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## **FOURTH INDUSTRIAL REVOLUTION AND MANAGERS' COGNITIVE COMPETENCES**



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## FOURTH INDUSTRIAL REVOLUTION AND MANAGERS' COGNITIVE COMPETENCES

### **Professor Lidia Białoń**

Warsaw Management University  
emalia1@o2.pl

### **Konrad Werner, Ph.D.**

Faculty of Philosophy and Sociology, University of Warsaw  
konrad.t.werner@gmail.com  
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### Summary

The aim of this paper is to provide a description of the cognitive competencies that should be possessed by managers amid the circumstances recently rounded up under the umbrella term "Economy 4.0." We pay attention especially to the group of specialists called marketers of innovation, devoted to setting up and maintaining links between business on the one hand, and science on the other. Economy's capacity for innovative solutions hinges on these links, and the whole project of economy 4.0 depends, in turn, on innovations.

**Keywords:** industry 4.0; economy 4.0; marketing of innovation; education



Dynamic economic and social development creates many problems in almost any area of human activity. Among these areas we would like to focus on the issue of marketing in the context of the phenomenon, which has recently been called the fourth industrial revolution, or economy 4.0. Moreover, we devote our attention to the issue of education understood as the formation of managers under conditions of the above-mentioned economy 4.0. This concerns mainly training managers at universities. As we try to prove, we can substantially enrich educational tools using sciences concerning the processes of human cognition, which in the recent few dozen years have taken the shape of an interdisciplinary network called cognitive science. It is because the art of management requires the ability to identify changes and adapt to the changes taking place on the market and in the economy as a whole, in particular, when market success to an ever greater extent depends on the implementation of the results of scientific research. Successful implementation is determined by appropriate management of innovative activity supported by marketing activity.

In the article we shall discuss:

- the characteristics of economy 4.0 as a starting point for deliberations concerning the role of marketing in fourth industrial revolution;
- the problem of building the intellectual potential of managers under conditions of the fourth industrial revolution, especially in the area of cognitive competences. This intellectual potential also forms all dimensions of the marketing of universities educating future managers. It is aimed at stimulating positive attitudes to the university among the current and potential students.

Here, we realize that the presented goals constitute just a fraction of the issue management and preparing personnel in the discussed economic circumstances.

## **Characteristics of economy 4.0.**

The term "Industrie 4.0" was first used in public in 2011 at a fair in Hannover. It constitutes a kind of label for the results of a broad research

project financed by the government of Germany, which combines a diagnosis of current trends in the broadly understood economic reality, forecast of the future effects of the indicated trends for the German and global economy; finally — defined recommendations for people managing private and public capital (for the sphere of politics in particular)<sup>1</sup>. Another name — "Economy 4.0" — has become popular also in Poland, where it has become the centre of, among others, the Strategy for Responsible Development<sup>2</sup>. Adopted by the Ministry of Development. The Strategy was presented to the participants of the Impact'17 conference in Kraków in May 2017. Even though the concept of fourth industrial revolution in its original shape is supposed to constitute a new engine driving the German economy and an instrument maintaining its leading role in the world<sup>3</sup>, we can see clearly that it has grown beyond the local context and became, among others, the subject of discussion at the World Economic Forum<sup>4</sup> and provides conceptual blueprints for the formulation of long-term economic strategies of other countries, even with very different potential, among others Poland, or Holland<sup>5</sup>.

In this paper we use the term "economy 4.0" or talk about the *fourth industrial revolution*. There is no precise and commonly accepted definition of the fourth industrial revolution, nevertheless, we can distinguish a few characteristic points<sup>6</sup>.

Similarly as in case of earlier industrial revolutions, economy 4.0 is the effect of fast technological changes combined with changes in the social order, customs, etc. However, the development of technology is the main engine of growth.

From the historical perspective we can distinguish three stages of the development of industry called industrial revolutions:

- first industrial revolution — the period of transition from manual work to steam engines,
- second industrial revolution — mass production powered by electricity,
- third industrial revolution — advancing automation and digitalization associated with mass computerization of practically all spheres of life and economy.

The fourth industrial revolution proposed right now involves ever greater integration of humans and machines, as well as a kind of

emancipation of machines. It is because a network of connections is being formed not only between producers and clients, but also between users and products and between products themselves (the so-called Internet of things). In the above-mentioned "Strategy for Responsible Development" we can read, among others:

"The world is currently entering the stage of the fourth industrial revolution based on digital solutions. The scientific and technological progress in the area of robotization, mechanization, automation, storing energy, programmes of development of artificial intelligence and programmes of development of digital economy may bring a deep transformation of the global economy. The fourth industrial revolution will lead to the introduction of technologies allowing communication between machines, the dissemination of digital process in product management and robotization on an unprecedented scale"<sup>7</sup>.

