Quantum strategy creation by interlocking interconnecting directors in boards of directors in modern organizations at time of globalization

Ledenyov, Dimitri O. and Ledenyov, Viktor O.

James Cook University, Townsville, Australia

16 December 2015

Online at https://mpra.ub.uni-muenchen.de/68404/
MPRA Paper No. 68404, posted 17 Dec 2015 23:21 UTC
Quantum strategy creation by interlocking interconnecting directors in boards of directors in modern organizations at time of globalization

Dimitri O. Ledenyov and Viktor O. Ledenyov

Abstract – The research explores a scientific problem on the quantum strategy creation and implementation by the interlocking interconnecting directors in the boards of directors in the modern organizations at the time of globalization, solving the winning virtuous strategy search, the most effective strategy selection and the organizational strategy optimization paradigms. We know that, having the different mindset architectures, the directors in the interlocking interconnecting directors networks in the boards of directors in the modern organizations complete the information sensing, filtering, processing, resonant absorption, analysis, strategy decision making processes with the aim to create and implement the most effective optimal winning virtuous organization development strategy, applying the early researched deductive, inductive and abductive logics. We propose that the new quantum strategy can be considered as a most effective optimal winning virtuous organizational strategy, allowing the board of directors to set a right direction vector toward the business development, to establish a necessary actions plan and to reach the sustainable business profitability goals in the economies of the scales and scopes. We explain that the quantum strategy can be formulated, going from: 1) the new quantum logic principles in the Copenhagen interpretation in the quantum mechanics science, 2) the deductive, inductive and abductive logics existing knowledge in the philosophy science, and 3) the modern strategy research findings in the business administration science. We think that the directors in the boards of directors in the complex organizations can implement the quantum strategies with the ultimate goal to build the prosperous organizations in the economies of the scale and scope at the time of the disruptive changes and opportunities by the globalization.

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

PACS numbers: 89.65.Gh, 89.65.-s, 89.75.Fb .

Keywords quantum strategy, winning virtuous strategy, strategy creation and implementation, strategy selection logics, strategy decision making, strategy optimization problem, most effective strategy search, quantum/inductive/deductive/abductive logics, board of directors composition, board of directors chairman, interlocking directors networks, boards of directors seats accumulation number, centrality, Freeman degree, Betweenness, information flows measurements, destructive coordination, information absorption, theory of firm, microeconomics, Schrodinger wave function, quantum mechanics, econophysics.
Introduction

In our innovative research article in Ledenyov D O, Ledenyov V O (2015b), we explained that, having the different mindset architectures, the directors in the interlocking interconnecting directors in the boards of directors in the modern organizations complete the information sensing, filtering, processing, resonant absorption, detailed analysis, and strategy decision making processes with the aim to create and implement the most effective optimal winning virtuous organization development strategy, applying the deductive, inductive and abductive logics. Let us note that a necessity to apply all the three logics such as the deductive, inductive and abductive logics in the strategy creation and implementation processes has been emphasized for the first time in Ledenyov D O, Ledenyov V O (2015b).

In the modern economies of the scales and scopes in the time of constant introduction of the market-creating innovations, sustaining innovations and efficiency innovations on a global scale, we think that the business strategies, formulated with the application of the deductive, inductive and abductive logics, cannot always be considered as the most effective optimal winning virtuous organization development strategy. One of the formidable challenges is that the modern economies of the scales and scopes have the quantum nature, hence they can only be accurately characterized by the quantum microeconomics theory in Ledenyov D O, Ledenyov V O (2015j) and the quantum macroeconomics theory in Ledenyov D O, Ledenyov V O (2015h). Therefore, it is logical to suppose that the directors in the interlocking interconnecting directors in the boards of directors in the modern organizations must be willing to create and implement the most effective optimal winning virtuous organization development strategy, applying the new type of logic: the quantum logic.

Thus, exploring the outlined research subject, we 1) define the quantum logic, 2) provide the examples of quantum logic and 3) explain how the directors in the boards of directors in the complex organizations can create and implement the quantum strategies with the use of the quantum logic, ultimately aiming both to build the prosperous valuable organizations and to reach a quantum leap in the organization market value in the economies of the scale and scope at the time of the disruptive changes and opportunities by the globalization.

Rommens, Cuyvers, Deloof (November 2007), Santella, Drago, Polo, Gagliardi (2009), Uddin (2012), we would like to focus our research attention on the limited aspects of the quantum strategy creation and implementation by the interlocking interconnecting directors in the boards of directors in the modern organizations at the time of globalization, solving the winning virtuous strategy search, the most effective strategy selection and the organizational strategy optimization paradigms. Speaking clearly, we explain that the quantum strategy can be formulated, using the following things:

1. the new quantum logic principles in the Copenhagen interpretation in the quantum mechanics science,
2. the existing knowledge on the deductive, inductive and abductive logics principles in the philosophy science, and
3. the modern strategy research findings in the business administration science.

In addition, we propose that the new quantum strategy can be considered as a most effective optimal winning virtuous organizational strategy, allowing the board of directors:

1. to set the right strategy direction vector toward the quantum strategy creation for the successful business development in the economies of the scales and scopes,
2. to establish the necessary actions plan for the quantum strategy implementation by the organizations in the economies of the scales and scopes, and
3. to reach the sustainable business profitability goals in the economies of the scales and scopes in the long time perspective.

Completing a short introduction, let us move forward with a more detailed consideration of research topic and uncover all our research thoughts on the subject of scientific interest comprehensively. Once again, we would like to be focused on the theory of the quantum strategy creation and execution by the interlocking interconnecting directors in the boards of directors in the modern organizations at the time of globalization.

Interlocking interconnecting directors in boards of directors in modern organizations at time of globalization

Beginning our research discussion, let us make a clear definition on the board of directors: The board of directors in the firm is an organized group of the business administrators, working together to create and execute the business strategy towards the successful business model development, the trade partnership relationships establishment and
the commerce interests promotion in time of infinite opportunities and challenges, which are created by the globalization.

We could also refer to another possible definition on the board of directors in Ledenyov D O, Ledenyov V O (2015b): “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 could be mathematically represented as a two dimensions matrix in Ledenyov D O, Ledenyov V O (2015b):

\[
\text{Board of Directors} = \begin{bmatrix}
d_{1,1} & d_{1,2} & d_{1,j} \\
d_{2,1} & d_{2,2} & d_{2,j} \\
d_{i,1} & d_{i,2} & d_{i,j}
\end{bmatrix},
\]

where \(d_{i,j}\) is the position of a director’s seat in the matrix.

The change of the composition of the standard board of directors over the could be mathematically described as an integer in Santella, Drago, Polo (November 11 2007), Ledenyov D O, Ledenyov V O (2015b):

\[
\text{board}_{c,i} = \text{board}_{c,i-1} + \int_{t}^{t+1} (en - ex) dt,
\]

where

\[
en(t) = \frac{d}{dt} en \cdot t = en,
\]

\[
ex(t) = \frac{d}{dt} ex \cdot t = ex,
\]

\(en(t)\) is the number of directors entrants at time \(t\),

\(ex(t)\) is the number of directors exits at time \(t\),

\(\text{board}_{c,i}\) is the board of directors size at time \(t\),

\(c\) is the company,

\(i\) is the director.

