

CONTRIBUTIONS REGARDING THE DEFINITION OF THE TERM NEURAL NETWORK VS. NEURONAL NETWORK APPLICABLE IN THE ORGANIZATIONAL MANAGEMENT

Marinescu Simona-Ioana¹, Curteanu Silvia²

¹PhD. Student, “Lucian Blaga“ University of Sibiu, “Hermann Oberth“ Engineering Faculty, Strada Emil Cioran, nr.4, Sibiu, Romania, simona.arinescu19@gmail.com

²Professor, Dr. Eng., “Gheorghe Asachi“ Technical University Iași, Department of Chemical Engineering, Bd. Dimitrie Mangeron, No. 71A, 700050, Iași, Romania, silvia_curteanu@yahoo.com

ABSTRACT: *Since there is no clear definition of the terms "neural network" and "neuronal network", this paper is aimed primarily to establish the difference between them by a range of comparative research. As a result, the paper presents some argumentation regarding the differentiation and the point of views of its author, on the use of neural networks in studies and research regarding organizational management.*

KEYWORDS: neural network, artificial network, organization, neuron, artificial neuron, artificial intelligence

1. INTRODUCTION

In the the state of the art there is no clear definition of the terms "neural network" and "neuronal network". Thus, few people know the difference between the two networks, which is the fact that the neural network is related to a technical system, while the neuronal network refers to a biological system, the neuron. Therefore, by following advanced studies in this field, it is primarily intended to carry out a range of comparative research "targeted approach versus systemic approach," "neural network versus neuronal network", "artificial intelligence versus intelligence of the living world" "organizational neuron versus biological neuron."

When creating an artificial intelligence system, one of the difficult problems is the computer simulation of certain actions: to create sounds and to judge, to draw conclusions on the basis of mere perceptions of certain situations.

After 1995, mostly in the last 4-5ani, major applications are being developed of neural networks in modeling, simulation and management of industrial processes.

In 2013, scientists from the University of Illinois, Chicago (UIC) have tested one of the best artificial intelligence systems - ConceptNet 4 and the results showed that the system is as intelligent as a normal child with the age of four years, except the fact that the scores varied from one subject to another (figure 1).

Professor Robert Sloan, who led the study, said that: "If a child get scores that vary so much, then it would be something wrong with him," and that the system has done very well in analysis test of the

vocabulary and the analysis of the ability to recognize similarities.

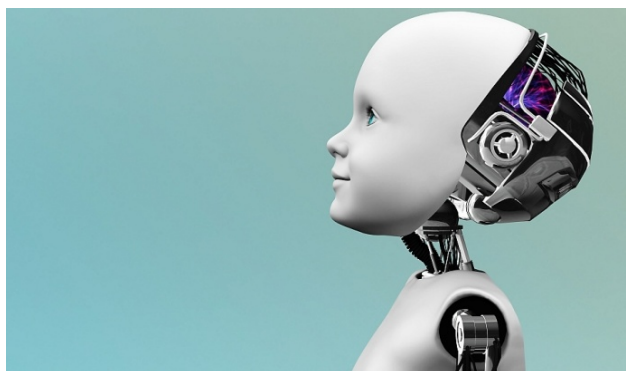


Figure1.Robot as a child

2. ANALOGIES AND COMPARISONS BETWEEN AN ARTIFICIAL NETWORK AND A BIOLOGICAL NEURAL NETWORK

The figures 2,3, and 4 show a comparison between an artificial neural network and a biological neural network to highlight the similarities between the two. [1]

Biological Neural Network	Artificial Neural Network
Soma (cell body)	Neuron
Dendrites	Inputs
Axon	Outputs
Synapses	Weight
	Hidden Layer

Figure 2. Comparison between biological neural network and artificial neural network