It is being said that as a result of the fourth revolution, the so-called intelligent company is emerging. In such a company, for example, machines are able to "make decisions" allowing us to avoid the breakdowns of devices linked within processes of production, mimicking in a way human's decision-making processes. Economy 4.0 relies on virtual social and business networks, Internet of things, digitalization of services and huge quantities of data (*Big Data*), which used in a proper way allow significant growth of the efficiency of production. The latter thing seems crucial. Under circumstances of the fourth industrial revolution, what has become a global trend is the exponential growth of the amount of information and computers' processing capacity, which has an impact on the management of a company's resources — managing people and durable assets. This means an opportunity for more efficient cooperation with other companies, suppliers and what's most important, entities from the sphere of science, that is, research institutes and universities, has emerged. Moreover, companies can substantially reduce the costs of production, boost the efficiency of work, raise the productivity of equipment and in the final stage — this will be discussed later — quickly reach a very precisely profiled recipient (thanks to psychometric tools, which itself leads to a series of social and political problems<sup>8</sup>). Thus, new digital channels of access to the client are gaining significance and this aspect will be crucial for us.

We may risk the claim that the fundamental difference between the utilization of machines at the previous stages of the development of the economy and their utilization under conditions of economy 4.0 is that now the devices we make, thanks to the fact that they are connected to a local and the global network, have the ability to exchange information (we could say — communicate) and thus have a certain limited capacity to regulate themselves. Thus, the network of "smart" devices is characterized by the ability to control and regulate themselves, which by now used to be a feature typical of only living beings<sup>9</sup>. Looking at the issue from the perspective of the most basic conceptual models ordering the surrounding reality<sup>10</sup>, we can say that what is typical of economy 4.0 is the disappearance of the separation of the real world, in the originally assumed sense, from the digital world. For this reason the technological revolution is in a way becoming a part of the evolution of the animate world. It is because both evolutions are in essence the evolution of complexity<sup>11</sup> — the transformation and aggregation of ever more complex structures in nature and the human environment. Here it is worth mentioning that already in the 1960's Stanisław Lem proposed such a vision of technological evolution in his "Summa technologiae"<sup>12</sup>.

These remarks of a philosophical character, placing the new industrial revolution project in a much broader context are not marginal in character, but in further part of the article they will allow discussing the issue of cognitive competences.

## Economy 4.0 is people

The successes of new business models — models of production, personnel and capital management, marketing models will obviously depend on appropriately prepared human resources (this will be discussed in more detail in further part of the paper). Organizational changes in companies have to take into consideration in particular cooperation with other companies and research centres. The latter issue is especially important, as companies in economy 4.0 have to be characterized by a high level of innovativeness and the ability to use the information available in

the global network. Thus, they have to participate to a large extent in financing and later utilize scientific discoveries — they have to be partners on the path from discovery to implementation — and to obtain broadly understood knowledge about the market, the experiences of other companies, needs of clients. For this purpose they have to possess tools and skills to extract this knowledge from an immeasurable amount of available data.

In Poland, compared to other companies, the so-called start-ups stand out in the context of economy 4.0. According to surveys conducted regularly by the Start-ups Poland Foundation, 76% of start-ups operate based on the research-development model. Most of them develop technologies in the area of *Big Data*, Internet of things; as well as in the area of healthcare and biotechnology. Start-ups attract foreign investors and for this reason are more internationalized. A half of them sell their products and services abroad. More and more often they cooperate with science (42% in 2015; 66% in 2016)<sup>13</sup>. The characteristic feature of these ventures — and a characteristic feature of economy 4.0 as a whole, which makes startups a good illustrating example — is the fact that their functioning doesn't require a broad and extremely expensive infrastructure, such as the infrastructure of a traditional factory, that's why we can say that their central component are the minds of people — their ideas, knowledge, experience.

Saying that it is a characteristic feature of the whole fourth industrial revolution we naturally don't mean that traditional industry and traditional industrial companies will cease to exist. The point is that the focus has moved — the value of generated product is now to a greater degree the result of the initial stage. This is the stage of concept and project which is created not just on the basis of identification of the needs of recipients, but also with their participation. This is the stage at which what we call *cognitive competences* play the decisive role.