As we know presently, the modern strategy creation algorithm has been described in Ledenyov D O, Ledenyov V O (2015b): “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
It would also be interesting to refresh the important research theses and propositions on the accurate characterization of the boards of directors in Ledenyov D O, Ledenyov V O (2015b):

1. “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
accordingly characterize the overlapping interconnecting interlocking directors networks performance and the director’s competence and effectiveness.

2. We propose to introduce the Quality of Service measurements scale for the directors’ competence and effectiveness measurements during their work performance evaluation in the boards of directors in the firms, going from the accurate characterization of the generated, transmitted and received information streams by the director in the boards of directors in the firms over a certain period of time.

3. 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.

4. Speaking about the accurate characterization of the overlapping interconnecting interlocking directors networks in the boards of directors in the firms, we would like to emphasis 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)).

5. 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).

6. 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.”

Quantum strategy creation and execution by interlocking interconnecting directors in boards of directors in modern organizations at time of globalization


Researching the strategy theory, we think that the new quantum strategy theory must be formulated to account for the changing business administration practices and existing theoretical discrepancies by/in in the boards of directors in the modern organizations at the time of globalization. In this connection, we would like to make a theoretical proposition that the

10
interlocking interconnecting directors in the boards of directors in the modern organizations can apply the creative imperative integrative intelligent conceptual co-lateral adaptive logarithmic thinking with the use of the quantum logic instead of the inductive, deductive and abductive logics to create and implement the most effective optimal winning virtuous organization development strategies.


Now, let us say a few words on the quantum mechanics and explain that the Copenhagen interpretation of the quantum mechanics science considers a quantum phenomenon as a process, which takes place from the initial condition to the final condition. The evolving understanding of the quantum mechanics led to the new theoretical discoveries, particularly, to the introduction of the Schrödinger wave function, which can accurately probabilistically characterize the quantum system, using the probability distributions in Schrödinger (1926). One of the interesting facts is that the probabilities distribution depends on the system’s quantum state at the instant moment of the measurement in the quantum mechanics in Planck (1900a, b, c, d, 1901, 1903, 1906, 1914, 1915, 1943), Einstein (1905, 1917, 1924, 1935), Einstein, Podolsky, Rosen (1935), Bohr (1922, 1924, 1933), de Broglie L (1924, 1925, 1926, 1927, 1928), Compton (1926), Compton A, Allison S K (1935), Schrödinger (1926), Schiff (1949), Akhiezer, Berestetsy (1953, 1964, 1980), Berestetsy, Lifshits, Lifshits, Pitaevsky (1980), von Neumann (1955), Dirac (1958), Merzbacher (1961), Feynman, Leighton, Sands (1965), Heisenberg (1967), Petersen (1968), DeWitt (1970), Atkins (1974, 1977, 1978), Landau, Lifshits (1977), Bransden, Joachain (1983), Resnick, Eisberg

Let us make the two examples to draw a clear boundary between the probability based logic and the value based logic:

1. We can illustrate the probability logic, using the quantum mechanics and by saying that the probability that the Schrödinger cat may be alive or dead (the two possible choices) in the superposition state in the observable closed box is 50% until the moment of the measurement in Schrödinger (1935). In other words, the interlocking interconnecting director in the board of directors in the organization must consider the probabilities distribution of the various events, related to the particular business matter / situation, before the moment of the creation of the quantum business strategy.

2. We can describe the value based logic by referring to the inductive, deductive and abductive logics and by showing that it operates with / converges to the values: Yes and/or No, hence it has some similarity with the binary logic: 1 and/or 0. It means that, the interlocking
interconnecting director in the board of directors in the organization must inductively / deductively / abductively come to the conclusion: Yes and/or No, related to the particular business matter / situation, before the moment of the creation of the usual business strategy.

We would like to comment that the practical implementation of the **Quantum Strategy Creation Algorithm** can be conducted in agreement with the **early proposed business administration science practices** in the **information theory of firm** in Ledenyov D O, Ledenyov V O (2015c).

We believe that the **interlinking interlocking directors** in the boards of directors in the complex organizations will greatly benefit by creating and by implementing the **quantum strategies**, pursuing the **ultimate goal** to build the **prosperous organizations** at the **time of the disruptive changes and opportunities** by the globalization.

**Conclusion**

The **research article** discussed a **scientific problem** on the **quantum strategy creation and implementation** by the interlocking interconnecting directors in the boards of directors in the modern organizations at the time of globalization, solving the winning virtuous strategy search, the most effective strategy selection and the organizational strategy optimization paradigms.

We reminded that, having the **different mindset architectures**, the directors in the interlocking interconnecting directors networks in the boards of directors in the modern organizations complete the information sensing, filtering, processing, resonant absorption, analysis, strategy decision making processes with the aim to create and implement the **most effective optimal winning virtuous organization development strategy**, applying the early researched deductive, inductive and abductive logics in Ledenyov D O, Ledenyov V O (2015b).

Then, we proposed that the **new quantum strategy** can be considered as a **most effective optimal winning virtuous organizational strategy**, allowing the board of directors to set a right strategy direction vector toward the business development, to establish a necessary list of business expansion actions and to reach the sustainable business profitability goals in the conditions of the irrational human nature and the inefficient global markets.

We explained that the **quantum strategy** can be formulated in accordance with the following **accumulated knowledge**:
1. the new quantum logic principle in the frames of the Copenhagen interpretation of the quantum mechanics science;
2. the existing knowledge base on the deductive, inductive and abductive logics in the philosophy science; and
3. the modern strategy research findings in the business administration science.

We proposed the **Quantum Strategy Creation Algorithm** with the purpose to describe the decision making process by the interlinking interlocking directors in the boards of directors in the complex organizations at the time of globalization.

We think that the interlinking interlocking directors in the boards of directors in the complex organizations can implement the quantum strategies with the ultimate goal to build the prosperous organizations at the time of the disruptive changes and opportunities by the globalization.

**Acknowledgement**

Authors acknowledge the multiple scientific discussions on the econophysics and the quantum mechanics with Oleg P. Ledenyov in Kharkov, Ukraine in 2015. The first author appreciates the many hours of research polemics with Janina E. Mazierska in Townsville, Australia in 2000 - 2015. The second author would like to make a comment that the Niels Bohr’s visit to Kharkov, Ukraine in 1933 led to the creation of the econophysics science, and the second author’s visits to Lyngby, Denmark and Copenhagen, Denmark in 1995, 1996-1997 resulted in the new theories formulation in the modern econophysics science. The second author thanks for a wonderful opportunity to conduct an important exchange by the research opinions with Roger L. Martin in Toronto, Canada in 1998 - 1999 and in 2005 - 2006.

*E-mail: dimitri.ledenyov@my.jcu.edu.au,
   ledenyov@univer.kharkov.ua .
References:

Economics Science, Finance Science, Economic History Science:


8. Bagehot W 1873, 1897 Lombard Street: A description of the money market Charles Scribner's Sons New York USA.


13. Schumpeter J A 1906 Über die mathematische methode der theoretischen ökonomie ZfVSV Austria.


15. Schumpeter J A 1911; 1939, 1961 Theorie der wirtschaftlichen entwicklung; The theory of economic development: An inquiry into profits, capital, credit, interest and the business cycle Redvers Opie (translator) OUP New York USA.


