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The Knowledge Society at Crossroads: The Road Map and Incubating Role of the Competitive Intelligence, Digitalization and Neurosciences

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Abstract. *The today human being is part of the technological and scientific development dominated by information as a both raw material and base of knowledge.*
The easy and open accesses to information thrust forward the frontiers of development and communication, enlarge the development's paths and generate amazing changes, faster than ever happened. The way that data bases increase its volume becomes the most actual and complex problem.
The ability to extract and process the knowledge and the speed of its processing represent unknown and provocative challenges for business profit and the intelligent society success. Their extraction from the informational noise and the ability to react and rapidly communicate are also important to be accurately customized and harmonized with the social elements.
This paper demonstrates the usefulness of neuroscience, neuro-technologies and cognitive computing in finding innovative and customized solutions for solving complex problems in business.
The conclusion of our study is that, in order to have an advanced and competitive European Union, it is absolutely necessary to develop innovative solutions for Competitive Intelligence that would include the fundamental elements of neuro-technologies and advanced Artificial Intelligence as Cognitive Business profitable keys.

Keywords: Competitiveness, Competitive Intelligence, Cognitive Business, Neuroscience, Neuro-technologies

JEL Codes: M15, M19, O30

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1. The New Approach of Competitive Intelligence as a Tool for the Evolution of the Knowledge Society

Information is the foundation of the contemporary world, being the most valuable capital, the company holds. Information is a modern exchange currency. Through his power, she is the master of all

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fields of activity. Information is a fearsome weapon in the hands of people who know how to use it, and at the same time, it is also an attractive target for competitors through collection operations. Companies need to collect information efficiently and process it quickly, otherwise it disappears because of the aggressive competitive environment.

Many managers work with large amounts of data, not being trained to make a difference between data and information that adds value. Their decisions are based, as a rule, on some knowledge from previous experiences and much "intuition". During stable periods, making decisions is much based on previous experience, as there are not many changes, and the environment is relatively constant.

In the meantime, during the periods of versatile transformations, the experience is less justified; the decision-makers look for relevant information to configure their best decisions. Tversky and Kahneman consider that decisions are often based on options related to the likelihood of occurrence. The role of these subjective probabilities is not insignificant because people tend to make decisions based on past experiences (Tversky & Kahneman, 1974).

In “Knowledge Management in the Intelligence Enterprise”, Edward Waltz explains the transformations that he has gone through since the antiquity (Waltz, 2003:7-10). Alvin and Heidi Toffler define the three waves of civilization and transition in the creation of value: the first wave – agrarian, until 1700, was based on the production of the earth; The second wave – industrial, between 1700 and 2000, was based on mass production of goods and the third wave was informational, after 2000, where production of goods and services is based on knowledge. We are in this third wave of civilization and transition and Toffler argues that in the future the focus will be on human knowledge, decision-making and influence.

This idea is not new; since ancient times, people have been fascinated to find out what others think, how they think, and what decisions they take to be able to defend or attack. However, in this digital age, information and knowledge gain a special interest and great value because the level of human communication has reached unprecedented odds due to the unprecedented evolution of technology. Everything that surrounds us is information.

Knowing how the human mind works can have different goals: from influencing decisions to improving life, through medical applications and devices. In this logic, we can say that the human mind is the last frontier of knowledge.

Radical changes in Intelligence are attributed to IT development through advanced information technologies. IT support for intelligence is at the level of each stage of the intelligence cycle: collecting data, information and knowledge from different sources, processing the collected results to facilitate the operation of analytical methods, analyzing data and information in accordance with well-defined analysis methods and dissemination of results in the form of a intelligence report or graphic presentation.

In recent years, technological development in IT has led to the development of systems that can teach, even without external help. These systems, called A.I. - Artificial Intelligence perceive the environment and learn to maximize chances of success. In 1997, IBM developed a computer that plays chess, called Deep Blue, a computer that defeated world champion Chess Gary Kasparov. In 2011, IBM tested the skills of the supercomputer Watson, developed through the project called *DeepQA*, in a question competition. Watson defeated the two champions he competed with. The processing capacity of this computer is 500 gigabytes per second, equivalent to one million books. At the end of 2015, Ginni Rometty, IBM CEO, announced the

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launch of the IBM Watson platform, a Cognitive Business platform. With the launch of this platform, we virtually entered a new era of development - the Cognitive Era.