The first important component of cognitive competences are cognitive skills in their narrow meaning, that is, the ability to perceive the reality with senses, using a language, thus also categorizing sensual perception; the ability to think, in particular to think creatively; finally, remembering.<sup>14</sup> Moreover, among cognitive competences there are such skills as imaginations, or feeling emotions, which belong to the traditionally

understood cognitive competences. The joint product of these two groups will be, for example, the ability to think using metaphors and heuristics, which is exceptionally important especially in the process of creative problem-solving<sup>15</sup>.

Thus, to put it in a slogan, fourth industrial revolution is above all people. The fourth industrial revolution requires creators and thus, also — to enable and facilitate this creative process and transform it into a product — new leaders and managers. However, we cannot forget that the slogan "Economy 4.0 is people" refers also to clients. Thus, we are dealing with the emergence of new needs among the recipients of new technologies, as well as changes of consumer awareness, their hierarchy of values, way of life, etc. Thus, eventually talking about people on two sides — the creators of technology and their recipients (we need to point out that these groups obviously interact) — we cannot forget about people who act as agents between the two groups; especially those who define the communication routes between them, that is, marketing specialists. We will like to focus our attention on the latter group in further part of the paper. In particular — on their cognitive competences in the meaning adopted above.

### Marketing under conditions of industry 4.0.

Marketing doesn't stand still — Philip Kotler<sup>16</sup> says. In the development of marketing the following three stages are usually distinguished:

- Marketing 1.0.
- Marketing 2.0.
- Marketing 3.0.

While in case of the industry we can talk about successive revolutions, which introduce changes to a large extent overturning the previous state, in case of marketing we are dealing more with development, which doesn't reject the preceding states, but develops and enriches them with new features resulting from the current economic and social situation.

The concept of marketing 1.0 applies a business strategy focused mainly on the product. In this concept the client is anonymous and carries out a purchase-sale transaction and this is where the relations between the seller and the buyer end, while the seller cares only about maximizing sales and profits. The strategy was used till about 1970, however, some companies still use it.

The main concept of marketing 2.0 was and is focused on the client as an extension of product orientation. A need of this kind emerged along with the saturation of the market and growth of consumers' expectations. Here the most important problem for companies is building such relations with clients that allow to keep them as long as possible. The first purchase is treated as the start of these relations. Marketing 2.0. can still be applied, even though it is assumed that it generally became outdated around the year 2000. The basis for the development of marketing 2.0, called the marketing of relations, was the development of communication technologies (both long-distance communication — telephone, fax, sometimes Internet — as well as means of transport e.g. mass air transport), which facilitated communication between clients and companies and between clients themselves. At the moment when personal computers became a mass product and when Internet appeared, interactions between participants of the market became common. Also, broad access to information became common.

An important goal of marketing 2.0. is looking for gaps on the market. Thus, marketing 2.0. expands to diversified areas, including those which up till recently were regarded as non-business areas — education, healthcare and social capital.

In the environment in which marketing 2.0 operated and which it co-created, clients have become more demanding buyers; they have become much more dynamic in the choice of products and services and also they are much better informed. So, the need for another enrichment of marketing activity emerged. In essence, the development of marketing 2.0. created the environment for next generation marketing — 3.0. An element stimulating marketing 3.0. is technology, to an even greater extent than in case of marketing 2.0.

The essence of marketing 3.0. is taking into consideration in marketing strategy human's emotions and to a greater extent than before taking into

consideration his whole hierarchy of needs and — what constitutes a key novelty — hierarchy of values<sup>17</sup>. In this context Kotler even talks of *spiritual marketing*. What is becoming more important than ever is the morale of a company and its position on the market is based not just on the quantity of the offered products and their quality, but also on the honesty of those who made them. Company reputation now plays an even greater role than before, as it has a huge impact on the company's market position and covers areas which are not directly associated with the quality of products themselves, but concern all circumstances that led to the creation of the products, e.g. whether the company pollutes the environment; whether it takes advantage of slave-like labour in developing countries thanks to lower costs of employment; whether it discriminates against its employees, depending on their views, race, or sexual orientation, etc. Thus, what also fits in marketing 3.0. is the concept of corporate social responsibility. This way marketing enters to a greater extent than ever the area of human emotions, customs and morality and thus the axiological area.

We are convinced that the coming changes in social-economic development, mainly the emerging fourth industrial revolution, create premises for another enrichment of the concept of marketing from the point of view of its conceptual, instrumental and decision-making dimension<sup>18</sup>.

With regard to the conceptual dimension we think that marketing under conditions of economy 4.0 is in essence a variety of innovation marketing, which is defined as follows:

"Innovation marketing can be defined as a social and management process thanks to which creating, offering and exchange of research, technical and management solutions for practical application and implementation may satisfy the needs of people and institutions through the rationalization of actions aimed at raising the competitiveness of companies and as a result raising the level of social life"<sup>19</sup>.