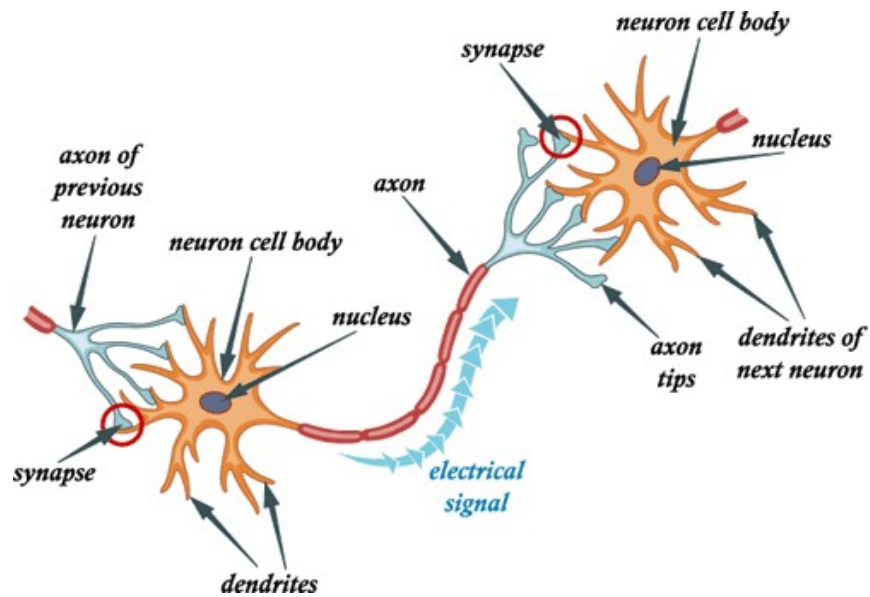


Figure 3. Interconnecting neurons

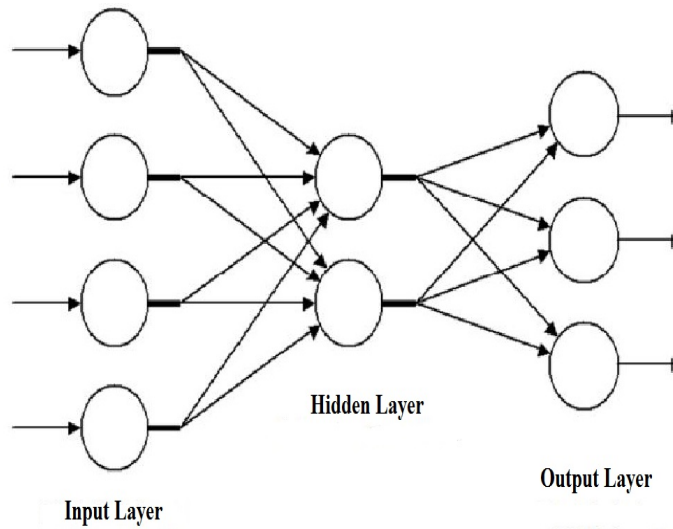


Figure 4: Artificial Neural Network

Figure 5 shows the differences between a computer and the human brain:

Computer (von Neumann)	Human brain
One or several processors with high speed (response time, <u>ms</u>) and high computing power	A large number (10^{11}) of functional units of relatively low speed with limited computing power
One or several high-speed communication arteries Memory accessed by address	Large number (10^{15}) of limited speed connections Memory with associative character
The component that incorporates knowledge is separate from the intended calculations	Knowledge stored in synapses
Reduced adaptability	Adaptation is achieved by modifying the connections

Figure 5. Comparison between a computer and the human brain

In the state of the art there is no clear definition of the terms "neural network" and "neuronal network". Thus, few people know the difference between the two networks, which is the fact that the neural network is related to a technical system, while the neuronal network refers to a biological system, the neuron.

For example, the neural network is easier than the neuronal network, having lower computing units capacity. Therefore, by following advanced studies in this field, it is primarily intended to carry out a range of comparative research "targeted approach versus systemic approach," "neural network versus neuronal network", "artificial intelligence versus intelligence of the living world" "organizational neuron versus biological neuron."

