (1989), Prisch (1998), Wanhammar (1999). Thus, we firmly believe that the *director's mindset architecture* may have the *multiple distinctive impacts* on the *information processing volume, quality and time*, resulting in an appearance of the *different professional director's characteristics*. In other words, the *nature of the director's mindset architecture* can partly explain an observation of variations in the *functional performance of the board of directors*, resulting in the *different paths of enterprises evolution*.

Focusing on the **information resonant absorption**, the authors want to note that the *director's resonant absorptive capacity* in respect to the *information*, that is his ability to obtain and store the *knowledge and information* from the *external environment*, is defined by the *director's professional education, professional experiences*, etc. The *absorption phenomena* in the *economics* has been researched in Cohen, Levinthal (1989, 1990), Kumar, Nti (1998), Lane, Lubatkin (1998), Farina (2008). The *director's resonant absorptive capacity in respect to the information* is to some degree analogous to the *resonant absorption phenomena* in the *condensed matter* and *soft condensed matter* in the *physics* and *chemistry*, which has been researched by the authors early:

1. The ***absorption of the different radioactive chemical elements and their isotopes in the soft condensed matter (the coal granules of different geometric shapes, the coal dust particles of micro- and nano- sizes) at the sound frequencies*** have been researched in the *nuclear physics* in Neklyudov, Dovbnaya, Dikiy, Ledenyov O P, Lyashko (2014), Ledenyov O P, Neklyudov (2013), Neklyudov, Dovbnaya, Dikiy, Ledenyov O P, Lyashko (2013), Neklyudov, Ledenyov O P, Fedorova, Poltinin (2013a, b), Neklyudov, Fedorova, Poltinin, Ledenyov O P (2013), Ledenyov O P, Neklyudov, Poltinin, Fedorova (2012a, b), Neklyudov, Ledenyov O P, Fedorova, Poltinin (2012), etc.

2. The ***absorption of the electromagnetic signals in the condensed matter (the high pure metals and superconductors) at the ultrasonic frequencies*** has been investigated in the *solid*

state physics at the in Ledenyov O P (2012a, b, c), Ledenyov V O, Ledenyov D O, Ledenyov O P, Tikhonovsky (2012), Ledenyov O P, Fursa V P (2012), Shepelev, Ledenyov O P, Filimonov (2012a, b, c, d, e), etc.

3. The **absorption of the electromagnetic signals in the sub-surface layers in the condensed matter (the high temperature superconducting ceramics and dielectrics) at the ultra high frequencies** has been studied in the solid state physics in Ledenyov D O, Mazierska, Allen, Jacob (2012), Leong, Mazierska, Jacob, Ledenyov D O, Batt (2012), Mazierska, Ledenyov D O, Jacob, Krupka (2012), Jacob, Mazierska, Ledenyov D O, Krupka (2012), Mazierska, Krupka, Jacob, Ledenyov D O (2012), Jacob, Mazierska, Leong, Ledenyov D O, Krupka (2012), Jacob, Mazierska, Krupka, Ledenyov D O, Takeuchi (2012), Mazierska, Jacob, Ledenyov D O, Krupka (2012), Ledenyov D O (2013), Ledenyov D O, Ledenyov V O (2014), Mazierska, Leong, Ledenyov, Rains, Zuchowski, Krupka (2014), etc.

Going to the topics of the **information analysis and subsequent decision making** by the director in the board of directors in the firm, let us focus on a possible representation of the **board of directors** in terms of the *information communication theory*. In the predefined set of coordinates, the **board of directors** with a certain number of elected appointed directors can be theoretically represented as

1. An **electronically scanned electronically steered phased array radar** with a certain number of active elements (*directors*), which can sense the information and tune into the selected *information carrier frequencies bands* in the *information fields*;

2. A **filters bank** with a certain number of *information filters*, which tunes into a certain *data streams frequencies* and reject the *unnecessary information streams* in the *adjacent channels* over all the *frequencies range*;

3. An **array of digital signal processors** with the *Harvard / von Neumann architectures*, which process the *digitized data streams*, using the *predefined information processing algorithms*, which can be implemented in the *hardware* or the *software*;

4. A **memory chipset** with the *ultra fast short and long term memories*, which store the *absorbed information* and provides a fast access to the *absorbed information*.

