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Neuroeconomic Conditioning of the Influence of a Market Demand of Consumers on an Innovative Character of Polish Companies

Anna Gardocka-Jałowiec¹

ABSTRACT

The aim of the article is an identification of key sources of an innovative character and their conditioning in contemporary Polish economy. In the discussion, it is stated that consumers – the smallest, but the most numerous economic unit – through their expectations of the way / form of meeting their own needs, create a direction and dynamics of innovative business and confirm or undermine the legitimacy of accepted directions of actions of the supply side and greatly determine their economic force. In addition, the discussion concerning market decisions (their sources) of consumers and businessmen is based on the results of neuroanatomical brain research. Analyses, that were carried out, allow for stating that: 1) consumers in a market play take on the following roles: creators of an innovative activity based on the reported potential demand; evaluating results of actions taken by innovative businessmen through effective demand; 2) in Poland, there has been a gradual redefinition of key factors of innovative character; 3) businessmen (over 90%) consider coming closer to consumers, meeting their needs through the use of the Internet, interactive and social media as the most important initiatives; 4) an action of businessmen within the scope of improving operative efficiency, aiming at accelerating reactions to market consumers expectations increase; 5) brain activity accounts for nearly $\frac{3}{4}$ decisions made – each choice constitutes a completely real process engaging a particular neuron number (including von Economo neurons), which influences particular behaviour; 6) a network of neural connections in the brain changes as one gains knowledge and experience – in effect, brain structures become more flexible.

Key words: innovation, stakeholder, consumer, consumer information, neuroeconomics, von Economo neurons, mirror neurons.

JEL Classification: D87, O31

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Introduction

The existing gap between the innovativeness of Polish and European businesses is revealed by, among other things, annual reports of the European Innovation Scoreboard EIS (2009)¹. According to the latest edition of the report (January 2010), Poland was ranked 23 among the EU countries, just like in the previous

year. According to the results of the study, Poland is characterised by a lower value of the Summary Innovation Index (SII) than the average of all EU countries, but the rate of increase of this index was higher than the EU average (European Innovation Scoreboard, 2009: 6). Owing to the rise in the innovation index, Poland moved from the group of catching up countries to the group of moderate innovators². The monitoring of indices assessing the innovativeness of the Polish economy does not provide unambiguous information

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about the progress in this area. Their changes are not unidirectional. An increase in the expenditure on investment projects taking place since 2003 is regarded as a positive tendency, while the identification of key sources of innovativeness and their conditioning in the contemporary economy remains an open question.

Undeniably, innovativeness, as an entity's ability to use its own creativity, is a key value in contemporary society. The progressing process of globalisation, growing importance of the competitive advantage (and not the position), turbulence of the internal and external environments requires that the market players use more and more of the following in the management process:

- flexibility (openness to change, cooperation) in adjusting to constant, turbulent changes occurring in the environment and the ability to operate under the conditions of chaos and crisis;
- market activity based on: the assumptions of the sustainability concept (i.e. a holistic one, a constantly developing look at the reality), development of knowledge resources (concealed and explicit);
- control and adjustment to the changing institutional conditions, both formal and informal (including in business activity, among other things, trust, ethical principles, a system of values, reflections, etc.).

Understanding the intentions of individuals on the basis of the observations of their behaviour is a fundamental element of all social relations (Lee, 2008: 404-409; Sanfey, Rilling, Aronson, Nystrom & Cohen, 2003: 1755). Businesses dealing with the transformation of innovative visions into new, so far unknown or known, but more effective, more useful goods/services satisfy the needs of other entities, including in particular consumers. They are dependent on each other in a number of specific ways. Hence, the following hypothesis is verified in the discussion: consumers determine the direction and dynamics of innovative activity and confirm or undermine the legitimacy of the adopted direction of the activity of suppliers and largely determine their economic force. It is assumed that the influence of the smallest and, at the same time, the most numerous economic unit, i.e. the consumers, results from: the potential demand, i.e. the expectations concerning the form/method of satisfying the needs, which have not been satisfied so far or has been satisfied in an inadequate way; (2) the effective demand, i.e. the assess-

ment of the correspondence between the expectations and the market offer expressed by the number and the extent (quality) of the needs, which have already been satisfied. Moreover, it is assumed that the sources of the intentions of market behaviour of consumers and entrepreneurs are set in their cerebral structures. Both the need and innovation are characterised by unlimitedness, developmentality, changeability in time – i.e. characteristics being a result of human evolution and, as such, expressing the level of the development and re-organisation of cerebral structures.

To verify the hypothesis, Polish and foreign publications pertaining to the following areas: innovation, consumer theory and neuroeconomics³ are used. The analyses were based, among other things, on: The Oslo Manual, The Conference Board reports, IBM Global Business Services reports, the results of neuroanatomical examination of the brain. The discussion has a hypothetical and deductive character.