19. Slutsky E E 1915 Sulla teoria del consumatore *Giornale degli economisti e rivista di statistica* 51 no 1 pp 1 – 26 Italy.


21. von Mises L 1912 The theory of money and credit *Ludwig von Mises Institute* Auburn Alabama USA


27. Ellis H, Metzler L (editors) 1949 Readings in the theory of international trade *Blakston* Philadelphia USA.

28. Friedman M (editor) 1953 Essays in positive economics *Chicago University Press* Chicago USA.


34. Minsky H P 2015 Minsky archive The Levy Economics Institute of Bard College Blithewood
   Bard College Annandale-on-Hudson New York USA
   http://www.bard.edu/library/archive/minsky/.
41. Scornick-Gerstein F May, 1996 Private communications on land value taxation theory by
   Henry George Royal Automobile Club London UK.
42. Scornick-Gerstein F 1999 The future of taxation: The failure of the poll tax in the UK
46. Stiglitz J E 2015 The great divide Public Lecture on 19.05.2015 London School of
   Economics and Political Science London UK
   http://media.rawvoice.com/lse_publiclecturesandevents/richmedia.lse.ac.uk/publiclecturesan
devents/20150519_1830_greatDivide.mp4.
49. Dodd N 2014 The social life of money Princeton University Press NJ USA

Juglar Economic Cycle in Macroeconomics:
50. Juglar C 1862 Des crises commerciales et de leur retour périodique en France en Angleterre
    et aux États-Unis Guillaumin Paris France.

**Kondratiev Economic Cycle in Macroeconomics:**

53. Tugan-Baranovsky M 1894 Industrial crises in contemporary England: Their causes and influences on the life of the people *St Petersburg/Moscow* Russian Federation.


56. Kondratieff N D 1925 The big cycles of conjuncture *The problems of conjuncture* 1 (1) pp 28 – 79.


60. Kondratieff N D 1984 The Long wave cycle *Richardson & Snyder* New York USA.


64. Kowal L 1973 The market and business cycle theories of M I Tugan-Baranovsky *Revista Internazionale di Scienze Economiche e Commercial* vol 20 part 4 Padova Italy.


74. Van Duijn J J 1983 The long wave in economic life *Allen and Unwin* Boston MA USA.


78. Tinbergen J 1981 Kondratiev cycles and so-called long waves: The early research *Futures* **13** (4) pp 258 – 263.


87. Freeman C, Louçã F 2001 As time goes by: From the industrial revolutions to the information revolution *Oxford University Press* Oxford UK.

88. Goldstein J 1988 Long cycles: Prosperity and war in the modern age *Yale University Press* New Haven CT USA.


90. Berry B J L 1991 Long wave rhythms in economic development and political behavior *Johns Hopkins University Press* Baltimore MD USA.


96. Modelski G, Thompson W R 1996 Leading sectors and world politics: The co-evolution of global politics and economics *University of South Carolina Press* Columbia SC USA.


100. Perez C 2002 Technological revolutions and financial capital – The dynamics of bubbles and golden ages *Edward Elgar* Cheltenhem UK.


Kitchin Economic Cycle in Macroeconomics:


Kuznets Economic Cycle in Macroeconomics:

110. Kuznets S 1924 Economic system of Dr. Schumpeter *M. Sc. Thesis under Prof. Wesley Clair Mitchell* Columbia University NY USA.

111. Kuznets S 1930 Secular movements in production and prices *Ph. D. Thesis under Prof. Wesley Clair Mitchell* Columbia University NY USA.
Kuznets S 1930 Secular movements in production and prices. Their nature and their bearing upon cyclical fluctuations *Houghton Mifflin* Boston USA.

Kuznets S 1937 National income and capital formation, 1919 – 1935.


Kuznets S 1966 Modern economic growth: Rate, structure, and spread.

Kuznets S 1968 Toward a theory of economic growth, with reflections on the economic growth of modern nations.

Kuznets S 1971 Economic growth of nations: Total output and production structure.

Kuznets S 1973a Population, capital and growth.


Accurate Characterization of Properties of Economic Cycles in Macroeconomics:


158. Sussmuth B 2003 Business cycles in the contemporary World Springer Berlin Heidelberg Germany.

159. Hirooka M 2006 Innovation dynamism and economic growth: A nonlinear perspective Edward Elgar Cheltenham UK Northampton MA USA.


164. Jourdon Ph 2008 La monnaie unique Europeenne et son lien au developpement economique et social coordonne: une analyse cliometrique Thèse Universite Montpellier France.


173. Uechi L, Akutsu T 2012 Conservation laws and symmetries in competitive systems
   *Progress of Theoretical Physics Supplement* no 194 pp 210 – 222.

174. Central Banking Newsdesk 2013 Swiss board member supports counter-cyclical capital
   buffer
   http://www.centralbanking.com/central-banking/speech/2203857/swiss-board-member-
supports-countercyclical-capital-buffer.

175. Union Bank of Switzerland 2013 UBS outlook Switzerland

176. Da Costa 2015 Weak first-quarter growth due to seasonal issues after all, SF Fed says
   *The Wall Street Journal* New York USA.

177. Federal Reserve Bank of St Louis 2015 US Federal Reserve Economic Data (FRED)
   Federal Reserve Bank of St Louis
   http://research.stlouisfed.org/fred

178. Desai M, King St, Goodhart Ch 2015 Hubris: why economists failed to predict the crisis
   and how to avoid the next one *Public Lecture on 27.05.2015* London School of Economics
   and Political Science London UK

179. Desai M 2015 Do we need a new macroeconomics? *Public Lecture on 09.07.2015*
   London School of Economics and Political Science London UK (the presentation was made
   after the publication of an initial version of our research article at the MPRA and SSRN)

180. Wall Street Journal 2015a Economic forecasting survey US GDP (quarterly) for 5 years
   (28.06.2015) Wall Street Journal New York USA
   http://projects.wsj.com/econforecast/#ind=gdp&r=20

181. Wall Street Journal 2015b Economic forecasting survey US GDP (quarterly) for 7 years
   (28.06.2015) Wall Street Journal New York USA
   http://projects.wsj.com/econforecast/#ind=gdp&r=28

182. Wikipedia (English) 2015c Business cycle *Wikipedia* California USA

**Firm Theory Science, Business Administration Science:**
183. Babbage Ch 1832 On the economy of machinery and manufacturers Charles Knight 13 Pall Mall East London UK.
189. Ohlin B 1933 Interregional and international trade Harvard University Press Cambridge Massachusetts USA.


206. Fogel R 1964 Railroads and American economic growth: Essays in econometric history *Johns Hopkins Press* Baltimore USA.


208. Stigler G 1968 The organization of industry *Richard Irwin Inc* Homewood USA.


240. Hart O 2011 Thinking about the firm: A review of Daniel Spulber’s the theory of the firm *Journal of Economic Literature* 49 (1) pp 101 – 113


**Board of Directors Science, Interlocking Directors Networks Science, Firms Networks Science, Social Networks Science:**

250. Brandeis L D 1933 Other people’s money-and how the bankers use it *Jacket Library* Washington National Home Library Foundation USA.