In this context the three parts that make up the neuron (neuron structure, Figure 6): cell body, dendrites and axon will be compared with the structure of an organization in order to determine within it who has which role / position, how can the biological neuron can be reproduced and its reproduction at the structuring level of an organization.

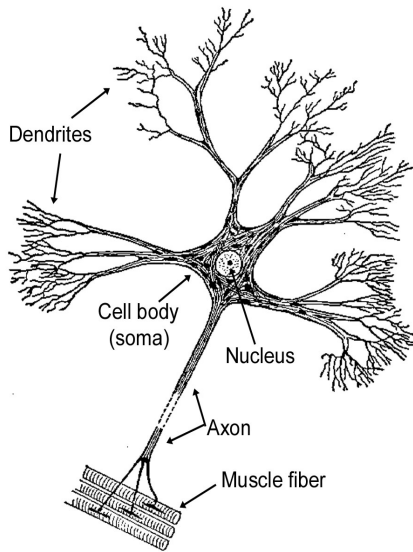


Figure 6: Components of a neuron

Nerve cells called neurons are fundamental elements of the central nervous system (CNS). In this system there are about 5 billion neurons.

Neurons have five specialized functions [2]:

- receive signals coming from the vicinity of the neuron;
- integrates (sums up these signals);
- give rise to nerve impulses;
- lead these impulses;
- transmit impulses to other neurons.

The **nucleus** is the cell body and supervises

biochemical transformations necessary for the synthesis of enzymes and other molecules necessary for the neuron's life. The cell body has a few micrometers in diameter.

Each neuron has a **dendrite** structure around it; they are thin tubes, cross, extended on several tens of micrometers. Dendrites are the main receiving recipients of the neuron, receiving signals from other neurons, signals they transmit to the **neuronal soma (body neuron)**.

The **axon** represents the centrifugal ending of the neuron, which aims to transform signals to target cells represented by the neurons that he makes synapses with. In the axon the signals are converted into nerve impulse trains or nerve impulses or potential of neuronal action. The axon is longer than the dendrites ranging from one millimeter to more than a meter long; axonal endings are called the done button.

The connections between neurons are achieved via synapses. **Synapses** are connections between the axonal endings of the transmitter neuron and soma or dendrites of the receiver neuron. Synapses can have through a chemical mediator an excitatory or inhibitory effect.

There is no generally accepted definition for neural networks, the majority of authors agree that they represent some simple processing assemblies aimed at interacting with the environment and also holding biological brain abilities to learn, being strongly interconnected and operating in parallel. [3]

Personally, I think that the neural networks represent a simulation (clone) of the capacity of the human brain, weaker, however, than the neuronal networks, with the power to learn, but only as much as they will be allowed by the person that schedules them (creates them).

Therefore, I will use the term "neural network" for all research and personal statements and the expressions: "neural network" or "neuronal network" as seen in the works analyzed in the literature.

3. NEURAL NETWORKS APPLIED IN THE ORGANIZATIONAL MANAGEMENT

One of the most effective tools used to solve management problems is represented by neural networks, making them an essential component of business intelligence. Predictions on production costs, delivery dates, optimization and quality control are important issues of production. All these are essentially matters of classification, the artificial neural networks are proving to be an appropriate

method. The number of publications dealing with these two topics are continuously increasing. [4]

Sharma and Chopra [5] reviewed a series of applications of neural networks in management. Research related to strategic planning systems are oriented in two directions, toward strategic planning impact on the performance of the company and over the role of strategic planning in making strategic decisions. Neural networks have been successfully applied to determine and clarify the relationship between strategic planning and performance, establishing at the same time, the most appropriate decisions. The authors underline the practical utility of neural modeling, but also the lack of papers describing the complete methodology of its implementation.