The goal of innovation marketing is building a communication bridge allowing joint actions in the area of raising innovativeness, which means that innovation marketing is in the stream of research on the transformation of knowledge and in particular, on the transformation of the results of scientific works for practical applications. The goal is

facilitating the innovative processes under conditions of the fourth industrial revolution. In particular:

- raising the accuracy of innovative concepts, so that they comply with the actual needs of the economy;
- reducing the distance from the formation of an innovative idea to its implementation and commercialization, which as a result saves time and prevents wasting both: time and ideas themselves;
- implementing the results of scientific research in successive stages of the innovation process;
- faster commercialization of the effects of implementations, which should be preceded by marketing research on current, or conscious demand for these products/services, or making potential clients become aware of these needs.

We claim that gaps in the area of innovation marketing under conditions of economy 4.0 lead to numerous barriers hampering its development. Up till now the most important reasons on the side of science have been<sup>20</sup>:

- inaccurate formulation of research problems from the point of view of economic needs, which means scientific units haven't identified the potential for the absorption of scientific research results;
- insufficient readiness to help in the implementation of the results of research works.

On the side of economic sphere units:

- lack of knowledge about the existence of scientific results, which could be implemented in production;
- insufficient ability to implement the results of scientific works;
- uncertainty with regard to the demand for goods, or services created as a result of scientific works (in other words, lack of awareness of *potential* needs of clients; focusing on the declared, that is, easily measurable *current* needs).

Instrumental dimension of innovation marketing under conditions of economy 4.0 covers a mixture of all marketing tools used up till now. However, in particular, we need to emphasize the changes concerning two tools. First — marketing communication. What would be typical of marketing communication under conditions of economy 4.0 is fully bilateral character of communication, which means that it is not just the producer who informs the client about a product, but the client in response informs the producer about his needs, satisfaction etc. Fully bilateral communication results from the will, or even necessity to take into consideration ever more personalized needs of consumers and adapting the methods of production to market trends among the clients. Under conditions of the fourth industrial revolution this means that conscious consumers are a kind of advocate of the producers of consumer goods. This advocacy is supposed to constitute a distinctive feature of another step in the historical development of marketing, which has recently been proposed by Kotler<sup>21</sup>.

The second tool is product. Under conditions of the fourth industrial revolution in the life cycle of a product, in which we can distinguish the pre-production, production and post-production stage, the first and last stage gain particular importance. It is because these two cycles create the biggest added value in the new economy. It is them that justify the conceptual dimension of marketing and the emergence of innovation marketing.

The decision-making dimension of innovation marketing under conditions of economy 4.0 can be contained in the most general assumption, according to which marketing contributes not just to management, but to the creation of intellectual capital and the fact that marketing specialists cooperate closely with innovators. What seems advisable is creating a kind of discussion platforms gathering the representatives of marketing in companies from a particular branch and the marketing specialists of research institutions, potential units delivering to companies new innovative solutions, which could be a potential source of growth of companies in economy 4.0. The main purpose of establishing such a platform would be defining the strategy of development of innovative activity. Conclusions from this work would constitute guidelines for the operation of individual companies and marketing specialists.

The general purpose of the establishment of this discussion platform would be building channels of communication between the sphere of business and the sphere of science and preparing strategies leading to the formation of new companies and adapting existing companies to the needs of economy 4.0. If companies worked on solutions together, they could save time and resources that each of them would have to spend on independent works (which would naturally be similar in each of the forms). The means leading to this goal would be different, complying with the characteristics of a given branch and its level of technological development.

Among the basic goals of the above-mentioned discussion platform we can name:<sup>22</sup>

- segmentation of the innovation market, that is, an attempt to identify real and potential clients who could purchase and implement the results of research works,
- preparing research plans with regard to particular clients,
- care about the formation of a competent team of employees and training them regularly,
- the creation of organizational structures in companies and in research centres working in a network,
- promoting the results of concluded research work and works in progress.

### **Cognitive competences of a marketing specialist under conditions of economy 4.0: general outline**

It can be seen clearly that the nature of tasks ahead of an innovation marketing specialist requires from him, or her very specific competences. He is neither a researcher, nor a producer, that is, he doesn't work in any of the scientific areas e.g. biochemistry and he doesn't operate in any specific branch e.g. the pharmaceutical branch, but has to act as an agent between them and thus has to, in a way, become the person researching and producing the tools that will allow him to play this intermediary role.