1. Innovation in contemporary economy

Innovative activity is defined as: scientific (research-based), technical, organisational, financial and commercial activity aimed at developing and implementing innovation (Oslo Manual⁴, 2005: 45-46); (2) the ability of business entities to constantly search for and use in practice the results of scientific research, research and development work, new concepts as well as ideas and inventions.

Eric von Hippel's concept of "functional sources of innovation" assumes that functionally and mutually connected stakeholders⁵ achieving specific economic, technical and market benefits are involved in the process of innovation development and implementation (Kalinowski, 2010: 45-46). The broad spectrum of (internal and external) stakeholders creates the innovative potential of an entity (Duraj & Papiernik-Wojdera, 2010: 105; Slowinski, Hummel, Gupta & Gilmont, 2009: 27-29).

Innovativeness should be perceived as: a stakeholder's ability to use their own creativity, the mental process leading to the creation of new ideas, concepts or new associations, connections with the ideas and concepts which already exist. Innovative thinking means thinking which leads to original and applicable solutions based on: collected and codified explicit knowledge, implicit knowledge typical of an individual,

experience, intuition (the ability to take a broad view of a situation) Undoubtedly, innovativeness, as a characteristic of an entity is an expression of a complex set of skills, a different way of organisation, synthesis, expressing knowledge, perceiving the world and creating new ideas, perspectives, reactions and products.

It is considered that both pecuniary and non-pecuniary criteria (i.e. intensification of competition and of relative efficiency) can be the basis of innovative activity (Cantner, Güth, Nicklisch, Weiland, 2009: 724). Contemporary businesses achieving market success clearly emphasise the role of a system of values in the process of innovation creation in their strategies. Values influence the quality of interactions occurring inside the company and in its relations with the environment. As Bugdol (2006) states, the following qualities are important: trust, fairness, integration, involvement and solidarity. The effectiveness of innovation implementation depends on the form of leadership, personnel attitudes and a recognised system of values (McAdam, Moffett, Hazlett & Shevlin, 2010: 195-204).

It is worth mentioning that studying various symptoms of trust and its lack is not a contemporary invention. Already liberal thinkers, such as David Hume or James Madison pointed to the significance of trust in economic processes. It is interesting to note that opinions pertaining to trust have not lost their relevance and they are as relevant as they were in the 18th and 19th centuries. As Hardin (2009) points out, contemporary economic reality is far more diversified and complex than the world of our ancestors, which results in both greater trust and also in lack of trust between entities. P. Zak (2008), on the other hand, shows that human attitudes and a recognised system of values affect politics, law and public order are the key for a high standard of living, a prerequisite for economic growth in developing countries. Innovative changes should bring positive economic and/or social effects depending on the area in which they are introduced. The creation of a store of key competences, which should include the ability of systematic and permanent innovative activity, makes it possible to achieve measurable results on the supply side, such as increasing or keeping the market share, winning new market, keeping long-term economic leadership (Grudzewski & Hejduk, 2008: 243).

As Vyas (2005: 103) notices, innovations are one of the conditions of a company's presence on the

market. Some researchers (Prahalad, Krishnan, 2010; Przedpelski, 2005) point out that reliance on innovations created owing to the use of global resources and co-creation of values by clients are of great significance for market activity. Hence, the competitive advantage of large companies in the area of innovative activity is a considerable barrier for small or newly-established companies (Vyas, 2005: 103-116).

Undeniably, innovation is perceived as the key to competitiveness and economic growth (Gilbert, 2006; Horn, 2005: 28). It is pointed out in the National Innovation Initiative Report (Innovation..., 2004: 9) that they contribute to an increase in productivity, cost reduction, an increase in employee satisfaction, eventually leading to the company's higher profits. As the basis of innovative activity, an increase in the dynamics of the company's profits, according to the report devised by The Conference Board⁶, receives low ratings (26% of the respondents) compared to the management's strategy (56%), the company's customer expectations (52%) (Źródła i strategie..., 2005: 7-9).

In the method of the Summary Innovation Index calculation recommended for the years 2008-2010, the results of innovative activity block⁷ occurring next to the following blocks: innovation motors⁸, activity of companies⁹ deserves particular attention. The economic innovation effects including: the employment structure, the quantity of exports, sales of new or modernised products are distinguished in the innovative activity group. And, after all, it is the sales index – its value and the dynamics of growth – reflects the level of acceptance of translating the potential demand into the effective demand. The incompatibility of expectations with the market offer manifests itself by lack of demand for specific goods and services. As a result, it is necessary to undertake further innovative actions. Hence, the consumer should not be regarded merely as the party assessing the compatibility of the results with the expectations (the level of the correlation between the potential demand and the effective demand). The consumer should also be perceived (or perhaps primarily so) as the creator of sources of necessary innovative actions aimed at transforming the expectations into approved and recognized results (Balsano, Goodrich, Lee, Miley, Morse & Roberts, 2008: 23).