Now, let the authors formulate the **Ledenyov theory** on the winning virtuous business strategies creation by the directors at the resonant absorption of discrete information in the diffusion - type financial economic systems with the induced nonlinearities. **The Ledenyov theory** postulates that the director with the **highest information absorption capacity**, who experience the phenomenon of resonant - type absorption of information, is able to create the winning virtuous strategies through the decision making process on the available business

choices in the diffusion - type financial economic system with the induced nonlinearities, applying the econophysical econometrical analysis techniques in Schumpeter (1906, 1933), Bowley (1924), Box, Jenkins (1970), Grangel, Newbold (1977), Van Horne (1984), Taylor S (1986), Tong (1986, 1990), Judge, Hill, Griffiths, Lee, Lutkepol (1988), Hardle (1990), Grangel, Teräsvirta (1993), Pesaran, Potter (1993), Banerjee, Dolado, Galbraith, Hendry (1993), Hamilton (1994), Karatzas, Shreve (1995), Campbell, Lo, MacKinlay (1997), Rogers, Talay (1997), Hayashi (2000), Durbin, Koopman (2000, 2002, 2012), Ilinski (2001), Greene (2003), Koop (2003), Davidson, MacKinnon (2004), Campbell, Lo, MacKinlay (1996), Vialar, Goergen (2009) and using the creative imperative integrative intelligent conceptual co-lateral adaptive logarithmic thinking process with the use of the inductive, deductive and abductive logics in Martin (1998-1999, 2005-2006) in the frames of the strategic choice structuring process, that is the winning through the distinctive choices process in Porter (1979, 1980, 1982a, b, 1983, 1985, 1987a, b, 1991, 1994a, b, 1996a, b, 1997, 2001a, b, 2008, 2013), Porter, Harrigan (1981), Porter, Salter (1982), Montgomery, Porter (1991), Porter, Rivkin (2000), Porter, Sakakibara (2004), Anand, Bradley, Ghemawat, Khanna, Montgomery, Porter, Rivkin, Rukstad, Wells, Yoffie (2005), Porter, Kramer (2006), Hill, Jones (1998, 2004), Martin (1998-1999b, 2004, 2005-2006a, b, 2009), Moldoveanu, Martin (2001), Lafley, Martin (2013), Grant (2001), Choo, Bontis (2002), Drejer (2002), Sadler (2003), Roney (2004), Ireland, Hoskisson, Hitt (2006), Besanko, Shanley, Dranove (2007), Hitt, Ireland, Hoskisson (2007), Gavetti, Rivkin (2007), Teece, Winter (2007), aiming both to get an increased business valuation (a return premium) and to make a positive social impact in the local community and society in the frames of the socially responsible investment (SRI) process that integrates social, environmental, and ethical considerations into investment decision making in the real sector of economy in Waddock, Graves, (1994), Arora, Gangopadhyay (1995), Sparkes (1998, 2004, 2008), Johnson, Greening (1999), Lydenburg (2002), Cox, Brammer, Millington (2004), Kotler, Lee (2005), Louche, Lydenberg (2006), McWilliams, Siegel, Wright (2006), Scholtens (2006), Cespa, Cestone (2007), Cumming, Johan (2007), Williams (2007), Hull, Rothenberg (2008), Reinhardt, Stavins, Vietor (2008), Renneboog, Horst, Zhang (2008), Arjalies (2010), Crifo, Mottis (2010), Morrell, Clark (2010), Baron, Harjoto, Jo (2011), Crifo, Forget (February, 2012).

Let us add a few *important research remarks*, which should be considered during an *accurate characterization of the overlapping interconnecting interlocking directors networks in the boards of directors in the firms* in the frames of the *presented corporate governance research*.