The competences we are talking about are the already mentioned cognitive competences and we could also say — cognition-related competences (emotional, volitional etc.). Thus, it is time to explain what cognitive sciences can contribute to the discussion about economy 4.0 and innovation marketing and why the thread of marketing specialist deserves special treatment. It is because, somebody could argue that distinguishing the issue of marketing is *impromptu*, while associating the issue of cognitive sciences with marketing issues is random. This is not the case here. To understand this we need to imagine the following, exemplary situation, which out of necessity has been simplified: two research teams are working at a university of technology: one is developing a new aircraft seat design, while the other one is working on a new plastic material. At the same time, at the nearby academy of arts there is a group of prolific designers. Each of the groups has an innovation marketing specialist in the meaning adopted above. Moreover, on the one hand we have a company producing small passenger airplanes and on the other hand a company producing dentist seats, so it seems they don't have much in common. Both of them also have innovation marketing specialists.

It doesn't require much effort to notice that all mentioned entities can benefit a lot from cooperation, however, they need communication channels for this. To make it possible, each of the sides has to use a similar conceptual model, share knowledge, for example, about the binding law, as well as support offered by the state, local government, or international institutions. Finally they need to reach an agreement with regard to the mode of operation, procedures, ways of making decisions, etc. So the point is to share a common content-related and procedural plane. It is not hard to guess what differences in the mentioned areas can take place between the mentioned exemplary entities. Thus, the position of innovation marketing specialist requires from him, or her to, on the one hand understand the specific character of the work of a research team, or company who employs him, or her — he has to have certain general knowledge, or in essence the ability to understand material from the area of material sciences, or machine building — and on the other hand have the analogous ability to understand the specific character of every branch in which a product offered by him, or her may be applied.

Thus, for example, a marketing specialist employed by a research team developing new plastic material has to know he has something to offer to specialists designing aircraft seats; that their cooperation may create an interesting offer for the aircraft producer and the producer of dentist seats, but only as long they will be able to enhance their offer with interesting design, which in turn requires getting in touch with designers from the academy of fine arts. Innovation marketing specialists find themselves in an analogous situation in each of the remaining entities.

Naturally, the presented illustration is quite intuitive; someone could actually say that you don't need an expert to notice that the seat designers have common interests with the creators of plastic materials, but in the era of so far advanced specialization of scientific research on the one hand and at the same time an epoch offering such a huge variety of goods, these networks of relations are not always that obvious. Moreover, it is those entities that identify non-obvious, but in the longer term fruitful links that may find themselves in an advantaged position.

So this leads to the question what cognitive competences an innovation marketing specialist should have to successfully play his intermediary role. In a nutshell, we could say: he, or she has to have an above-average *ability to cope with complexity*: first of all, with the diversity of scientific fields and conducted primary research and operational trials, including also the correlation of primary research and research focused on application; on the other hand, complexity related to the diversity of the markets on which a company employing him, or her may operate, next, he or she has to have the ability to assume a synthetic view and arrange the diversity of more broadly understood human efforts covering not just science in the strict sense, but also humanities, or arts. It is because the potential that can be used in innovative activity can be found everywhere. Finally, the specialist has to understand the complexity of clients' needs in association with their hierarchies of values lifestyles, social-economic status, etc. The specialist gets all of this as a huge wave of data, so the most abstract definition of the cognitive skill we are talking about, could also be this: the ability to order, synthesize and analyse data to draw valuable information from the data.

## Economy 4.0, the problem of complexity and cognitive competences: generalization

Here we allow ourselves to take into consideration a more general thought concerning the already outlined problem of complexity. Talking about complexity, we have in mind the emergence of certain internally diversified and at the same time coherent wholes, both in the world of nature and in areas of typically human activity. Complexity manifests itself in practically all areas available to human cognition — where we research the basic structure of matter; where we investigate the structure of a cell and a multicellular organism; where we investigate interactions between organisms and their ecological niches; finally, where we investigate human creations such as language, institution, culture; finally — economy. Thus, it comes as no surprise that in the second half of the 20th century an interdisciplinary network of complexity sciences<sup>23</sup>, was formed. It intended, among others, to formulate the formal rules governing these structures<sup>24</sup>.