255. Hopkins T K 1964 The exercise of influence in small groups *Bedminster Press* Totawa New Jersey USA.


260. Harary F 1969 Graph theory *Addison-Wesley* Reading MA USA.


263. Mace M L 1971 Directors: Myths and reality *Harvard University Press* Cambridge Massachusetts USA.


283. Tukey J W 1977 Exploratory data analysis *Addison-Wesley* USA.


285. Freeman L 1979b Visualizing social networks *School of Social Sciences* University of California Irvine California USA.


300. Mizruchi M S 1992 The structure of corporate political action *Harvard University Press* Cambridge USA.

306. Barnes J A 1983 Graph theory in network analysis Social Networks vol 5 pp 235 – 244.
312. American Bar Association 1984 Section on Antitrust Law Monograph 10 Interlocking Directorates under Section 8 of Clayton Act. Task force on interlocking directorates Washington USA.
313. American Bar Association 2011 Interlocking directorates Handbook on Section 8 of the Clayton Act Washington USA.
317. Useem M 1984 The inner circle Oxford University Press New York USA.


361. Demb A, Neubauer F F 1992 The corporate board: Confronting the paradoxes Oxford University Press NY USA.


391. Krackhardt D 1994 Graph theoretical dimensions of informal organizations in Computational organization theory Carley K M, Prietula M J (editors) *Lawrence Erlbaum Ass Hillsdale USA.*

392. Tricker R I 1994 International corporate governance: Text, readings and cases Prentice-

*Hall Singapore.*


421. Park S, Rozeff M 1996 The role of outside shareholders, outside boards, and management entrenchment in CEO selection *Working Paper* SUNY Buffalo NY USA.


426. Williamson O E 1996 The mechanisms of governance *Oxford University Press* New York USA.
Bianco M, Pagnoni E 1997 I Legami creati tra le società quotate dagli interlocking
directorates: Il caso delle banche Quaderni di Moneta e Credito Banca Nazionale del Lavoro
Italy.

Cotter J, Shivdasani A, Zenner M 1997 Do independent directors enhance target

Davies P L, Gower L C B 1997 Gower's principles of company law 6th edition Sweet &

Hallock K 1997 Reciprocally interlocking boards of directors and executive

John K, Senbet L W 1997 Corporate governance and board effectiveness Working Paper
New York University NY USA.

Loderer C, Martin K 1997 Executive stock ownership and performance: Tracking faint

Loderer C, Peyer U September 5 2001, 2002 Board overlap, seat accumulation, and share
prices Social Science Research Network USA SSRN-id273465.pdf, European Financial
Management 8 pp 165 – 192.

Podolny J M, Baron J N 1997 Resources and relationships: Social networks and mobility

Rowley T J 1997 Moving beyond dyadic ties: A network theory of stakeholder influences

Rowley T J 1998 Social network analysis in action: Using social network methodologies
in stakeholder research Proceedings of the 9th Annual Meeting of the International
Association for Business and Society.

Elms H, Berman S L, Rowley T J 2000 Network influences on CEO compensation
Proceedings for the 11th Annual International Association for Business & Society Vermont
USA.

Rowley T J, Behrens D, Krackhardt D 2000 Redundant governance structures: An
analysis of structural and relational embeddedness in the steel and semiconductor industries

Rowley T J June 3, 2005a Invited talk on Canadian directors networks Rotman School of
Management Alumni Meeting 2005 Fairmont Royal York Hotel Toronto Canada.

Rowley T J June 3, 2005b Private communications on the directors networks in board of
directors of North American corporations Rotman School of Management Alumni Meeting
2005 Fairmont Royal York Hotel Toronto Canada.


444. Miller G T March 26 1997 Interlocking directorates and the antitrust laws Colorado Lawyer 53.


Spencer S 1998 The Netherlands board index *3rd edition* Amsterdam The Netherlands.


Watts D J 1999a Small worlds *Princeton University Press* Princeton New Jersey USA.

Watts D J 1999b Worlds. The dynamics of networks between order and randomness.


Barabasi A 2002 Linked *Perseus Publishing* Cambridge MA USA.


Borgatti S P 2002 Basic social network concepts *AoM PDW* Denver CO USA.


Borgatti S P 2006 Identifying sets of key players in a social network *Computational and Mathematical Organization Theory* **12** pp 21 – 34.

Carroll W K, Malcolm A August 1999 Finance capital and capitalists class integration in the 1990s: Networks of interlocking directorships in Canada and Australia *Canadian Review of Sociology & Anthropology* vol **36** issue 3 pp 331 – 354.

494. Maman D 2001 The organizational connection: Social capital, the career expansion of directors of business groups in Israel Social Science Research 30 pp 578 – 605.
503. Fich E 2000 Do directors who are CEOs of other firms enhance firm performance? UNC Working Paper University of North Carolina NC USA.
507. Miwa Y, Ramseyer M 2000 The value of prominent directors: Lessons in corporate governance from transition Japan University of Tokyo, Harvard University Japan, USA.
511. Ferri G, Masciandaro D, Messori M 2001 Corporate governance, board turnover and performance: The case of local banks in Italy Paolo Baffi Centre Working Paper no 01-150 Italy.


532. Carver J 2002 Corporate boards that create value: Governing company performance from the boardroom *Jossey-Bass USA*. 


568. Stablein R, Cleland P, Mackie B, Reid D 2004 New Zealand exchange limited (nzx) boards and directors: It is a small world after all Working Paper.


572. Charan R 2005 Boards that deliver: Advancing corporate governance from compliance to competitive advantage Jossey-Bass USA.


574. Hanneman R A, Riddle M 2005 Introduction to social network methods University of California Riverside California USA http://faculty.ucr.edu/~hanneman/.


582. Batagelj V, Mrvar A 2006 *Pajek* *University of Ljubljana*.


588. Farina V 2008 Banks' centrality in corporate interlock networks: Evidences in Italy *Sefemeq Department University of Rome “Tor Vergata” Italy MPRA Paper no 11698* Munich University Germany pp 1 – 31 http://mpra.ub.uni-muenchen.de/11698/.


53
590. Chhaochharia V, Grinstein Y 2006b Executive compensation and board structure Working Paper Cornell University USA.
604. Prinz E 2006 Corporate governance and the uncertain role of interlocking directorates

605. Silva F, Majluf N, Paredes R D 2006 Family ties, interlocking directorates, performance
of business groups in emerging countries: The case of Chile Journal of Business Research 59
pp 315 – 321.

606. Soon Moon Kang May 23 2006 Equi-centrality and network centralization: A micro-
macro linkage Netsci Conference.

607. Welch J, Welch S 2006 The boardroom bunker The Welch way on Business Week
Business Week USA
http://www.businessweek.com/mediacenter/podcasts/welchway/welchway_12_17_06.htm.

pp 217 – 250.

609. Adams R B, Hermalin B E, Weisbach M S 2010 The role of boards of directors in
corporate governance: A conceptual framework and survey Journal of Economic Literature

Boringhieri Torino Italy.

611. Enriques L, Volpin M Winter 2007 Corporate governance reforms in continental Europe

612. Gerber B M 2007 Enabling interlock benefits while preventing anticompetitive harm:
Toward an optimal definition of competitors under section 8 of the Clayton Act Yale Journal
on Regulation vol 24 I p 107.