Continuing the *discussion* on the *accurate characterization* of the *overlapping interconnecting interlocking directors networks in the boards of directors in the firms*, the authors would like to note that the *wireline information communication networks (ADSL)*, *wireless information communication networks (GSM, WCDMA, UMTS)*, the *optical information communication networks (SONET, ATM, all optical CDMA)* can be accurately characterized by 1) the *transmitted data stream measurements*, and 2) the *existing bit error rate measurements (BER)*, using the *eye diagram* and the *special measurement equipment*, in accordance with the *US Federal Communication Commission (FCC)* technical requirements. We would like to add that 1) the *director's boards seats accumulation number*, 2) the *overlapping interconnecting interlocking directors networks configuration*, and 3) the *director's centrality* (the *Freeman Degree* [*the potentiality to act or communicate with a specified number of directors*] in *Freeman (1979a, b)* and *Betweenness Centralization* [*the number of paths that pass through a node*] as the *measures of connections density of a director in the core network*) in the *overlapping interconnecting interlocking directors networks in the boards of directors in the firms* are the *only parameters*, which describe the *overlapping interconnecting interlocking directors networks performance* in the *business administration science literature* so far. **The authors propose to use both 1) the transmitted information data-stream measurements, and 2) the existing bit error rate measurements (BER) in the overlapping interconnecting interlocking directors networks in the boards of directors in the firms to accurately characterize the overlapping interconnecting interlocking directors networks performance and the director's competence and effectiveness.** In other words, the *authors* suggest that the *information*, which is *generated, transmitted and received* by the *director* in the *overlapping interconnecting interlocking directors networks in the boards of directors in the firms* can accurately characterize the *overlapping interconnecting interlocking directors networks performance*, and tell the true story about the *director's competence and effectiveness*, impacting the *involved firms' valuations*. Let us highlight the existing differences between the *presently used parameters* such as the 1) the *director's boards seats accumulation number*, 2) the *overlapping interconnecting interlocking directors networks configuration*, and 3) the *director's centrality* (the *Freeman Degree and Betweenness*) on one side and the proposed parameters such as 1) the *transmitted data stream measurements*, and 2) the *existing bit error rate measurements (BER)* on another side of the coin. We would like to explain that the *director* can have a *big director's boards seats accumulation number*, an *advanced overlapping interconnecting interlocking director's professional networks configuration*, a *high degree of centrality*, however, at the same time, the *director* can generate, transmit, receive the *low information data*

streams (the information data flows) in the advanced overlapping interconnecting interlocking director's professional networks, behaving as a passive observer and making the little or no useful contributions to the boards of directors work in the considered firms. In other words, let the authors repeat that, in our opinion, the information, which is generated, transmitted and received by the director in the overlapping interconnecting interlocking directors networks in the boards of directors in the firms is the only important parameter, which can accurately characterize the director's competence and effectiveness during his/her work assignments in the boards of directors in the firms. In any firm, the work performance, shown by every director, will ultimately impact the work performance, demonstrated by the board of directors, which will certainly be reflected in the firm's valuation.

We do believe that the generated, transmitted, and received information data streams in the interlocking interlinking interconnecting directors' networks have a highly asymmetric nature, because of some reasons. In our opinion, every director has the different education, professional experience, accumulated knowledge base and can allocate the different amounts of time to work at the boards of directors in the firms, hence the director will generate, transmit, receive the various information data streams (the information data flows), resulting in the asymmetric information data streams appearance in the interlocking interlinking interconnecting directors' networks in the boards of directors in the firms.

Speaking about the accurate characterization of the overlapping interconnecting interlocking directors networks in the boards of directors in the firms, we would like to emphasize that the conducted empirical research reveals another interesting fact that the positive and negative feedback loops, which can be created by the interlocking directors networks in the boards of directors in the firms, can quite possibly lead to the destructive coordination among the directors in the boards of directors in the firms by eliminating the randomness element and introducing the greater uniformity in the pursuing business strategies (the destructive coordination term is well described in Whitehead (2011, 2014)).

We think that the stability of interlocking interconnecting directors' network depends on the nature of stochastic dynamic processes in the interlocking interconnecting directors' network, hence it can be impacted by the election / appointment / introduction of a new directors into the overlapping interconnecting interlocking directors networks in the boards of directors in the firms in the time domain in Anishenko, Vadivasova, Astakhov (1999), Kuznetsov (2001). For example, it is a well known fact that a fast random addition of the energy consumers to the energy distribution networks may result in a shift of the energy distribution networks out of a stable state, because of the origination of the stochastic dynamic resonance.

The same processes can have place in the case of the *electronic circuits* with the interconnected networks of *electronic components*, hence the *stability of electronic circuits is considered as an important parameter*. The *stability of wireless communications networks* with the millions of active users is assumed to be quite important parameter as well.