The issue of complexity combines the issue of fourth industrial revolution and the issue of cognitive competences. To show this issue, we shall refer to the proposal by Dirk Helbing<sup>25</sup> from ETH Zurich. From his perspective, economy 4.0 is a response to the diversity of problems we are dealing with in the contemporary world. All of them, by their nature, concern extremely complex phenomena. Thus, on the one hand we have e.g.: global warming and on the other hand speculative bubbles on the banking market.<sup>26</sup> The common feature of all this phenomena is that due to their complexity, we are not able to monitor them and thus learn the whole scope of cause-effect chains occurring within them. What happens here are the so-called cascade effects, when one event can lead to a whole series of unpredicted events and each of these events can lead to another series of events. Due to this, there is no chance for any kind of "central management" of these phenomena and what remains the only option is creating solutions from the area of artificial intelligence, which would secure the mechanisms of local, dynamic self-control of a particular complexity reacting to the current situation, as solving all problems requires the coordination of such a number of factors that it goes beyond the capacity of an individual person, or a group of people. Economy 4.0 in this most general view results from the

*inability to exercise central control* and at the same time the necessity to cope with the complexity of data, complexity of problems and the complexity of economic relations between people, organizations, states and even cultures; as well as between the whole human sphere and the natural conditions.

At the same time natural cognitive processes emerged as a way to cope with the complexity of the environment<sup>27</sup> and the late product of their evolution is the contemporary human. Now, in turn, in response to the complexity of the environment created by humans, artificial intelligence is being created. This is the source of the concept that human intelligence and artificial intelligence (meanwhile, the distinction is becoming more and more vague) share the same essence: coping with the complexity of the environment.

However, the human — for now — remains a part of this image as a creator and user of artificial intelligence. After all, economy 4.0 is not an economy of the machines, but an economy of humans, even though it is to a large extent determined by communication between machines. This way humans are facing new challenges of a cognitive nature. We should observe here that humans, coping with the complexity left over by economy 3.0 and for this purpose forming the next generation of artificial intelligence, that is, machines able to coordinate tasks and to exercise self-control, produces another complexity — complexity on a further level, which consists of people and these machines and further need to cope with this complexity. Humans face the necessity of finding such ways of life, consumption, thinking and producing which can fit in the reality of the fourth industrial revolution. This is nothing new — answers to some challenges create new challenges. We should notice here a certain important subtlety: at this new level of complexity we may invent new machines, so that coordination of people and machines will be facilitated by new machines, it makes no sense to claim that machines are facing the problem of coping with the complexity of their co-existence with humans. For now, even though intelligence, that is, the ability to solve problems can be attributed both to humans and machines, *having problems, or encountering problems* can be reasonably attributed only to humans.

The challenges that a human has to face on this new level of complexity have many aspects, starting from existential and moral issues, that is, among others, choosing what defines human dignity (this can't be the conviction about the exceptional nature of human mind, or soul any more),

ending with practical and organizational issues (organizing areas "governed" by machines and at the same time, we could say, the ability to retain control over this process).

Our subject concerns these practical-organizational issues. It concerns a new level of complexity; the level at which human remains the main actor: how the cooperation of creators and users of new, innovative technologies should be organized, so that the human could retain the ability to notice problems, as long as it is possible, to predict them and further the ability to find the right resources — including further generations of artificial intelligence — for solving them.

With regard to this new complexity, it is clear that there is no professional group, or a sector of economic life, or a discipline of knowledge particularly suitable for finding solutions. It is clear that we need tools — supported by machines, but still managed by humans — integrating the efforts of all these groups.

With regard to the cooperation of companies and entities from the sphere of science, innovation marketing specialists are supposed to be these integrators, or intermediaries.

## The issue of education

How should we educate a person who satisfies all the requirements described above, that is, has an above-average ability to cope with the complexity of data and generating information on the basis of the data? In the first place we should distinguish certain general intellectual and character-related traits, which should be possessed by a candidate for the role described here. The following list won't be surprising in any way:

- intellectual characteristics: ability of abstract thinking that is, analysis and synthesis of information coming often from very diversified sources,
- social characteristics: ability to cooperate and work in a group,
- approach: selfless curiosity focused on acquiring information from various areas and confronting already held information with new information.

It seems that in the process of educating an innovation marketing specialist we can take two paths:

- recruiting candidates for innovation marketing specialists from the group of people with specialist education in some area of science and experience in a position matching the education profile. Thus, we are talking about people who work in research and development, or the sector of companies and decide to use their current experience in a new role — as an intermediary between the spheres. This requires preparing special training courses, perhaps on the level of postgraduate studies, or simply in-house trainings in companies, or research institutions. Their purpose would be to provide the candidates with the conceptual apparatus and knowledge from the area of theory and practice of marketing;
- preparing special profiles for the students of BA and MA programmes, aimed directly at preparing them for the role of an agent between the sector of science and the sector of companies.