613. Ibarra H 2007 What you know or who you know? INSEAD Knowledge-casts INSEAD
France.

UK
www.ft.com/cms/s/e5406470-860a-11dc-b00e-0000779fd2ac.html.

615. Ledenyov V O 2007b Think like a leader The Globe and Mail Toronto Canada
http://www.reportonbusiness.com/servlet/story/RTGAM.20071121.wmartindiscuss1128/BN
Story/Business/home/?pageRequested=2.

616. Malloy Chr 2007 Social networks Public Lecture London School of Economics and
Political Science London UK.

617. Murray A S 2007 Revolt in the boardroom: The new rules of power in corporate America
Collins USA.
http://www.tinbergen.nl.


http://ssrn.com/abstract=971189 ,
http://mpra.ub.uni-muenchen.de/2288/.

http://mpra.ub.uni-muenchen.de/2265/ ,

624. Santella P, Drago C, Polo A, Gagliardi E 2009 A comparison among the director networks in the main listed companies in France, Germany, Italy, and the United Kingdom MPRA Paper no 16397 Munich University Germany pp 1 – 19
http://mpra.ub.uni-muenchen.de/16397/.


630. Vermeulen Fr 2008 How companies can get lucky and succeed Public Lecture London School of Economics and Political Science London UK.


632. Tutelman H 2008 The balance point: New ways business owners can use boards Famille Press USA.


649. Schifeling T, Mizruchi M S August 27 - 28 2012 The decline of the American corporate network 1960-2010 Corporate Networks in the 20th century Conference University of Lausanne USA.


Strategic Science, Strategic Governance Science, Management Science:


<table>
<thead>
<tr>
<th>No.</th>
<th>Author(s)</th>
<th>Title</th>
<th>Year</th>
<th>Publisher/Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>663</td>
<td>Andrews K R</td>
<td>The concept of corporate strategy</td>
<td>1971a</td>
<td>Richard D Irwin Homewood USA.</td>
</tr>
<tr>
<td>674</td>
<td>Porter M E</td>
<td>Cases in competitive strategy</td>
<td>1982a</td>
<td>Free Press New York USA.</td>
</tr>
<tr>
<td>676</td>
<td>Porter M E, Salter M S</td>
<td>Note on diversification as a strategy</td>
<td>1986</td>
<td>Harvard Business School Background Note Harvard University pp 382 – 129.</td>
</tr>
</tbody>
</table>
677. Porter M E 1983 Analyzing competitors: Predicting competitor behavior and formulating offensive and defensive strategy in Policy, strategy, and implementation Leontiades M (editor) Random House USA.


694. Porter M E 2001b The technological dimension of competitive strategy in Research on technological innovation, management and policy vol 7 Burgelman R A, Chesbrough H (editors) JAI Press Greenwich CT USA.


699. Porter M E January 2008 The five competitive forces that shape strategy Special Issue on HBS Centennial Harvard Business Review 86 (1)

   http://hbr.org/2008/01/the-five-competitive-forces-that-shape-strategy/ar/1 .


700. Porter M December 2013 Fundamental purpose Value Investor Insight pp 8 – 20


701. Porter M E, Heppelmann J E November 2014 How smart, connected products are transforming competition Harvard Business Review November USA


702. Porter M E 2015 Strategy award Thinkers50 London UK

   www.thinkers50.org .


704. Yelle L E 1979 The learning curve: Historical review and comprehensive survey Decision Sciences 10 (2) pp 302 – 328.

706. Schwenk C R 1984 Cognitive simplification processes in strategic decision making
708. Palepu K G 1985 Diversification strategy, profit performance and the entropy measure
Strategic Management Journal 6 pp 239 – 255.
Management Science 32 (10) pp 1231 – 1241.
710. Barney J B 1991 Firm resources and sustained competitive advantage Journal of
Management 17 (1) pp 99 – 120.
Management vol 13 no 2 p 211.
712. Hill C W L, Snell S A 1988 External control, corporate strategy, and firm performance in
research intensive industries Strategic Management Journal 9 pp 577 – 590.
713. Baysinger B D, Hoskisson R E 1989 Diversification strategy and R&D intensity in large
McGraw-Hill Singapore; Sage Beverly Hills California USA.
and innovation Administrative Science Quarterly 35 pp 128 – 152.
(2) pp 69 – 81.
717. Goold M, Luchs K 1993 Why diversify? Four decades of managed thinking Academy of
Management Executive 7 (3) pp 7 – 25.
718. Goold M et al. 1994 Corporate level strategy: Creating value in the multi-business
company John Willey & Sons Inc New York USA.
Business Review pp 131 – 143.
721. Yip G 1992 Total global strategy: Managing for worldwide competitive advantage
Prentice Hall NY USA.
Yip G 1998 Asian advantage: Key strategies for winning in the Asia-Pacific region Addison Wesley/Perseus Books USA.

Yip G 2000 Strategies for Central and Eastern Europe Macmillan Business USA.

Yip G 2007 Managing global customers Oxford University Press Oxford UK.


McKiernan P 1997 Strategy past, strategy futures Long range planning vol 30 no 5 p 792.


Moldoveanu M, Martin R L 2001 Agency theory and the design of efficient governance mechanisms Joint Committee on Corporate Governance Meeting Rotman School of Management University of Toronto Ontario Canada pp 1 – 57.

Martin R L 2004 Strategic choice structuring: A set of good choices positions a firm for competitive advantage Rotman School of Management University of Toronto Canada pp 1 – 14 www.rotman.utoronto.ca strategicChoiceStructuring.pdf.

Martin R L 2007 Becoming an integrative thinker Rotman Magazine Rotman School of Management University of Toronto Ontario Canada pp 4 – 9.

Martin R L 2007 Designing the thinker Rotman Magazine Rotman School of Management University of Toronto Ontario Canada pp 4 – 8.

Martin R L 2008 The opposable mind Harvard Business Press Cambridge Massachusetts USA.


743. Laffont J-J, Tirole J 1999 Competition in telecommunications *MIT Press* USA.


748. Drejer A 2002 Strategic management and core competencies 1st edition *Quorum Books* Westport Connecticut USA.


www.blueoceanstrategy.com,
https://smart.ly/blue-ocean-strategy/.
   www.thinkers50.org.
   Connecticut USA.
   Thomson Higher Education Mason OH USA.
   USA.
   Western Australia.
759. Kirkbride P S 2007 Developing a leadership and talent architecture MBS Leader-casts
   Melbourne Business School Melbourne Australia.
760. Murphy T, Galunic Ch 2007 Leading in the age of talent wars INSEAD Leader-casts
   INSEAD France.
   India.
762. Sull D 2007a Simple rules: Strategy as simple rules Part II Public Lecture London School
   of Economics and Political Science London UK.
763. Sull D 2007b Closing the gap between strategy and execution: Strategy and its
   discontents Public Lecture London School of Economics and Political Science London UK.
764. Sull D 2007c Closing the gap between strategy and execution: Making hard choices
   Public Lecture London School of Economics and Political Science London UK.
765. Sull D 2007d Closing the gap between strategy and execution: The strategy loop in action
   Public Lecture London School of Economics and Political Science London UK.
766. Sull D 2008 An iterative approach to the strategy Public Lecture London School of
   Economics and Political Science London UK.
767. Teece D J, Winter S 2007 Dynamic capabilities: Understanding strategic change in
   organizations Blackwell Oxford UK.
768. Samuels R 2008 Japan's grand strategy Public Lecture on 13.10.2008 London School of
   Economics and Political Science London UK
   http://www.lse.ac.uk/collections/LSEPublicLecturesAndEvents/events/2008/20080819t1316
   z001.htm
   http://richmedia.lse.ac.uk/publicLecturesAndEvents/20081013_1830_japansGrandStrategy.m
   p3
769. Chamberlain G P 2010 Understanding strategy Create Space Charleston South Carolina USA.