Hakimppor et al. [6] try to present a series of general applications of neural networks in the management sciences, using a classification on business disciplines, with subdivisions in areas such as marketing, production and strategic management:

- **neural networks used in manufacturing.** According to Krzcha and Wagner [7] forecast (production costs, delivery dates, etc.), quality control and optimization are the dominant elements in the manufacturing issues. Because the quality control is a matter of classification, RN are tools for dealing with it.
- **neural networks applied in strategic management and business policy.** Empirical research in strategic planning systems are oriented in two directions: the impact on the performance of a firm's strategic planning and strategic planning role in making strategic decisions [8]. NN were used to determine and clarify the relationship between strategic planning and performance and also to assess decision-making.
- **neural networks applied in organizational management [3], [9]**

A case on how to use a neural network (NN) will be presented, based on certain characteristics of a company [3].

It aims at presenting how a biological neuron will be transposed into an artificial neuron (people or departments within the company) and its reproduction at a structure level of the organization (functions of the nucleus, axon, dendrites, and so on).

To illustrate such a neural network, a Research-Development company was chosen as a model (Figure 7).

In this case, the components of the organizational neuron are the following:

Nucleus: The people in the department;

Dendrites: The information that the department has to receive;

Axon: The information coming out of the department to the higher level;

Synapses: Top decision-making body from the department.

We consider the Board of Directors is the **nucleus**, while the General Director (the CEO) is the **cell body**.

The **Dendrites** are: Scientific Board; Relationship with State Institutions, Agencies and Other Bodies Board; the Critical Infrastructure Protection Compartment; Quality Management Department; Financial Control and Internal Audit Service; Legal Services; Executive Director and Economical Director.

The **Axons** are: Management Programs Department; Strategy and Cooperation Department; Informatical System, Infrastructure and Classified Information Department; Research Center and Intern Management Department.

The **Synapses** are considered to be: National Programs Department; International Programs Department; Strategic Development, Intellectual Property and Business Development Department; Cooperation with European Departments; International Relationships Department; Promotion and Information Center; Information System and Infrastructure Department; The Security Structure Department; Computer Certification Authority Department; Special Technology Department; Special Applications Department; Economic, Financial and Administrative Services and Human Resources, Safety and PSI Services.

4. CONCLUSIONS

Applications of neural networks in the management, compared with traditional statistical techniques are based on a number of advantages, such as [6], [10]:

- N. N. can provide more accurate results than regression models;
- N. N. are capable of learning complex relationships and to approximate any continuous function, maneuvering nonlinearities directly or implicitly;
- significance and accuracy of models based on N. N. can be determined using traditional statistical measures (e.g., mean square error and the coefficient of determination);