Cognitive era is defined as the era in which advanced computing is used on platforms based on scientific disciplines of Artificial Intelligence (A.I.) and Signal Theory. Thus, starting from Toffler's thesis, the third wave of civilization, the informational era, will end in the period 2015-2020, and the next wave of civilization, the fourth one, will be the cognitive era. It will be based on the understanding of both the human mind and the way of thinking but also on the phenomena of business. Dario Gil, Director of Symbiotic Cognitive Systems at IBM Research, thinks that cognitive computing is "an innovation so sweeping that it's ushering in a new age of computing, along with a new partnership between humans and computers, one where we bring together skills and collaborate to produce better results." Also, Ray Kurzweil, Google's Director of Engineering, says that "Cognitive Computing is more than a repackaging of artificial intelligence" and describes cognitive computing as the "ultimate long-term solution for many of the challenges that face businesses today." (DeAngelis, 2015)

If we look at Competitive Intelligence as an intelligence-based activity in relation to the idea of an adversary and competition, and Business Intelligence as an intelligence-based activity that gathers data from the organization's internal work, implemented with the help of computing systems, the two areas of reflection are differentiated by the environment on which it concentrates: Competitive Intelligence focuses on the company's external environment and Business Intelligence focuses on the company's internal environment.

If Business Intelligence solutions migrate from local stations to more powerful cloud-computing systems, which are specific to the Cognitive Era, namely, Cognitive Business solutions, then a new approach to Competitive Intelligence is needed, along with technological development and with the new way of thinking.

Competitive Intelligence in Cognitive Era is the process of transformation of intelligence using techniques and technologies for evaluation and intervention that are based on neuroscience. The whole process of intelligence: collection, processing, analysis and dissemination of information can be enhanced by using the technologies and tools provided by cognitive neurosciences both through gathering high-quality data on consumer experiences and perceptions with integration of Cognitive Business solutions for processing and analyzing data and information, as well as by increasing the cognitive abilities of analysts with the help of cognitive technologies such as cognitive augmentation through neuro-feedback.

2. Technologies and Applications of Cognitive Neuroscience in Competitive Intelligence

The main advantage of cognitive neuroscience technologies is that intercultural barriers and communication are eliminated because the inter-behavior or the way the brain works is the same in the world.

Contributions of neuroscientific methods in research are considerable because the benefits of physiological measurements have many advantages. For example, self-evaluation methods commonly used in marketing research to improve communication are entirely based on respondents' ability and willingness to accurately relate their attitudes and behaviors (Petty, Cacioppo, 1983). On the other hand, physiological responses can be collected when respondents are exposed directly to messages or participate directly in

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consumer behavior and can be hardly controlled by them. Although there are individual differences between physiological responses, it seems that variations in social situations and stimuli have a strong effect on individuals (Cacioppo, Petty, 1985).

Neuroimaging techniques most used in neuromarketing are taken from medicine: electroencephalography, functional nuclear magnetic resonance, galvanometer, magneto electroencephalography, eye-tracking equipment (Pop et al., 2014).

Electroencephalography (EEG) records the alpha and beta rhythms of neural activity under the scalp. In particular, lowering the alpha rhythm and replacing it with the beta betrays a cognitive activity determined by will.

Galvanometer (GSR) indicates the intensity of emotional reactions by measuring changes (occurring in skin conductance) induced by the vegetative nervous system. However, this technique does not indicate the value of the emotional reactions, but only their intensity, so there can be no difference if, for example, the states of surprise are positive or negative.

Functional Nuclear Magnetic Resonance (NMR) records the level of oxygen concentration in the blood. Active neurons consume a higher amount of oxygen, so the oxygen level in the rest of the body decreases. This allows the recording of oxygen concentration changes in the body's blood (decreases concentration in the other parts of the body and increases for active neurons) and their output by the blood oxygen level dependent signal (BOLD).

If electroencephalography records only the activity of the neurons under the scalp, the functional nuclear magnetic resonance is much deeper, recording the activity of the neurons located within the cerebral hemispheres.

Magneto encephalography (MEG) studies brain activity in real-time (millisecond). This is possible by recording the magnetic field produced by the synchronized neurons.