**Disruptive Innovation in Technology, Economics and Finances:**

771. Schumpeter J A 1911; 1939, 1961 Theorie der wirtschaftlichen entwicklung; The theory of economic development: An inquiry into profits, capital, credit, interest and the business cycle Redvers Opie (translator) OUP New York USA.


790. Christensen C M 1999a Innovation and the general manager Irwin McGraw-Hill Homewood IL USA.

791. Christensen C M 1999b Impact of disruptive technologies in telecommunications in Bringing PC economies to the telecommunications industry PulsePoint Communications.


796. Christensen C M, Craig Th, Hart S March April 2001 The great disruption Foreign Affairs 80 no 2.


808. Shah Ch D, Brennan T A, Christensen C M April 2003 Interventional radiology: Disrupting invasive medicine.

809. Christensen C M March April 2003 Beyond the innovator's dilemma *Strategy & Innovation* 1 no 1.


1244. Dobbs R, Woetzel J, Flanders St 2015 No ordinary disruption: The four global forces breaking all the trends Public Lecture on 08.06.2015 London School of Economics and Political Science London UK


Information Absorption in Economics, Finances, Business Administration Sciences and Information Asymmetry in Economics, Finances, Business Administration Sciences:


837. Farina V 2008 Network embeddedness, specialization choices and performance in investment banking industry University of Rome Tor Vergata Italy MPRA Paper no 11701 Munich University Munich Germany pp 1 – 26
http://mpra.ub.uni-muenchen.de/11701/.

Selected Research Papers in Macroeconomics, Microeconomics & Nanoeconomics Sciences:
838. Ledenyov V O, Ledenyov D O 2012a Shaping the international financial system in century of globalization *Cornell University* NY USA pp 1 – 20

839. Ledenyov V O, Ledenyov D O 2012b Designing the new architecture of international financial system in era of great changes by globalization *Cornell University* NY USA pp 1 – 18


841. Ledenyov D O, Ledenyov V O 2012b On the risk management with application of econophysics analysis in central banks and financial institutions *Cornell University* NY USA pp 1 – 10

842. Ledenyov D O, Ledenyov V O 2013a On the optimal allocation of assets in investment portfolio with application of modern portfolio management and nonlinear dynamic chaos theories in investment, commercial and central banks *Cornell University* NY USA pp 1 – 34


845. Ledenyov D O, Ledenyov V O 2013d To the problem of turbulence in quantitative easing transmission channels and transactions network channels at quantitative easing policy implementation by central banks *Cornell University* NY USA pp 1 – 40

846. Ledenyov D O, Ledenyov V O 2013e To the problem of evaluation of market risk of global equity index portfolio in global capital markets *MPRA Paper no 47708* Munich University Munich Germany pp 1 – 25
http://mpra.ub.uni-muenchen.de/47708/.
847. Ledenyov D O, Ledenyov V O 2013f Some thoughts on accurate characterization of stock market indexes trends in conditions of nonlinear capital flows during electronic trading at stock exchanges in global capital markets MPRA Paper no 49964 Munich University Munich Germany pp 1 – 52
http://mpra.ub.uni-muenchen.de/49964/.

http://mpra.ub.uni-muenchen.de/50235/ ,

http://mpra.ub.uni-muenchen.de/51176/ ,

http://mpra.ub.uni-muenchen.de/51903/ ,

http://mpra.ub.uni-muenchen.de/61946/ ,

http://mpra.ub.uni-muenchen.de/61863/ ,

http://mpra.ub.uni-muenchen.de/61805/ ,


856. Ledenyov D O, Ledenyov V O 2014f MicroLBO software program with the embedded optimized near-real-time artificial intelligence algorithm to create winning virtuous strategies toward leveraged buyout transactions implementation and to compute direct/reverse leverage buyout transaction default probability number for selected public/private companies during private equity investment in conditions of resonant absorption of discrete information in diffusion - type financial system with induced nonlinearities *ECE James Cook University* Townsville Australia, Kharkov Ukraine.

857. Ledenyov D O, Ledenyov V O 2015a Nonlinearities in microwave superconductivity 8th edition *Cornell University* NY USA pp 1 – 923


75


870. Ledenyov D O, Ledenyov V O 2015n MicroID software program with the embedded optimized near-real-time artificial intelligence algorithm to create the winning virtuous business strategies and to predict 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 in conditions of the resonant absorption of discrete information in diffusion-type financial economic system with induced nonlinearities. *ECE James Cook University* Townsville Australia, Kharkov Ukraine.

### 871. Ledenyov D O, Ledenyov V O 2015

1. *MicroITF* operation system and software programs: 1) the operation system to control the firm operation by means of the information resources near-real-time processing in the modern firms in the case of the diffusion-type financial economic system with the induced nonlinearities; 2) the software program to accurately characterize the director’s performance by means of a) the filtering of the generated/transmitted/received information by the director into the separate virtual channels, depending on the information content, and b) the measurement of the levels of signals in every virtual channel with the generated/transmitted/received information by the director, in the overlapping interconnecting interlocking directors networks in the boards of directors in the firms during the Quality of Service (QoS) measurements process; and 3) the software program to create the winning virtuous business strategies by the interlocking interconnecting directors in the boards of directors in the modern firms in the case of the diffusion-type financial economic system with the induced nonlinearities, using the patented recursive artificial intelligence algorithm. *ECE James Cook University* Townsville Australia, Kharkov Ukraine.

### 872. Ledenyov D O, Ledenyov V O 2015

1. *MicroIMF* software program: the *MicroIMF* software program to make the computer modeling of 1) the interactions between the information money fields of one cyclic oscillation and the information money fields of other cyclic oscillation(s) in the nonlinear dynamic economic system, 2) the interactions between the information money fields of cyclic oscillation and the nonlinear dynamic economic system itself, and 3) the density distributions of the information money fields by different cyclic oscillations (the economic continuous waves) in the nonlinear dynamic economic system. *ECE James Cook University* Townsville Australia, Kharkov Ukraine.

### 873. Ledenyov D O, Ledenyov V O 2015

1. *MicroSA* software program 1) to perform the spectrum analysis of the cyclic oscillations of the economic variables in the nonlinear dynamic economic system, including the discrete-time signals and the continuous-time signals; 2) to make the computer modeling and to forecast the business cycles for a) the central banks with the purpose to make the strategic decisions on the monetary policies, financial stability policies, and b) the commercial/investment banks with the aim to make the
business decisions on the minimum capital allocation, countercyclical capital buffer creation, and capital investments. ECE James Cook University Townsville Australia, Kharkov Ukraine.