Making the *concluding comments on the strategy creation issue*, the *authors* think that the *different levels of the information sensing, information filtering, information processing, information absorption, information analysis and decision making with the obtained information* by the *director* may have the certain positive or negative impacts on the *director's winning virtuous strategy creation ability* in the *overlapping interconnecting interlocking directors networks in the boards of directors in the firms*. Of course, the *most complicated task for every wise director* is to adjust to the *optimal levels of the information sensing, information filtering, information processing, information absorption, information analysis, decision making*, which can allow the *winning virtuous strategy creation* in the *overlapping interconnecting interlocking directors networks in the boards of directors in the firms*. ***We would like to mention that the excessive or insufficient levels of the information sensing, information filtering, information processing, information absorption, information analysis by the director may result in the bifurcations and chaos appearances in the frames of a decision making process on the winning virtuous strategy creation in the case of presence of the considered overlapping interconnecting interlocking directors networks in the boards of directors in the firms.***

Using the *knowledge base in the probability theory* in *De Laplace (1812)*, *Bunyakovsky (1846)*, *Chebyshev (1846, 1867, 1891)*, *Markov (1890, 1899, 1900, 1906, 1907, 1908, 1910, 1911, 1912, 1913)*, *Kolmogorov (1938, 1985, 1986)*, *Wiener (1949)*, *Brush (1968, 1977)*, *Shiryayev (1974, 1988, 1995)*, *Pugachev (1979)*, the *authors* derived the *appropriate universal formula* to compute the *probability number of the additional directorship mandates issues*, depending on a set of *already existing directorship mandates* in the case of the *interconnecting interlocking directors' networks in the boards of directors in the firms*, $P(b + 1|b)$, in *Milaković, Raddant, Birg (2009)*, *Alfarano, Milaković (2009)*; and developed the ***MicroID software program***, which makes the *actual probabilistic prediction* toward the *director's election / appointment* in the *boards of directors in the firms*, taking to the consideration both the *director's technical characteristics* and the *interconnecting interlocking director's network parameters*. We tested the *MicroID software program*, improved the *computing recursive algorithm*, and evaluated the *accuracy of developed prediction models*, comparing the *obtained computing results* with the *real-world director's election / appointment numbers* in the *boards of directors in the firms* in the considered cases of research interest.

Conclusion

The *article* presented an *original research* on the *strategy creation* by the *interlocking interconnecting directors* in the *boards of directors* in the *firms* in an *information century*. We reviewed the *possible structures* of the *board of directors*, and show that there are the *interlocking directors networks* in the *boards of directors* in a big number of *firms*. Researching the *strategic governance of firms*, we highlight a fact that the *director* makes the *information sensing, filtering, processing, resonant absorption, analysis, decision making*, hence it can be empirically represented as a *digital signal processor* with the *Harvard* or *von Neumann director's mindset architectures*. We think that the *board of directors* can be theoretically represented as the *electronically-scanned electronically-steered phased array radar* with a certain number of *active antenna elements, filters banks, digital signal processors, memory chipsets* in agreement with the *digital signal processing* and *business administration sciences*. Using the above theoretical assumptions, we formulate the *Ledenyov theory* on the *winning virtuous strategies creation* by the *interlocking interconnecting directors* in the *boards of directors* in the *firms*, which make the businesses in the conditions of the *diffusion - type financial economic systems* with the *induced nonlinearities*. We suggest that 1) the *transmitted/received data stream measurements*, 2) the *bit error rate measurements* have to be used to accurately characterize the *interlocking interlinking interconnecting directors networks* in addition to the well known parameters such as the *director's boards seats accumulation number, centrality, Freeman degree, Betweenness* and *network configuration*. We believe that the *generated, transmitted, and received information data streams* in the *interlocking interlinking interconnecting directors' networks* have a *highly asymmetric nature*, because of some reasons. We think that the *positive and negative feedback loops*, which can be created by the *interlocking directors networks* in the *boards of directors* in the *firms*, can quite possibly lead to the *destructive coordination* among the *directors* by eliminating the *randomness element* and by introducing the *greater uniformity* in the *pursuing business strategies*. We derived the *appropriate universal formula* and developed the *MicroID software program* to compute the *probability number* of the *additional directorship mandates issues*, depending on a set of *already existing directorship mandates* in the case of the *interconnecting interlocking directors' networks* in the *boards of directors* in the *firms*. We applied the *accumulated knowledge bases* in the *nuclear physics, condensed matter physics, space physics, mathematical physics, econophysics* and *software engineering* to achieve our *main innovative advanced research goal*, namely to improve our *understanding* on the *winning virtuous strategies creation* by the

interlocking interconnecting directors in the boards of directors in the firms in the information century.