ORGANIZATION

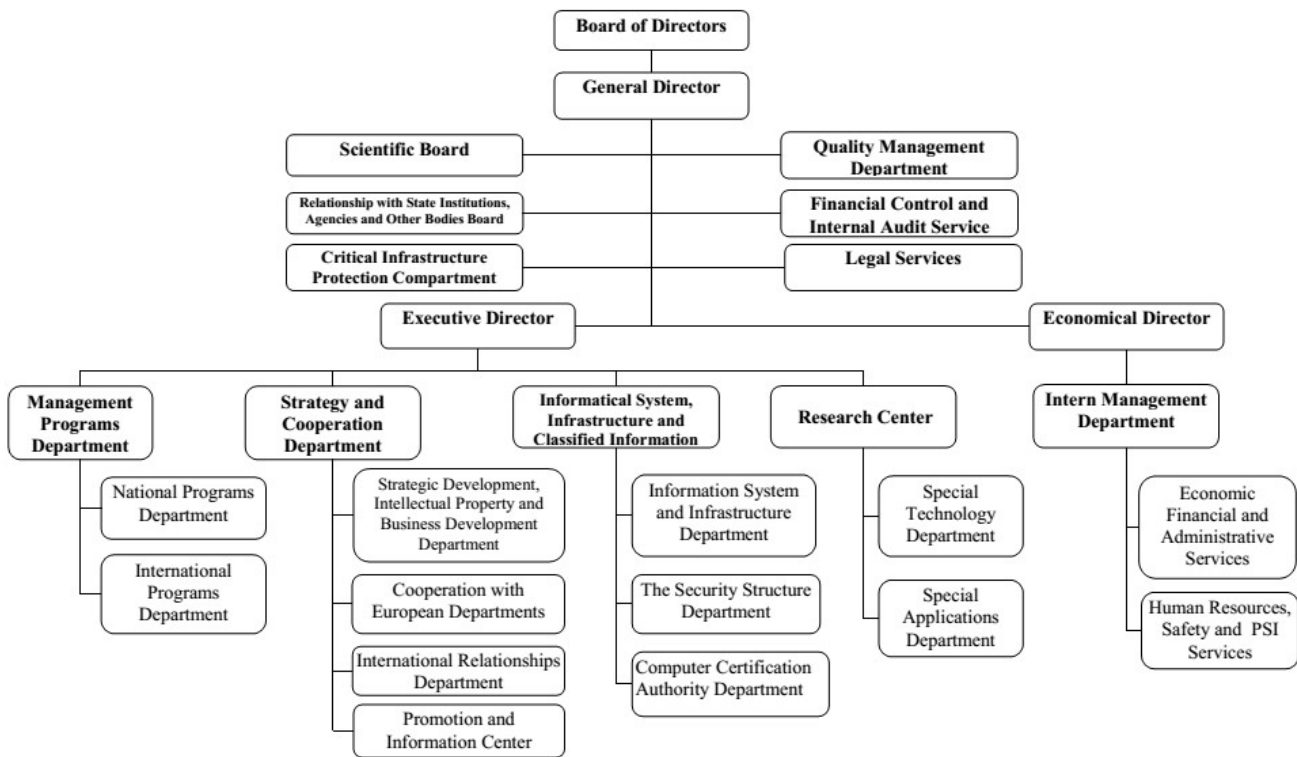


Figure7- Flowchart of an R&D company

- neural networks automatically handle any interactions between variables;
 - neural networks, as a preliminary nonparametric methods do not involve assumptions on the distribution of data input-output;
 - neural networks are very flexible in relation to missing or incomplete datas;
 - neural networks can be applied dynamically;
 - neural networks exceed a number of limitations of other statistical methods;
 - neural networks have associative skills - once developed, a neural network is robust to missing or inaccurate data;
 - multi-collinearity does not affect the NN as in the regression model;
 - neural networks are reliable tools for predicting the basic elements of quality relationships.
- Besides the advantages of using neural networks in management, disadvantages can also be recalled [9]:
- methods for determining the significance of independent variables (input) have not yet been developed;
 - in neural modeling, based on the principle of black boxes, qualitative informations and precise methods for determining their configuration are missing;
 - weights of neural networks can not be interpreted in the same way as the regression coefficients, they indicate the importance of entries, but the analysis becomes difficult, sometimes impossible, due to the complex interactions of the interlayers;
 - it is difficult to determine the best solution; although there are techniques to avoid local minima, there is no guarantee defining the best networks;
 - model selection and its training is "art" not "science", based on trial and experience, however, a careful methodology may be followed, that would lead to the best model, even if it is not optimal;
 - like any other dynamically model, when submitted to changes in the external environment, the neural model needs to be rebuilt and retrained;

- the learning process can sometimes be very long.

In general, compared with multivariate statistical methods, in many cases, neural modeling is a preferred alternative, both from the point of view of results, as well as a working methodology. Three arguments can be made for this comparison:

- by applying neural networks in management issues, numerical or analytical inputs can be used;
- complex interactions between input variables does not influence the performance of the neural model or the validity of the results, as it happens in the regression analysis;
- it is possible the labeling of the intermediaries neurons and thus can be examined the conjunction of the factors that contribute to each hidden node to evaluate their impact on the modeling's performances;