The latter of the two scenarios carried out by universities and faculties of management is definitely less challenging with regard to the structure of education programme. In the context of the above-mentioned three intellectual-character-related traits, we can say that the preliminary condition for starting studies is an appropriate approach. Perhaps it will sound banally, but it seems obvious that studies won't teach anyone selfless curiosity, the will to acquire new knowledge, if the person hasn't learned that already back at home, in primary school, or high school. Contrary to what it seems, this threshold is crucial — if an innovation marketing specialist is supposed to be a profession that will to a large extent determine the success of the economy 4.0 project, especially in Poland, where relations between the sphere of science and the sphere of business are weak, studies we are talking about here have to be hard, challenging, starting with entry exams (entry exams will probably be reintroduced to universities), ending with the diploma exam. It is also necessary to raise the social status of marketing as a branch of knowledge and practice.

Thus, attitude is the preliminary and necessary condition. Further, shaping appropriate social competences cannot be based on enriching the

programme of education with further subjects, but on the reorganization of the method of education. It is necessary to focus on training cooperation skills. It seems unjustified to launch another course, seminar, or lecture devoted to the issue of cooperation (even though there is a lot of empirical data concerning this subject), as here the goal is not knowledge *about* cooperation (knowledge *that* science has determined this and that), but cooperation *skills* (knowledge *how* to cooperate with each other). Subjects which have been included in teaching programmes by now should be taught so that students could improve their social competences. It is above all tasks and projects given to groups and not individual projects that should serve this purpose. Further, we should develop appropriate criteria for the evaluation of the work of a group as a whole and its individual members. An appropriate know-how in this area can be delivered by people with experience of work in corporations, where team work on projects is a daily practice and thus, appropriate methods are well developed.

Finally, teaching adequate intellectual competences, thus, the skills of abstract, analytical-synthetic thinking requires changes not just in teaching methods — as it seems — but also in the education programme. It is worth taking into consideration three subject areas:

- Specialist Area: subjects from the scope of theory, methodology and practice of marketing, management, economics, which constitute the centre of traditionally viewed marketing studies.
- Expanding Area: subjects introducing students to the research areas of sciences, perhaps divided into subsectors — students could choose some of them; e.g. subsector giving insight into the latest achievements of biochemistry and biotechnology, or a subsector devoted to the research efforts aimed at making electric engines more efficient, which at the same would comply with the so-called electromobility programme promoted by the Ministry of Ener<sup>28</sup>. The idea is to prepare this area of study in close cooperation with research centres, private and public entities financing research, so that it can remain in touch with current trends, needs and development strategies adopted at the local and national level.
- Formal-language Area: subjects delivering analytical tools and conceptual models, which will allow to notice relations between subjects

which belong to each of the areas mentioned above, as well as relations between these areas; e.g. someone will be able to notice and analyse the relation between the sources of energy he learned about in the expanding area and the issue of consumer awareness, which appeared in the specialist area. In the formal-language area we need to have such subjects as: statistics, philosophy with elements of ethics on the one hand and elements of mathematical logic on the other; finally, introduction into programming languages with elements of data analysis (*Big Data*).

The formation of intellectual capital for the conditions of the new economy and marketing activity is a very serious issue and at the same time a condition for the development of social capital able to confront the growing complexity of phenomena in life and social-economic development.

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- <sup>3</sup> This goal is formulated directly at the portal devoted to economy 4.0, sponsored by the government of Germany: <https://industrie4.0.gtai.de/INDUSTRIE40/Navigation/EN/Topics/industrie-4-0.html>. However, here we won't discuss the political — or more generally — the geopolitical aspects of the project.
- <sup>4</sup> <https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/> [viewed on 31.10.2017].
- <sup>5</sup> See: <http://www.dutchnews.nl/features/2017/06/the-new-dutch-cabinet-must-get-its-economy-4-0-act-together/> [viewed on 30.10.2017].
- <sup>6</sup> See: M. Herman, T. Pentek, B. Otto, Design Principles for Industrie 4.0 Scenarios, In: T.X. Bui, R.H. Sprague Jr., *Proceedings of the 49th Annual Hawaii International Conference on System Sciences HICSS2016*. The Institute of Electrical and Electronics Engineers, Inc., Los Alamitos–Washington–Tokyo 2016.
- <sup>7</sup> *Strategia na Rzecz Odpowiedzialnego Rozwoju*, op. cit. p. 9.
- <sup>8</sup> See e.g.: D. Helbig, B.S. Frey, G. Gigerenzer, E. Hafen, M. Hagner, Y. Hofstetter, J. van den Hoven, R.V. Zicari, A. Zwitter, Will Democracy Survive Big Data and Artificial Intelligence? „Scientific American” 25 Luty 2017, online access: <https://www.scientificamerican.com/article/will-democracy-survive-big-data-and-artificial-intelligence> [viewed on 29.10.2017]; R. Botsman, Big data meets Big Brother as China moves to rate its citizens, „Wired” 21 października 2017, online access: <http://www.wired.co.uk/article/chinese-government-social-credit-score-privacy-invasion> [viewed on 31.10.2017].
- <sup>9</sup> See e.g.: P. Godfrey-Smith, Individuality, Subjectivity, and Minimal Cognition, *Biology & Philosophy* 31 (6) 2016.
- <sup>10</sup> Thus, in essence from the philosophical perspective, as it is philosophy of this kind that investigates and generates the most general conceptual models.