2. The consumer as a market game participant

Consumers form a very internally diversified community as regards: their age, education, social status, economic function. The diversification of their market behaviour (e.g.: the method of looking for and processing information, the method and measures of satisfying the needs, perception and tendency to take risks, etc.) results from the diversification of individuals in terms of cultural, economic and social characteristics. As the smallest and the most numerous unit of market interactions, the consumer reveals their activity in the performance of the consumptive function by the following roles which they may assume:

1. Identifier and propagator of one's own expectations – determination of the potential demand.
2. Prototype tester – control of the transformation of consumer expectations into the results, which is of decisive importance for entrepreneurs as it translates into reduced risk connected with market failure of a given material product or a service before it is launched.
3. Evaluator of the level of the translation of the potential demand into the effective demand – it is considered that if the sales of a new or improved product (material and non-material) begins to increase over a short period of time (up to 6 months) after its launch, it means the acceptance of transformed expectations into results.

Needs are considered to be the original factor in the consumer's market behaviour¹⁰. One of the mechanisms of the creation of needs is the mechanism of secondary objectives (Rudnicki, 2004: 38). Striving to satisfy a specific need is always targeted at a specific aim or object. The primary needs become the basis for new, secondary needs (e.g. the need to satisfy one's hunger gives rise to the need of possessing money, which, in turn, triggers the need to gain a specific position on the job market and to enter into the individual-environment relations). Undeniably, the specificity of needs consists in their considerable diversification, changeability of the intensity of experience, hedonistic treadmill¹¹, the evolution under the influence of changes in the preference system, the system of values and the tradition. The connections between the needs are distinctly complementary or synergistic¹² (mutually stimulating, augmenting) and, to a lesser degree, substitutive (Bywalec, 2010: 18).

Changes occurring in the consumer's behaviour result from the specificity of their development. Age, gained and expanded knowledge, both explicit and implicit, and experience determine their participation in the market gain. Thus, market decisions taken by the consumer are an integral part of their behaviour. These decisions have the form of a process going through specific phases. Depending on a given product, which the consumer is going to purchase on the market, on the situation and even on the mood of the person taking this decision, these phases may be of varying duration and may be characterised by different attitudes. Market activity of consumers is determined, among other things, by personal values reflecting the actual differences between cultures, social classes and professional groups (more information in: Lee, Soutar & Sneddon, 2010). So the decision-making process is conditioned by both economic and extra-economic factors (hard and soft factors), which significantly influence the consumer's final choice.

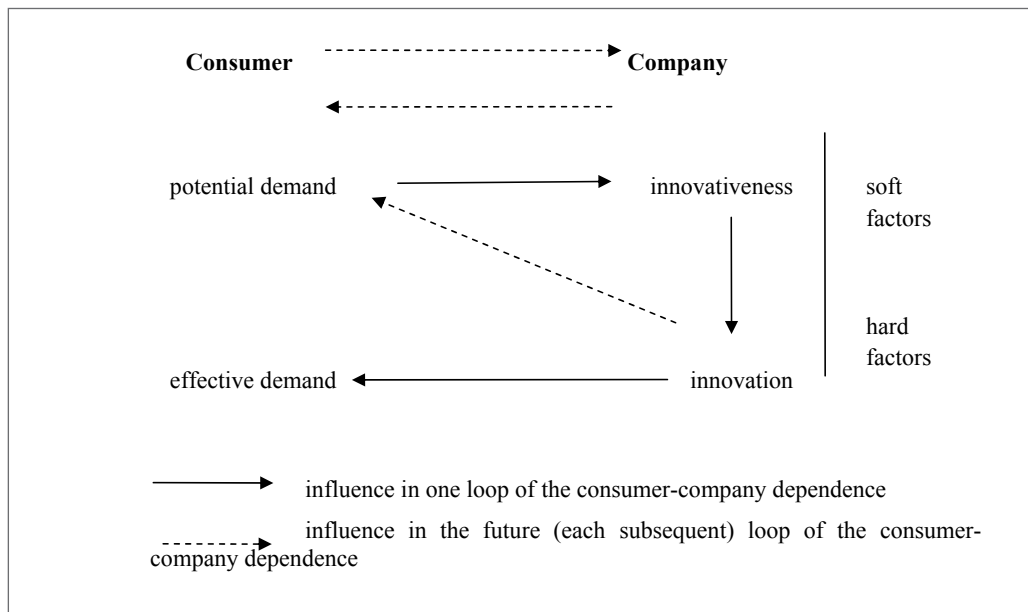
The contemporary consumer is more involved in the process of creating market value and their decisions are capable of changing the character of consumption to their advantage (Kucuk, 2009). Undoubtedly, the needs stimulate companies to undertake innovative activity (Fig. 1).