Eye-tracking equipment (ET) indicates eye movement and eye view. The view does not have a homogeneous course, but involves a series of short stops, called fixations. Thus, eye-tracking equipment mainly studies these fixations. This is possible by recording corneal reflections due to infrared radiation.

Because they provide different information, these techniques can be combined to get even more complex information. Even though processes are expensive, they have a considerable contribution to research into decision-making and marketing communication.

Although it has great potential, most neuroimaging applications in the specialty literature have focused on branding and the consumer's behavior. For example, electroencephalography (EEG) has been used to investigate reactions to television advertisements on numerous occasions. Thus, it has been investigated whether particular moments in commercials are primarily responsible for capturing brand awareness and evolution (Young, 2002), or whether certain visual scenes are better recognized (Rossiter et al., 2001). These research and many others suggest that different types of advertising generate very different types of brain activity, which may also lead to differences in efficiency. Another important aspect that neuromarketing can describe, and on which it can provide a new perspective, is trust.

Trust is an aspect whose prominence is growing increasingly in the field of communication and marketing and neuroimaging can answer questions that simple marketing and market research cannot

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answer. Neuromarketing can study whether trust is a simple response to a repeatedly positive stimulus, or it is more than this. Neuromarketing can also tell if consumer and product trust is similar to trust between friends or family in terms of brain activity (Lee et al., 2007).

Exploring and understanding such questions about the nature of trust will lead to a greater ability to explore past confidence factors and the ability to help businesses better communicate promotional messages to a diverse audience in terms of culture and build trust for both customers and collaborators to achieve mutually beneficial results.

The latest developments in cutting-edge technologies and their impact on the domestic and international business environment show that, in order to survive in the current digital economy, companies need a set of new registers with regard to the information they operate on the market, effective marketing strategies and the persuasive messages they send to the market.

The consequence is the increased risk of loss to the company and a downward trend. The lack of a culture in the activity of Competitive Intelligence or otherwise competitiveness through value-added information, often puts the managers in a position to make serious confusions between information and intelligence. Although similar, these two terms are at different levels in the pyramid.

The implementation of the Competitive Intelligence function in businesses can be a good indicator of market and industry maturity and the gap between the former Eastern Europe and Western Europe being very visible.

Over 90% of FORTUNE 500 companies use Competitive Intelligence to substantiate company decisions. Western European countries are present with many companies in different industries and business areas in this top. In contrast, with one exception, companies in the former Eastern Europe are not part of this top: a Polish company managed to rank at 454 out of 500. Unfortunately, in this case too, data are insufficient to provide conclusive results.

3. Research Objectives, Methodology and Data

The main objective of the study is to compare and identify the countries that are most competitive, digitally adapted and that invest and have developed an ecosystem in the field of neuro-technologies. Also, a secondary objective that this study has is related to the identification of a correlation coefficient of the indicators.

Comparative analysis is used as an effective tool in the search for a comprehensive understanding of the cause-result process of an action, characteristic or relationship. To fulfil its aim, the method usually introduces or increases variation in the explanatory variable or variables.

For the purpose of this study, the research method of qualitative comparative analysis helps to rank the countries with the help of the analyzed indicators. Comparative analysis also correlates indicators and develops a productive relationship by creating a competitive neurotechnology index. The main elements that ensure the structure of the comparative analysis are the three analyzed indicators and, finally, the new index built on them.

In this situation, we can use other indicators, on the basis of which, we can deduce the ability of some countries to increase their competitiveness by implementing innovative solutions such as neuromarketing and cloud computing. This comparative study will analyze and rank data from the following countries:

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Canada, France, Germany, Israel, Spain, Sweden, Switzerland, The Netherlands, UK and USA. An index of neurotechnology competitiveness (NTCI) has been created based on three indicators:

(1) First indicator is Global Competitiveness Index (GCI). GCI is index published by the World Economic Forum in yearly report (WEF, 2019) and measures national competitiveness.