**Probability Theory, Statistics Theory, Spectrum Analysis Theory, Brownian Movement Theory, Diffusion Theory, Chaos Theory, Information Communication Theory in Econometrics and Econophysics Sciences:**


875. Bernoulli J 1713 Ars conjectandi (The art of guessing).


877. De Moivre 1730 Miscellanea analytica supplementum (The analytic method).


881. Bunyakovskiy V Ya 1825 Rotary motion in a resistant medium of a set of plates of constant thickness and defined contour around an axis inclined with respect to the horizon Ph D Thesis no 1 under Prof. Augustin - Louis Cauchy supervision École Polytechnique Paris France.


885. Connor J J, Robertson E F (July) 2000 Viktor Yakovlevich Bunyakovskiy (December 16, 1804 - December 12, 1889) School of Mathematics and Statistics University of St Andrews Scotland UK

http://www-history.mcs.st-andrews.ac.uk/Biographies/Bunyakovsky.html .

887. Chebyshev P L 1846 An experience in the elementary analysis of the probability theory Crelle’s Journal für die Reine und Angewandte Mathematik.


894. Markov A A 1906 Extension of law of big numbers on variables, depending from each other Izvestiya Fiziko-Matematicheskogo Oboeschteva Pri Kazanskom Universitete 2nd series vol 15 (94) pp 135 – 156 Russian Federation.


896. Markov A A 1908, 1912, 1971 Extension of limit theorems of calculation of probabilities to sum of variables, connected in chain Zapiski Akademii Nauk po Fiziko-Matematicheskou Otdeleniyu 8th series vol 25 (3); Ausdehnung der Satze uber die Grenzwerte in der Wahrscheinlichkeitsrechnung auf eine Summe verketteter Grossen Liebmamn H (translator) in Wahrscheinlichkeitsrechnung Markov A A (author) pp 272 – 298 Teubner B G Leipzig Germany; Extension of the limit theorems of probability theory to a sum of variables
connected in a chain Petelin S (translator) in Dynamic probabilities systems Howard R A (editor) vol 1 pp 552 – 576 John Wiley and Sons Inc New York USA.


909. Slutsky E E 1915 Sulla teoria sel bilancio del consumatore Giornale degli economisti e rivista di statistica 51 no 1 pp 1 – 26 Italy.


916. Slutsky E E 1925b Ueber stochastische Asymptoten und Grenzwerte Metron Padova Italy vol 5 no 3 pp 3 – 89.


918. Slutsky E E 1927a The summation of random causes as sources of cyclic processes Problems of Conjuncture (Voprosy Kon’yunktury) vol 3 issue 1 pp 34 – 64 Moscow Russian Federation.


923. Slutsky E E 1937b The summation of random causes as the source of cyclical processes Econometrica 5 pp 105 – 146.


929. Kolmogorov A N 1947 The contribution of Russian science to the development of probability theory *Uchenye Zapiski Moskovskogo Universiteta* no 91.


949. Mandelbrot B B 1967a The variation of some other speculative prices *Journal of Business* vol 40 pp 393 – 413.


959. Mandelbrot B B 1977 Fractals: Form, chance and dimension *W H Freeman* San Francisco USA.

960. Mandelbrot B B 1982 The fractal geometry of nature *W H Freeman* San Francisco USA.

961. Mandelbrot B B 1997 Fractals and scaling in finance *Springer* New York USA.
962. Gnedenko B V, Khinchin A Ya 1961 An elementary introduction to the theory of probability *Freeman* San Francisco USA.


969. Shiryaev A N 1967 Two problems of sequential analysis *Cybernetics* 3 pp 63 – 69.


990. du Toit J, Peskir G, Shiryaev A N 2007 Predicting the last zero of Brownian motion with drift *Cornell University* NY USA pp 1 – 17


997. Karatzas I, Shiryaev A N, Shkolnikov M 2011 The one-sided Tanaka equation with drift

*Cornell University* NY USA

998. Shiryaev A N, Zhitlukhin M V 2012 Optimal stopping problems for a Brownian motion with a disorder on a finite interval *Cornell University* NY USA pp 1 – 10


1004. Lamperti J 1966 Probability Benjamin New York USA.


1010. Breiman L 1968 Probability Addison-Wesley Reading MA USA.


1017. Box G E P, Jenkins G M 1970 Time series analysis: Forecasting and control Holden Day San Francisco California USA.


1038. Taylor S 1986 Modeling financial time series *John Willey and Sons Inc* New York USA.
1039. Tong H 1986 Nonlinear time series *Oxford University Press* Oxford UK.
1046. Lancaster T 1990 The econometric analysis of transition data *Cambridge University Press* Cambridge UK.
1050. Cleveland W S 1993 Visualizing data *Hobart Press* Summit New Jersey USA.
1051. Pesaran M H, Potter S M (editors) 1993 Nonlinear dynamics, chaos and econometrics *John Willey and Sons Inc* New York USA.
1053. Peters E E 1994 Fractal market analysis: Applying chaos theory to investment and economics *John Wiley and Sons Inc* New York USA.

1058. Moore G E 2003 No exponential is forever – but we can delay forever ISSCC.


1067. Hubbard B B 1998 The world according to wavelets A K Peters Wellesley MA USA.


1069. Teolis A 1998 Computational signal processing with wavelets Birkhauser Switzerland.


1076. Hayashi F 2000 Econometrics *Princeton University Press* Princeton NJ USA.


1085. Woolridge J M 2002 Econometric analysis of cross section and panel data *MIT Press* Cambridge MA USA.

1086. Koop G 2003 Bayesian econometrics *John Wiley and Sons Inc* New York USA.


1089. Cameron A C, Trivedi P K 2005 Microeconometrics: Methods and applications *Cambridge University Press* Cambridge UK.


Weatherall J O 2013 Physics of Wall Street Houfton New York USA.

Quantum Physics, Quantum Electronics, Quantum Computing, Quantum Mechanics:

1096. Planck M 1900a Über eine Verbesserung der Wienschen Spektralgleichung On an improvement of Wien's equation for the spectrum Verhandlungen der Deutschen Physikalischen Gesellschaft 2 pp 202 – 204
http://archive.org/stream/verhandlungende01goog#page/n212/mode/2up.

http://archive.org/stream/verhandlungende01goog#page/n246/mode/2up.

1098. Planck M 1900c Entropie und Temperatur strahlender Wärme Entropy and temperature of radiant heat Annalen der Physik 306 (4) pp 719 – 737


1101. Planck M 1903 Treatise on thermodynamics Longmans, Green & Co London UK
http://archive.org/stream/treatiseonthermo00planuoft/page/n7/mode/2up,
1102. Planck M 1906 Vorlesungen über die Theorie der Wärmestrahlung *JA Barth* Leipzig Germany
http://lccn.loc.gov/07004527.

1103. Planck M 1914 The theory of heat radiation 2nd edition *P Blakiston's Son & Co*
http://openlibrary.org/books/OL7154661M.


http://adsabs.harvard.edu/abs/1943NW.....31..153P,
https://dx.doi.org/10.1007%2FBF01475738.

1106. Einstein A 1905 Zur Elektrodynamik bewegter Körper On the electrodynamics of moving bodies *Annalen der Physik* Berlin Germany (in German) 322 (10) pp 891 – 921
http://onlinelibrary.wiley.com/doi/10.1002/andp.19053221004/pdf,
http://adsabs.harvard.edu/abs/1905AnP...322..891E,
http://dx.doi.org/10.1002%2Fandp.19053221004.