Innovation gives, with time, an impulse to create the potential demand resulting from the change in the ways of satisfying needs, in the ways of thinking and perceiving the surrounding economic reality. This impulse is a starting point for another loop of market dependence between the consumer and the company.

3. The consumer and the innovativeness of companies

Research setting on the world's trends in entrepreneurship conducted in the years 2007-2008 and 2009-2010 by IBM consultants (The Global CEO Study)¹³ shows the growing importance of the information consumer category. The information consumer is a participant of the market game who requires all kinds of product information and, therefore, is more demanding, better informed, willing to popularise their opinions and expectations on a wide scale via the Internet or the mobile phone. Owing to the development of technology and tele-information services, both consumers and companies have ever greater access to information. Thanks to

Fig. 1. The loop of market dependence between the consumer and the company based on soft and hard conditions of economic activity



Source: prepared by the author.

ICT, companies are capable of getting to the sources of ideas. For examples, companies can use ICT tools to acquire information about the client (e.g. about their current and future attitude towards specific products and services) (Awazu, Baloh, Desouza, Wecht, Kim & Jha, 2009: 51).

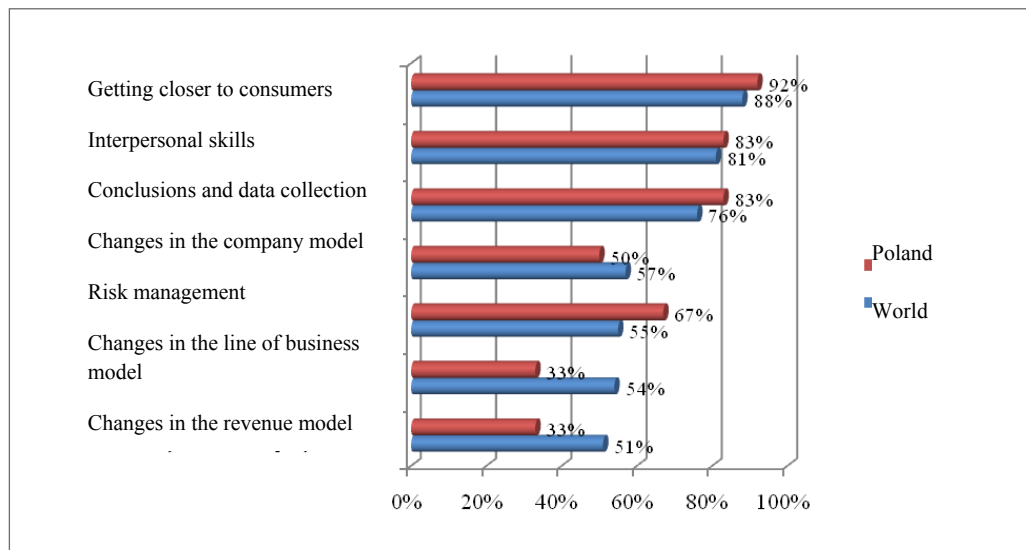
In a survey conducted in 2007 in a group of 1000 consumers, 53% of the respondents stated that they used the Internet to compare the characteristics and prices of products and 10% sent messages to their family and friends while shopping to acquire information or share knowledge (IBM, CEO Study, 2010).

Over 90% of surveyed Polish entrepreneurs (Fig. 2) point out that getting closer to consumers is their most important strategic initiative in the next years. They consider the Internet as well as interactive and social media channels to be the main sources for establishing such contacts. These contacts are perceived as the basis for understanding and initiating changes in relations with consumers. The results of the research are additionally corroborated by the conclusion of the analyses conducted by the Institute of Market and Social Opinion Research ordered by RSCG Poland stating that

companies willing to gain the competitive advantage in the future should have another objective apart from the profit, i.e. be socially involved, respect consumers and conduct an open dialogue with them (Grudzewski, Hejduk, Sankowska & Wańtuchowicz, 2010: 25).

In this way, the recognition of the factor encouraging companies to undertake innovative activity is on the increase in Poland, i.e. "forcing innovation by clients" (Żołnierski, 2005: 20), while in the years 1998-2000 the survey conducted among companies by the Central Statistical Office (GUS) showed the following reasons for the introduction of innovation in Polish companies (GUS, Innovative activity, 2001):

- improvement in the product quality (64.5% companies employing over 49 people and 63.1% companies employing 10-49 people);
- opening new markets or increasing the market share (58.1% companies employing over 49 people and 54.2% companies employing 10-49 people);
- increasing the range of products (57.4% companies employing over 49 people and 53.4% companies employing 10-49 people).