BIBLIOGRAPHY

- [1] Neagu, C., Ioniță, C.- Neural Networks. Theory and Applications in Modelling and Simulation of Manufacturing Processes and Systems. Academy Press Publisher, 2010.
- [2] Toderan, H.N., Chelaru M., Gâldea, D., Nistor, S., Tofan, I.-Fuzzy Systems and Applications. Politechnic Institute, Iași, 1989.
- [3] Marinescu S.I.- Research on Applications of Neural Networks in Organizational Management. In ACTA Universitatis Cibiniensis, Vol. 65, Issue 1, pg.64-68. 2014, ISBN (online) 1583-7149, DOI: 10.1515/ancts-2015-0011, 2015, de Gruyter
- [4] Hutcheson, Graeme D. "The Application of NN to Management Problems." Quantitative Modelling in Marketing and Management (2012): 151.
- [5] Sharma A., Chopra A., Artificial neural networks: „Applications in Management”, IOSR Journal of Business and Management, 12(3), 32-40, 2013.
- [6] Hakimpoor H., Arshad K., et. al.”Artificial Neural Networks’ Applications in management”, World Applied Sciences Journal 14(7), 1008-1019, 2011.
- [7] Krzcha K.A., Wagner U., 1999, Applications of artificial neural networks in management science: a survey, Journal of Retailing and Consumer Services, 6, 185-203.
- [8] Grant, R.M., 2003, Strategic planning in a turbulent environment: evidence from the oil majors. Strategic Management Journal, 491-517.
- [9] Oprean, C., Titu, M., Bucur, V.- Global Management of an Organization Based on Knowledge, Agir Publisher, Bucharest, 2011.
- [10] Marinescu, S.I., Titu, M.- Aspects Regarding the Possibility to Use “Neural Networks” in the Selection of the “R&D” Strategy in the “Nonconventional Technologies”Field. In ACTA Universitatis Cibiniensis, Vol67, Issue 1, Pg 179-184, 2015, ISSN(online) 1583-7149, DOI: 10.1515/ancts-2015-0086, 2015, de Gruyter
- [11] Dumitrescu, D.- Principles of Artificial Intelligence, Blue Publisher, Cluj-Napoca, 2002.
- [12] Dzitac, I.- Artificial Intelligence, Aurel Vlaicu University Publisher, Arad, 2008
- [13] Enăchescu, C., Data Predictions using Neural Networks.; Proceedings of the International Conference on Knowledge Engineering, Principles and Techniques “KEPT-2007”, "Babes-Bolyai" University of Cluj-Napoca, Cluj-Napoca, June 6 – 8, 2007, 290-297, Editura Presa Universitara Clujeana, 2007.
- [14] Fukushima, K., Neocognitron: A Self-Organizing Neural Network Model for a Mechanism of Pattern Recognition Unaffected by Shift in Position. Biological Cybernetics 36, 193-202, 1980.
- [15] Hopfield, J.J., Tank, D.W., Neural Computation of Decisions in Optimization Problem. Biological Cybernetics, 52, 141-152, 1985.
- [16] Kai Cheng- Machinig Dynamics - Fundamentals, Applictions and Practices, Springer, 2009.
- [17] John McCarthy and Patrick J. Hayes. "Some Philosophical Problems from the Standpoint of Artificial Intelligence", Sect. 2.1, Machine Intelligence 4, ed. Donald Michie (Elsevier, 1969), p.463 ff., ISBN 0444197443
[https://en.wikiquote.org/wiki/John_McCarthy_\(computer_scientist\)](https://en.wikiquote.org/wiki/John_McCarthy_(computer_scientist))
- [18] Simon Haykin - Neural Networks: A Comprehensive Foundation. Macmillan/IEEE Press, 1994.
- [19] Widrow, B., Lehr, M.A.R., ``Adaptive Neural Networks and their Applications," *International Journal of Intelligent Systems*, 8(4):453-507, April 1993.
- [20] Brown, C., O’Leary, D.-Introduction to artificial intelligence and expert systems. International Journal of Intelligent Systems, 1995.