1107. Einstein A 1917 Zur Quantentheorie der Strahlung On the quantum mechanics of radiation *Physikalische Zeitschrift* (in German) 18 pp 121 – 128
http://adsabs.harvard.edu/abs/1917PhyZ...18..121E.

http://echo.mpiwg-berlin.mpg.de/MPIWG:DRQK5WYB.

http://journals.aps.org/pr/pdf/10.1103/PhysRev.47.777,
http://adsabs.harvard.edu/abs/1935PhRv...47..777E,
https://dx.doi.org/10.1103%2FPhysRev.47.777.


1114. de Broglie L 1926 Ondes et mouvements Waves and motions *Gauthier-Villars* Paris France.

1115. de Broglie L 1927 Rapport au 5e Conseil de Physique Solvay Brussels Belgium.

1116. de Broglie L 1928 La mécanique ondulatoire Wave mechanics *Gauthier-Villars* Paris France.

https://www.worldcat.org/oclc/1871779.

1118. Compton A; Allison S K 1935 X-Rays in theory and experiment *D Van Nostrand Company Inc* New York USA
https://www.worldcat.org/oclc/853654.


1121. Fermi E 1934 Radioattività indotta da bombardamento di neutroni *La Ricerca scientifica* **1** (5) p 283 (in Italian)

1123. Townes Ch 1939 Concentration of the heavy isotope of carbon and measurement of its nuclear spin PhD thesis Caltech California USA  
http://thesis.library.caltech.edu/4202/.


1125. Gordon J, Zeiger H, Townes Ch 1955 The maser — new type of microwave amplifier, frequency standard, and spectrometer Physical Review 99 (4) p 1264  


1128. Townes Ch H 1964 Nobel Prize in Physics Stockholm Sweden  

1129. Townes Ch H 1966 Obtaining of coherent radiation with help of atoms and molecules Uspekhi Fizicheskikh Nauk (UFN) vol 88 no 3.

1130. Townes Ch H 1969 Quantum electronics and technical progress Uspekhi Fizicheskikh Nauk (UFN) vol 98 no 5.


95


http://www.springer-sbm.de/index.php?id=121&L=0 .


1146. Schawlow A, Townes Ch 1958 Infrared and optical masers Physical Review 112 (6) p 1940
http://dx.doi.org/10.1103%2FPhysRev.112.1940 ,


1148. Schawlow A 1964 Nobel Prize in Physics Stockholm Sweden


1153. Josephson B D 1965 Super currents through barriers Advances in Physics vol 14 p 419.
1157. Petersen A 1968 Quantum physics and philosophical tradition MIT Press Cambridge USA.
1167. Mygind J 1997 Private communications on the new sources of noise in the single electron transistors Department of Physics Technical University of Denmark Lyngby Denmark.


**Wave Function in Schrödinger Quantum Mechanical Wave Equation in Quantum Mechanics:**


https://dx.doi.org/10.1002%2Fandp.19263840404 ,

http://adsabs.harvard.edu/abs/1926AnP...384..361S .


Bibcode:1926PhRv...28.1049S

https://dx.doi.org/10.1103%2FPhysRev.28.1049 ,

http://adsabs.harvard.edu/abs/1926PhRv...28.1049S .


1180. Einstein A 1917 Zur Quantentheorie der Strahlung On the quantum mechanics of radiation *Physikalische Zeitschrift* (in German) 18 pp 121 – 128

http://adsabs.harvard.edu/abs/1917PhyZ...18..121E .
http://journals.aps.org/pr/pdf/10.1103/PhysRev.47.777 ,
http://adsabs.harvard.edu/abs/1935PhRv...47..777E ,
https://dx.doi.org/10.1103%2FPhysRev.47.777 .


Abstract

This chapter introduces the reader to the historical development of artificial intelligence, from its early beginnings in the 1950s to the contemporary era. The focus is on the evolution of artificial intelligence as a field of study, its key concepts, and its applications in various domains.

Historical Overview

The history of artificial intelligence (AI) can be traced back to the 1950s, with the publication of seminal works such as Turing’s paper on “Computing machinery and intelligence” in 1950. AI has since evolved significantly, with advances in technology, computational power, and data availability.

Early Years

The early years of AI in the 1950s were marked by optimism and a belief in the potential of machines to emulate human intelligence. Key figures such as John McCarthy, Marvin Minsky, Nathaniel Rochester, and Claude Shannon played crucial roles in shaping the early development of AI.

Mid-1960s: The First Decade of Research

The 1960s saw a significant increase in AI research, with universities and government agencies funding projects. However, the field faced challenges, including the limits of early computational capabilities.

1970s: The Era of Expert Systems

The 1970s were characterized by the development of expert systems, which were applications designed to emulate the problem-solving abilities of human experts. This era also saw the emergence of AI planning systems.

1980s: AI and Symbolic Computation

The 1980s were marked by the growth of AI and symbolic computation, with advances in AI planning and expert systems.

1990s: The Rise of Machine Learning

The 1990s saw a resurgence in AI research, driven by advances in machine learning and the availability of large datasets. This period saw the development of tools such as Deep Belief Networks (DBNs).

Recent Trends

The 21st century has brought new challenges and opportunities for AI, including the development of deep learning, natural language processing, and autonomous vehicles. AI is now being integrated into many aspects of society, influencing fields such as healthcare, finance, and transportation.

Conclusion

AI has come a long way since its early beginnings, evolving from a theoretical concept to a practical technology. As AI continues to develop, it will play an increasingly important role in shaping the future of society.
complex problem solving 5th edition The Benjamin Cummings Publishing Company Inc
1230. Bach J 2008 Seven principles of synthetic intelligence in Artificial general intelligence
Continuous Time Signal, Analog Signals, Discrete Time Signal, Digital Signals, Spectrum of
Signals, Electromagnetic Field, Gravitation Field, Calibrating Field, Information Field
Theories in Physics and Engineering Sciences:
1232. Maxwell J C 1890 Introductory lecture on experimental physics in Scientific papers of
J C Maxwell Niven W D (editor) vols 1, 2 Cambridge UK.
1233. Walsh J L 1923a A closed set of normal orthogonal functions American J Math 45
pp 5 – 24.
1234. Walsh J L 1923b A property of Haar’s system of orthogonal functions Math Ann 90
p 3845.
1235. Wikipedia 2015d Joseph L Walsh Wikipedia USA
1236. Gabor D 1946 Theory of communication Part 1 The analysis of information J Inst Elect
Eng 93 pp 429 – 441.
1237. Shannon C E 1948 A mathematical theory of communication Bell System Technical
http://cm.bell-labs.com/cm/ms/what/shannonday/paper.html .
1238. Bose R C, Shrikhande S S 1959 A note on a result in the theory of code construction
Information and Control 2 (2) pp 183 – 194 doi:10.1016/S0019-9958(59)90376-6
CiteSeerX: 10.1.1.154.2879
http://dx.doi.org/10.1016%2FS0019-9958%2859%2990376-6
University Press Princeton USA.


1243. Orfanidis S J 1995 Introduction to signal processing *Prentice-Hall* Englewood Cliffs NJ USA.


1245. Fountain T 1987 Processor arrays, architecture and applications *Academic Press* London UK.