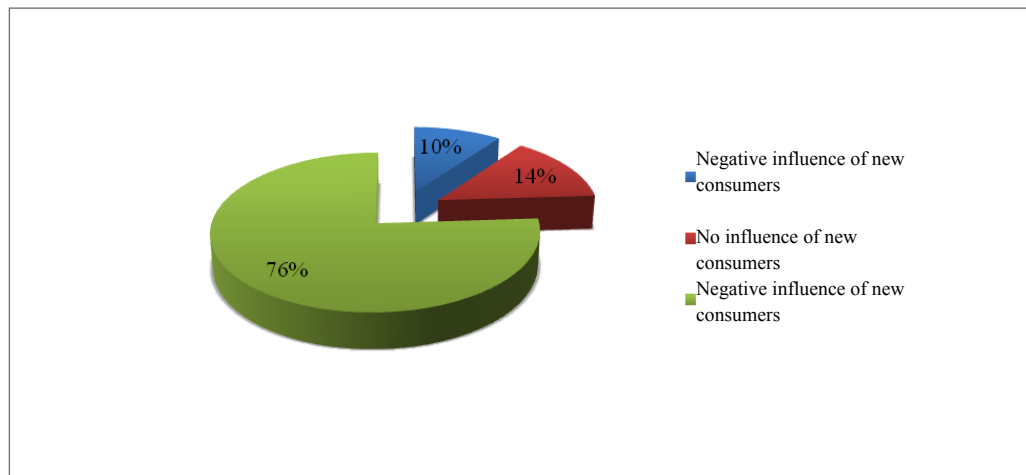
Fig. 2. Aspects of company activity in the following years

Source: <http://www.networkmagazyn.pl/najwazniejsza-cecha-prezesa> (downloaded on: 16.08.2010).

The world IBM studies conducted in the years 2007-2008 (Fig. 3) show that more than three quarters of surveyed representatives of managerial staff sees an opportunity in the emergence of new and demanding consumers. Entrepreneurs surveyed in 2010 sustain the claim that changes occurring in consumer expectations are not a threat, but an opportunity for devel-

opment (IBM, CEO Study..., 2010). Managerial staff perceives them as factors:

- stimulating changes in the company model;
- opening an opportunity to develop more diversified products or services;
- increasing the ability of companies to gain advantage over competition.

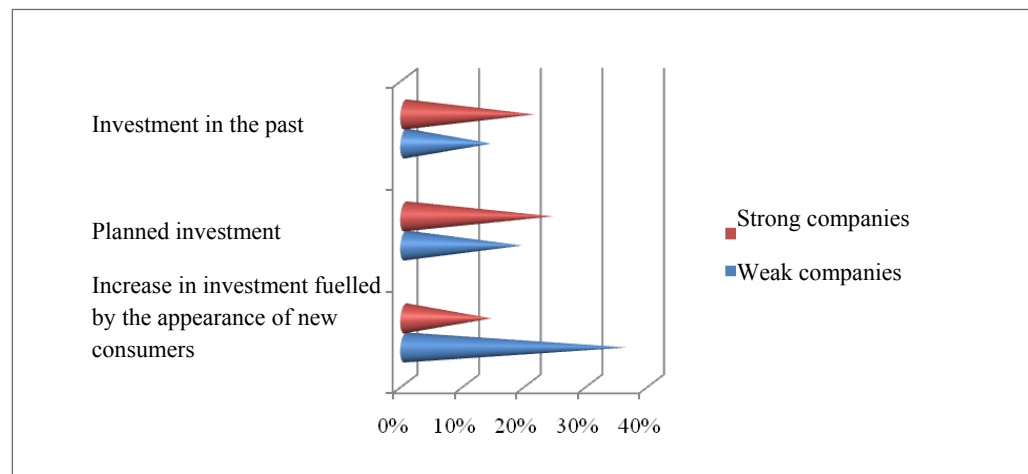
Fig. 3. Influence of new and demanding consumers on the company

Source: IBM Global CEO Study, 2008: 26.

It is thought that the majority of investment projects (Fig. 4) aimed at satisfying the expectations of new and demanding consumers should be directed at new operational possibilities, which will improve coopera-

tion and increase the company's innovativeness. Companies which are more effective in operational terms expect that 20% of their future revenue will come from new sources (IBM, CEO Study..., 2010).

Fig. 4. The level of investment projects targeted at the new consumer category (i.e. better informed and willing to share their knowledge about the quality of products or services)



Source: IBM Global CEO Study, 2008: 27.