Acknowledgement

The *directors* in the *boards of directors* in the *firms* face a number of business challenges as a result of *appearing disruptions* in the *economics* in an *information age*. In this *introductory condensed research article*, the *authors* use an original research approach in an attempt to find a *possible solution* for the *strategy creation problem*, which has to be solved by the *directors* in the *boards of directors* during the *strategic governance* of *firms*. The *international students* prepared the *brief abstracts of our invited lectures* at the *leading universities* around the *World* over the last two decade, and then the *authors* combined our *lecture notes* with the *brief abstracts of our invited lectures*, aiming to write a *research article*. We also decided to include *some our thoughts*, expressed during the *Q&A sessions* after the presented lectures and kindly recorded by our students. In addition, the *authors* included the *most interesting comments, professional advises, private opinions* on the *research subject* by the *directors of firms*, recorded during a few thousands of *business meetings* in *Europe, North America* and *Asia*. In our opinion, the *presented research findings* may be in the scope of interest by the *MBA students, professors in the business administration, management, finances, economics sciences, directors in the boards of directors, chairmen of the boards of directors, subject experts, and business leaders*, who would like to stay up to the date on the recent developments in the *business administration science*.

The *first author's* knowledge on the *origins of the nonlinearities* in the *complex systems* in the *electrical, electronic, computer and financial engineering* has been obtained during the intensive innovative scientific collaboration with *Prof. Janina E. Mazierska, Personal Chair, Electrical and Computer Engineering Department, James Cook University, Townsville, Australia* and *former Dean, Electrical and Computer Engineering Department, James Cook University, Townsville, Australia, and former IEEE Director Region 10 in Australia, and IEEE Fellow*. The first author would like to acknowledge *Prof. Janina E. Mazierska* by expressing his sincere gratitude for the kind scientific advices on how to develop the *logical mathematical analysis skills, the scientific problems analytic solving ability* and the *abstract scientific thinking* to tackle the complex scientific problems on *the nonlinearities in the microwave superconductivity* as well as on *the nonlinearities in the economics*, applying the interdisciplinary scientific knowledge together with the advanced computer modeling techniques

in the course of the cutting-edge highly innovative research projects at *James Cook University* in *Townsville* in *Queensland* in *Australia* in 2000 – 2014 after the graduation from *V. N. Karazyn Kharkov National University* in *Kharkov* in *Ukraine* in 1994 – 1999.

There would be appropriate to say that, in an *information age*, the *first author's* special efforts have been primarily directed towards the *scientific information gathering, systematization and detailed analysis* in the frames of this research project on the *business strategy creation* by the *directors* in the *boards of directors* in the *firms*; hence, the *first author* would like to thank the professional staff at the *central library* at *James Cook University* in *Townsville, Queensland, Australia* for providing the *first author* with all the necessary technical support in relation to the literature search on the subjects of his *multidisciplinary research interest* in the *electronic research databases* at *Australian* universities, replying to the numerous chaotic research requests timely, and making everything possible to assist with the completion of the highly innovative advanced research on the *business strategy creation* by the *directors* in the *boards of directors* in the *firms*, which has been conducted at the *James Cook University* in *Townsville, Queensland* in *Australia* in 2000 – 2015.

The *first author* would like to comment that the *informative scientific discussions* on the *business strategy creation* by the *directors* in the *boards of directors* in the *firms*, which have been conducted by the *first author* with the *M.Sc. students, Ph.D. candidates, professors, visiting scientists and other faculty members* during the *numerous scientific seminars and brain storm research meetings* at *James Cook University* in *Townsville* in *Queensland* in *Australia*, are generously appreciated, because these *valuable scientific opinions exchanges* encouraged the *first author* to generate the new original scientific ideas and make the *creative imperative integrative intelligent conceptual co-lateral adaptive logarithmic thinking* with the application of the *inductive, deductive and abductive logics analysis* as far as the *business strategy creation* by the *directors* in the *boards of directors* in the *firms*, is concerned.