(2) The second indicator is ICT adoption. This indicator is the average of the following indicators obtained from ITU: "Internet users% of adult population"; "mobile-cellular telephone subscriptions per 100 pop"; the ratio of "Fibre internet subscriptions per 100 p." to "Fixed broadband Internet subscriptions per 100 pop."; the ratio of "Mobile-broadband subscriptions per 100" to "mobile-cellular telephone subscriptions per 100 pop". Flexible work arrangements: Response to the survey question "In your country, to what extent do companies offer flexible working arrangements (virtual teams, remote working, part-time employment)? 1=Not at all; 7=to a great extent. Digital skills refer to the response to the survey question "In your country, to what extent does the active population possess sufficient digital skills (e.g., computer skills, basic coding, digital reading)? 1=Not at all; 7=To a great extent. Digital legal framework refers to the response to the survey question "In your country, how fast the legal framework of your country is adapting to digital business models (e.g. e-commerce, sharing economy, fintech, etc.)?" [1 = not fast at all; 7 = very fast]

Country	Score (GCI)*	Rank GCI (1)	ICT Rank	Rank (2)
Canada	79.6	**7**	35	**8**
France	78.8	**8**	28	**6**
Germany	81.8	**4**	36	**9**
Israel	76.7	**9**	45	**10**
Spain	75.3	**10**	19	**3**
Sweden	81.2	**5**	4	**1**
Switzerland	82.3	**3**	17	**2**
The Netherlands	82.4	**2**	24	**4**
UK	81.2	**6**	31	**7**
USA	83.7	**1**	27	**5**

Table 1 – "Countries Ranking of The GCI 4.0 and ICT adoption"

*Data Sources: *WEF, The Global Competitiveness Report 2019 ** GovData360, World Bank*

(3) The third indicator is number of neuro-technology companies based on Neurotech Analytics. Neurotech Analytics is the world's premier source of NeuroTech Industry Analytics, Forecasting and Benchmarking, as an original creation of Alon Braun (Riverbanks Solutions) and Dmitry Kaminskiy (Deep Knowledge Group).

Country	No. of companies	Rank (3)

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Canada	67	**3**
France	37	**4**
Germany	21	**9**
Israel	36	**5**
Spain	31	**6**
Sweden	18	**10**
Switzerland	29	**7**
The Netherlands	23	**7**
UK	90	**2**
US	647	**1**

Table 2 – "Top 10 Neurotech Companies by Countries in 2021"

Data Source: Neurotech Analytics Ltd, 2022

According to the Neurotech Analytics' study, in 2021, the main players in this field are located in North America – 714 and in Europe – 346 companies. The global market for neuro-technologies has reached to 407.44 billion USD of cumulative capitalization, with an annual growth of investment in neurotechnology is 31% while the average growth for life science investment, in general, is 12%. Private capital funds invested more than $19 billion in NeuroTech companies since the year 2000 (Neurotech Analytics, 2021).

4. Discussions

In order to identify the most important countries in term of their relevance and impact in the knowledge society, we have built an index of neurotechnology competitiveness (NTCI). The NTC index is an indicator based on the average ranking that countries have had according to the following formula:

$$\text{TCI} = \frac{Rank\ (1) + \ Rank\ (2) + \ Rank\ (3) + \ (\ldots) + \ Rank\ (n)}{n}$$

Country	Rank GCI (1)	Rank ICT (2)	Rank Neurotech (3)	NTCI
Canada	**7**	**8**	**3**	**6**
France	**8**	**6**	**4**	**6**
Germany	**4**	**9**	**9**	**9**
Israel	**9**	**10**	**5**	**10**
Spain	**10**	**3**	**6**	**8**
Sweden	**5**	**1**	**10**	**5**
Switzerland	**3**	**2**	**7**	**2**
The Netherlands	**2**	**4**	**7**	**3**
UK	**6**	**7**	**2**	**4**
USA	**1**	**5**	**1**	**1**

Table 3 – "Comparative Analysis of Neurotechnology Competitiveness Index"

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Following the comparative analysis of the neurotechnology competitiveness index (NTCI), we find that the most competitive country in terms of neurotechnology are US, followed by Switzerland, The Netherlands, UK, Sweden, Canada and France, Spain, and Israel.

5. Conclusions

The conclusion of our study is that, in order to build an advanced and competitive European Union, innovative Competitive Intelligence solutions are necessary to include elements of neuromarketing and Artificial Intelligence as Cognitive Business profitable tools. Then business and society will increase and profit together within the European Union and strengthening its identify.

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