The reformulation of the strategy of company actions is necessary. It is shown that, as a result of more intense competition and changes in technologies and needs, the average life-span of a company has been reduced. Companies, which are incapable of keeping up with market changes and which do not make an effort to meet consumer expectations, automatically disappear from the market. The period during which a company is listed by, e.g. Standard & Poor's 500, has been reduced by approx. 80% - from 75 years in the late 1930s to 15 years in 2000 (Hagel & Brown, 2006: 23).

4. Neuroeconomic conditions of the consumer's and entrepreneur's economic activity

The understanding of an individual's intentions on the basis of the observation of their behaviour is the basic element of all social relations, such as the consumer-entrepreneur relationship. As research reveals, the recognition of such intentions begins at the level of a system using the mechanism of the so-called mirror neurons¹⁴.

The existing neural mechanisms enhancing empathy and inclination to cooperation and pro-social behaviour by social exchange lead to the creation and, subsequently, consolidation of relations between people (Adolphs, 2003: 165-170). In people capable of cooperation, greater activity is shown by the areas of prefrontal cortex (Krueger, Barbey, McCabe, Strenziok, Zamboni, Solomon et al., 2009: 22486; Krueger, Grafman & McCabe, 2008: 3859) connected with control over impulsive behaviour and the ability to postpone gratification (Blakemore & Frith, 2008: 24; Sanfey, Rilling, Aronson, Nystrom & Cohen, 2003: 1755-1756).

The signs of lack of bonds between individuals, hostile attitudes and a tendency to commit acts contrary to the applicable system of values in a given society are typical of the behaviour of some people within a given social group. Research by Harrisona & Fiske (2006: 847-853) showed that there is no neural basis of social cognition in this group of people by means of magnetic resonance imaging.

The ability to cooperate requires the skill of identification of common goals and resignation from immediate enhancements (McCabe, Houser, Ryan, Smith & Trouard, 2001: 11832-11835). Specialised neurons deserve special attention (located, among other things, in the premotor cortex). They are called mirror neurons (Rizzolatti, Fadiga, Gallese & Foggassi, 1996: 137-139). They “reflect” the behaviour of others, which is directly involved in predicting the actions of other entities (Gallagher & Frith, 2003: 77) and in drawing conclusions about the intentions, empathy and imitation – such behaviour is significant for accepting innovative solutions of the satisfaction of needs. Ramachandran (2006) states that owing to mirror neurons, the human brain has become specialised in culture and has become an organ of cultural diversity in the full meaning of this word.

Defective function of mirror neurons is connected with problems with relations with other people and with social situations (Shermer, 2009: 222-224). The inability to interpret somebody's intentions makes the behaviour of another person seem completely random and insignificant, and therefore, requires no reaction or such a reaction becomes equally random, i.e. inadequate (Ramachandran & Oberman, 2006: 62-69). Moreover, lack of trust is the fundamental barrier to innovation. Consumer's opportunism towards innovative solutions of the satisfaction of their needs translates into the consolidation of the demand for tested, well-known products, which are commonly approved by the majority of consumers.

Trust depends on the time, in which the accumulation of experience occurs. The accumulation of experience depends on the type of activity undertaken by the parties, the effects of learning and forgetting. Gaining new experience leads to chemical and structural cerebral changes connected with inter-neural communication (Shermer, 2009: 138). Neurons are organised in groups and each such group specialises in processing a specific type of stimulus. The entire communication between neurons occurs by means of synaptic connections. The so-called dendritic spines, which are small protrusions from a neuron's dendrites contact the axon ending of the closest neuron or neurons, which release chemical substances into the synaptic cleft. Under some conditions, dendritic spines may shrink and disconnect this contact: in other conditions – the existing

(or new) spines grow and establish a new contact. The more frequently one neuron stimulates another, the stronger connection is formed between them. With each new experience of an individual, small changes occur in the connections in the physical brain structure¹⁵. The experiences of a consumer become consolidated; as a result of which, subsequent neural connections consolidate positive or negative associations, which accompany market behaviour. As a result, the consumer: engages in subsequent proposals of market innovations with or without trust, (2) defines their potential demand, (3) propagates information.