A certain part of an *introductory condensed research article* has been written during the *first author's* *yachting* with the *Australian friends* in *Melbourne, Victoria, Australia* and in *Brisbane, Queensland, Australia*, when a number of the *creative research ideas and important research findings* on the *business strategy creation* by the *directors* in the *boards of directors* in the *firms*, came to his mind. Most of the ideas have been discussed with the *Australian friends*, when on the *yachts*. Sometimes, the thoughtful discussions have been further conducted during the “*numerous meetings without the ties*” with the great *Australian philosophers, professors, scientists, businessmen, lawyers, governmental officials and political leaders* in the relaxing trusted mutual-respect atmosphere, characterized by the *pluralism of research opinions* on the

topics of interest, during the *Yarra valley* and *Mornington-Peninsula limo tours* (www.yarravalleylimowinetours.com.au). All these exchanges of opinions fascinated the *first author's mind*, stimulated the *abstract thinking on the presented assumptions*, and inspired to *work consistently* to complete the writing of this *highly innovative condensed research article* on the *business strategy creation by the directors in the boards of directors in the firms*, at *James Cook University* in *Townsville, Brisbane, and Gold Coast* in *Queensland* in *Australia* in *2015*.

The *first author* would like to thank cordially all the *European universities rectors, universities deans, distinguished professors, world renowned financiers, reputable economists* and *well respected businessmen* for *many tens of highly creative and productive business meetings* during the *first author's global intellectual journey* over the *European capitals*, including: *Warsaw, Poland; Berlin, Germany; Amsterdam, The Netherlands; Brussels, Belgium; Luxemburg, Luxemburg; Paris, France; Barcelona, Madrid, Spain; and Coimbra, Lisbon, Porto, Portugal* in *October, 2014*. It was nice to meet and discuss all the *problems of mutual research interest* with the *old European Friends*, coming from *Brisbane, Australia*.

It is not possible to underestimate an influence by the *classic music* on the development of *strategic thinking skills*, hence a visit by the *first author* to the *City of Vienna* in *Austria* in *Europe* during the *Christmas and New Year festivities* in *December 2014- January 2015* had a quite positive overall impact on the completion of *research article writing*.

After the graduation from *V. N. Karazyn Kharkov National University* in *Kharkov* in *Ukraine* in *1993*, the *second author* worked on the *research programs* in a number of universities and institutions around the *World*. Thinking about this *research paper*, the *second author* would like to kindly acknowledge the numerous private communications with the participants of the *V. Ya. Bunyakovsky international conference* with the special focus on the *V. Ya. Bunyakovsky's research contributions* to the *mathematical theory of probability* and its modern applications in the *econophysics* and *econometrics*, which had place during a tour to the *Town of Bar, Vinnytsya Region, State of Ukraine* in the time of the conference, organized by the *Institute of Mathematics of National Academy of Sciences of Ukraine (NASU), Kyiv, Ukraine* on *August 20 – 21, 2004*. Absorbing the *brilliant research ideas* during a fruitful exchange by the *scientific opinions* among the conference attendees, the *second author* came up with a remarkable conclusion that the foundations of the *mathematical theory of probability* by *V. Ya. Bunyakovsky* enable us to perform a more accurate scientific analysis and characterization of the complex research problems on the *business strategy creation by the directors in the boards of directors in the firms*. The *first author* has been worked on the *research article*, discussing the

points of mutual research interest with the second author, during his regular visits to the Town of Bar, Vinnytsya Region, State of Ukraine over the recent years.