According to neuroanatomical research, von Economo neurons (VENs) (Allman, Watson, Tetreault & Hakeem, 2005: 367-373) are described by Romanian-Austrian neurologist Constantin von Economo (Shermer, 2009: 214) (large, spindle-shaped, bipolar neurons of the fifth cortex layer occurring only at two locations in the frontal cortex: in the anterior cingulate cortex and in the fronto-insular cortex). The suppositions that von Economo neurons play a significant role in social emotions are based on their particular location (Watson, Jones & Allman, 2006: 1107-1112). Neuroanatomical research shows that the anterior cingulate cortex is responsible for controlling attention, higher cognition processes, pain sensation and responds to signals from autonomic body control systems. The fronto-insular cortex, on the other hand, becomes active in situations involving suffering, harm, pain, deceit and disgust. Hence, von Economo neurons are considered to be the location of complex human emotions. These neurons are equipped with neurotransmitters (such as: serotonin, dopamine and vasopressin) enhancing positive feelings, the sense of bonding. Key importance is assigned to the size of these cells, especially to the characteristic, very large axons. Axons are responsible for sending signals and the promptness of response constitutes the basis for the proper assessment of the existing situation and the recognition of mutual interpersonal relations. Human decisions are made under the influence of emotions, so they are made on an immediate basis.

The specificity of need satisfaction is their prioritisation, evaluation of their usefulness. The usefulness is commonly considered to be a measure of relative satisfaction from the purchase, possession of a specific product or service. On numerous occasions, useful-

ness, as (a sense of) satisfaction, is considered to be tantamount to the achievement of happiness by a human being. This is not true as satisfaction is an emotion based on the result of a right and conscious decision, the effect of a conscious choice; happiness is a subjective sense of a positive influence of events, which took place with the participation of other individuals or without it. The basic difference lies in the appearance of responsibility for decisions taken independently. Therefore, satisfaction as an emotion is connected with brain activity – the activity of individual neurons in the LIP area (lateral intraparietal area) – a region located just above the ears and extending backwards. This area is connected with attention, decision-making and movement planning (Goldberg, Bisley, Powell, Gottlieb & Kusunoki, 2002: 212,214; Hamed, Duhamel & Bremner, 2001).

Changes in the LIP activity are correlated with changes affecting economic decisions made by individuals, i.e. when the reward value increases (usefulness – in the case of the satisfaction of needs), the frequency of the activity of neurons processing appropriate information rises (Platt & Glimcher, 1999: 234). Therefore, the brain is equipped with networks of neurons involved in the process of calculating values and usefulness, and, consequently, in pure market decisions (Knutson & Peterson, 2005: 305-315). As neuroanatomical studies confirm, people generally exhibit greater sensitivity to loss than to profit (Tom, Fox, Treppel & Poldrack, 2007: 515-517).

According to research by Russell Poldrack & Craig Fox, the correlation between the activity of neurons in the LIP area (brain activity) and decisions (behaviour) amounts to 0.85 and the determination coefficient is 0.72. This means that as much as 72% of the variance (diversification) of the decisions made by people can be accounted for by means of brain activity (Shermer, 2009: 186-187). The results of research by Fox & Poldrack attract interest as the determination coefficient is usually below 0.20.

Conclusions

In Poland, gradual redefinition of key innovation factors occurs. According to entrepreneurs, getting closer to consumers and satisfying their needs are their most important strategic initiative in the next few years (over 90% of Polish entrepreneurs). Over 75% of represen-

tatives of the world's managerial staff, also including Polish managerial staff (according to IBM Global Business Services) notices the influence of well-informed consumers (i.e. more demanding, better informed and more willing to share their knowledge about the quality of the product or service) on the development of the company and, therefore, the majority of them expresses the willingness to increase their investment and to improve the operational efficiency to react more promptly to signals coming from the market, better use of experience. Consumers are perceived as participants of market game fulfilling two functions: firstly – creators of innovative activity based on the reported potential demand; secondly – evaluators of the results of innovative actions by the effective demand.

As shown by the results of neuroanatomical research, neuronal modules located in the brain of each individual are responsible for decisions, including market decisions. Each choice is a completely real process engaging a specific number of neurons, as a result of which specific behaviour occurs. As an individual develops, networks of internal neural connections develop and consolidate under the influence of the experience gained. The basic, universal brain architecture is common for all people. However, under the influence of new experiences, neurons become stimulated and, in response, they create new synaptic connections, which are the individual property of a particular brain.

The network of brain connections in an individual's brain constantly changes with the intensification of actions undertaken. Contrary to previous assumptions, brain plasticity is not limited only to childhood. During sensitive periods in an individual's development, some brain regions keep developing throughout adolescence and even during adulthood. It means that whenever an individual gains knowledge or experience, the brain structure becomes flexible. As a result, an individual activates new/modified expectations. And they constitute an impulse for another loop of market dependence between the consumer and the enterprise.

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Notes

1. *European Innovation Scoreboard (EIS) has been published every year since 2001. The report is used to present the level and dynamics of innovation changes in EU member states. The EIS methodology was modified in 2008. The number of analysed dimensions of innovation was increased to 7 and it was divided into 3 main blocks: (1) internal activity, (2) company activity, (3) external activity. The blocks constitute a set of connected indices which make it possible to obtain an assessment of an economy's innovation. The blocks and their composition were designed to include the diversity of changes in innovative processes in the intereconomic context. According to the report, the most innovative economies include: Sweden, Finland, Germany, Great Britain, Denmark, which belong to the so-called innovation leaders.*
2. *The Czech Republic, Portugal, Greece, Hungary, Italy, Lithuania, Malta, Slovakia, Spain belong to the group of moderate innovators..*
3. *Neuroeconomics is a branch of economics which studies the causes of and forecasts future human behaviour. It is based on three disciplines: economics, neurology and psychology. The establishment of neuroeconomics was the reason and the result of combining tools (both theoretical and empirical ones) used in the three disciplines for a common*

- purpose, i.e. the analysis of the market behaviour of human beings. The application of contemporary, constantly developing and non-invasive technologies of brain activity measurement plays a significant role in research performed by neuroeconomists. Owing to their application, it is possible to measure the activity of the brain and to correlate these results with decisions made by an individual to understand them and create forecasts for the future.
4. The Oslo Manual devised by the European Commission (Eurostat) and the Organisation for Economic Co-operation and Development (OECD) contains the description of methods of collecting and interpreting the indices pertaining to innovation in a system ensuring their international comparability. It is a commonly used standard of statistical research in the area of innovativeness.
 5. The notion of stakeholders was first explained by R.E. Freeman at the beginning of 1980s. It is assumed that a stakeholder is each person or group that can exert influence on a given company or that is influenced by this company.
 6. The Conference Board is an international research organisation for business practitioners. One of its objectives includes preparation of reports on economics and management; <http://www.conference-board.org>. The Conference Board report (a research project organised in cooperation with the Instytut Nauk Ekonomicznych PAN (Institute of Economic Sciences, Polish Academy of Sciences) and the companies Accenture and House of Skills), is based on 111 surveys received from respondents from a group of 500 of the largest companies (Rzeczpospolita's 500 list) and 700 largest companies from the high technology sector (the Teleinfo Weekly report) and 19 direct interviews.
 7. It includes 9 indices divided into two blocks: innovators implementing innovation on the market or within a company; economic effects of innovation understood by the employment structure, the quantity of export, the sales of new or modernized products.
 8. It includes 9 indices divided into two blocks: human resources and the possibilities of project financing.
 9. It includes 11 indices encompassing innovative actions of companies in three aspects, i.e. investment projects, external connections and entrepreneurship, indirect effects.
 10. Decisions concerning the level and structure of the satisfaction of needs (measured by means of expenses) are made based on the income, prices of goods, prices of goods and services, tastes and preferences, social and professional characteristics as well as customs and traditions.
 11. Hedonistic treadmill – never-ending pursuit after an unattainable objective, e.g. a person feels satisfaction when their income increases. A higher income stimulates the development of needs. To satisfy them and to feel the same satisfaction as after an increase in income, the person feels the need of achieving a higher income again.
 12. Educational needs may constitute an example of synergism. The need to acquire and broaden knowledge from one discipline stimulates a person to gain broader knowledge about some issues from another angle (or the acquisition of knowledge stimulates the development of cultural needs).
 13. The Global CEO Study is conducted every two years, it provides a reference point and sets international business trends. The results of reports are based on a series of interviews conducted by IBM Global Business Services.
1130 CEOs, leaders of the private and public sectors from 40 countries participated in surveys conducted at the end of 2007 and in the first quarter of 2008. They represented companies of various sizes and various industrial lines of business. IBM consultants conducted over 1000 interviews during meetings, and the remaining part was performed in cooperation with the research centre The Economist Intelligence Unit.
The research was conducted from September 2009 to January 2010 (fourth edition of the research) involved 1541 presidents, CEOs, leaders of the private and public sectors from 60 countries representing companies from 33 lines of business.
 14. This statement can be regarded as evidence of Adam Smith's hypotheses from "The Theory of Moral Sentiments": However selfish a person could be, there are undoubtedly some elements in his nature, which make him interested in the fate of other people and which make happiness necessary for him, although the only pleasure he may derive from this is the pleasure of watching it. Pity and compassion belong to this kind – sentiments which we feel in the face

- of the misfortune of theirs or when we witness it or when we managed to realise it in a vivid manner.*
15. *The idea of reorganisation of connections under the influence of experience is referred to as Hebbian (from the name of its advocate – Donald Hebb). The mechanism of Hebbian learning means, in other words, long-term potentiation (LTP), whose essence consists in a constant increase in the synapsis efficiency, which results from neural stimulation. Stronger connections between nerve cells and long-term lesions & synaptic connections are a consequence of LTP. These changes are responsible for learning and memory (Shermer, 2009: 136-137).*