It is a real tremendous pleasure to comment that some fundamental issues on the *business strategy creation by the directors in the boards of directors in the firms* have been researched by the *second author* during his *intensive research assignments* at the *Rotman School of Management, University of Toronto, Canada* in 1998 – 1999 and 2005 – 2006. The *second author* met with many hundreds of *North American Corporations Presidents, Board of Directors Chairmen, Chief Executive Officers (CEOs), Chief Information Officers (CIOs), Chief Operating Officers (COOs)* and visited the *Research Triangle Park high-tech cluster near Durham in North Carolina in the USA* as well as the *Kanata high-tech cluster near Ottawa in Ontario; the Calgary high-tech cluster in Calgary in Alberta; the Richmond high-tech cluster near Vancouver in British Columbia in the North America in 1998 – 2006, the Montreal high-tech cluster in Montreal in Quebec*, making his *innovative research on the business strategy creation by the directors in the boards of directors in the firms*. The obtained information has been researched and analyzed by the *second author* at the *Rotman School of Management, University of Toronto, Canada*, which was a *global hub of innovative scientific thinking in the economics and finances* mainly due to the *high level organizational and personal efforts* by *Prof. Roger L. Martin, former Dean, Rotman School of Management, University of Toronto, Canada*, who strongly supported and facilitated the *initiation of innovative research and the creation of intensive business education courses in Canada* on that time. It is important to underline the fact that the *Prof. Roger L. Martin, former Dean, Rotman School of Management, University of Toronto, Canada* took a right decision to support our *innovative research* by all the available resources at *Rotman School of Management, University of Toronto, Canada*, including the *library, computer laboratory and professional management consulting*. Indeed, the *Rotman School of Management, University of Toronto, Canada* was a *global financial and economic center of gravity* on that time, where the *highly innovative research work* has been conducted by the *second author* from the early morning hours until the deep night, being occasionally interrupted by the *thoughtful long hours scientific discussions* on a variety of *research problems in the finances* with *Profs. John C. Hull and Roger L. Martin, Rotman School of Management, University of Toronto, Canada* in 1998 – 1999 and in 2005 - 2006. It makes sense to note that, in some cases, the *intensive research discussions and numerous consultations* have been continued during our *frequent meetings* at the *Economic Club of Toronto, Empire Club of Canada and Canadian Club in Toronto, Canada* outside the *U of T* in 2005 – 2006. Using every free minute in our busy

research schedules, we discussed all the *scientific problems of mutual research interest*, aiming to find the *possible solutions* for the *challenging research problems* in the *time of globalization*.

The *second author* would like to thank *Prof. Roger L. Martin, former Dean at the Rotman School of Management* for a kind invitation to attend a day-long seminar, which has been organized by the *Rotman School of Management, University of Toronto, Toronto, Canada* at the *Canadian room* at the *Fairmont Royal York Hotel* in *Toronto, Canada* on *June 3, 2005*. The *second author* has been particularly interested in an announced presentation of research on the *complex interlocking directors networks in the boards of directors* within the *Canadian corporations* by *Tim Rowley, Professor, Rotman School of Management, Toronto, Canada; visiting Professor, INSEAD, France*.

The *second author* would like to thank *Prof. Roger L. Martin, former Dean at the Rotman School of Management* for a *cordial personal invitation* to attend a day-long seminar: “*Creativity: 21st Century Capital*,” which has been organized by the *Rotman School of Management, Toronto, Canada* at the *Fairmont Royal York Hotel* on *June 2, 2006*. It was a nice opportunity to discuss an *increasing role of creativity in the business opportunities widening in the XXI century* with *Mr. Thomas Stewart, former Editor-in-Chief, Harvard Business Review, Boston, USA; Prof. Jonathan Feinstein, Yale University, USA; and Prof. Richard Florida, Rotman School of Management, Canada*. It is necessary to especially highlight a long polemic on the numerous examples of *creativity in the field of econophysics*, which has been conducted with *Prof. Jonathan Feinstein, Yale University, USA*. It makes sense to mention an interesting thoughtful conversation on the *strategic governance in North America*, which has been conducted with *Prof. Roger L. Martin* and cheered by a *friendly toast* with the *two glasses of young white wine* from the *Niagara Fall region* in *Ontario, Canada*.

It is wonderful to see that *Prof. Michael E. Porter, Founding Director, Strategy Institute, Harvard Business School, Harvard University* finds the enough time to write the numerous research articles and books despite of his heavy administrative work load at the *Strategy Institute, Harvard Business School, Harvard University*. As always, we are very grateful to *Prof. Michael E. Porter, Bishop William Lawrence University Professor and former Dean of Harvard Business School, Harvard University*, who is considered by the *authors* as a *father of the modern business strategy*, for his *valuable personal efforts and time* to write a number of interesting *informative research articles and books* as well as to create the *lecture notes*, providing us with his professional expertise, exceptional quality professional advices and wise opinions in the *field of competitive strategy in the 21st century*. In fact, *Prof. Michael E. Porter* is regarded by the *authors* as a “*guiding star*” in the *science of strategy*.

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