- <sup>11</sup> See e.g.: S. Kauffman, *At Home in the Universe: The Search for Laws of Self-Organization and Complexity*, Oxford University Press, Oxford–New York 1995.
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- <sup>13</sup> M. Beauchamp, A. Kowalczyk, A. Skala, *Polskie Startupy. Raport 2017*, Fundacja Startup Poland, Warszawa 2017.
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- <sup>15</sup> Patrz: P. Kotler, *Marketing nie stoi w miejscu. Nowe spojrzenie na zyski, wzrost i odnowę*, Wyd. PLACET, Warszawa, 2002.
- <sup>16</sup> See: Kotler Ph. *Marketing — Analiza, planowanie, wdrażanie i kontrola*, Gebethner & Sp., Warszawa 1999; P. Kotler, H. Kartajaya, I. Setiawan, *Marketing 3.0.*, Wydawnictwo MT Biznes, Warszawa, 2016.
- <sup>17</sup> Kotler and his colleagues recently proposed the concept of marketing 4.0; see: P. Kotler, H. Kartajaya, I. Setiawan, *Marketing 4.0.*, Wydawnictwo MT Biznes, Warszawa, 2017. However, our proposal goes in a slightly different direction. It is not just about adding new dimensions to the concept of marketing, but finding a new role for marketing. According to the concept of innovation marketing, this will be a kind of mediation between the sector of science and the sphere of business.
- <sup>18</sup> Białoń L., *Zarządzanie marketingiem*, Wyd. WSM w Warszawie, Warszawa, 2011, p. 45.
- <sup>19</sup> L. Białoń, *Zarządzanie działalnością innowacyjną*, Wyd. PLACET, Warszawa, 2010; Sprawa nie dotyczy tylko Polski; patrz: J.J. Mohr, Sengupta S., Slater S., *Marketing of High-Technology Products and Innovations*, Pearson, Upper Saddle River NJ.
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- <sup>21</sup> See: L. Białoń, A. Kamińska (ed.), *Uwarunkowania przekształceń małych i średnich przedsiębiorstw w firmy innowacyjne*, Wydawnictwo WSM w Warszawie, 2014.
- <sup>22</sup> See: S. Kauffman, op. cit.; I. Prigogine, *The End of Certainty*, The Free Press, New York 1997; M. Newman, *Networks. An Introduction*, Oxford University Press, Oxford 2010; Y. Bar-Yam, *General Features of Complex Systems*, In: *Encyclopedia of Life Support Systems (EOLSS)*, on-line <http://www.eolss.net/sample-chapters/c15/E1-29-01-00.pdf> [viewed on 31.10.2017].
- <sup>23</sup> All of this originates from certain projects in the area of ontology that is, the most general philosophical-formal theory of a subject, especially in the theoretical efforts of such people as Plato, Gottfried Wilhelm Leibniz, Ludwig Wittgenstein, or Roman Ingarden; See: J. Perzanowski, *Miejsce Wittgensteina w PL-metafizyce*, In: J. Bremer, J. Rothhaupt (ed.) *Ludwig Wittgenstein, przydzielony do Krakowa/Krakau zugeteilt*, Wyd. WAM and Ignatianum, Kraków 2009.
- <sup>24</sup> D. Helbig, *Economy 4.0. Prezentacja w ramach projektu FuturICT*, dostępna on-line: [https://www.ethz.ch/content/dam/ethz/main/news/treffpunkt/Pr%C3%A4sentationsfolien/2014\\_Fr%C3%BChjahr/Helbing\\_futurICT\\_Economy4.0.pdf](https://www.ethz.ch/content/dam/ethz/main/news/treffpunkt/Pr%C3%A4sentationsfolien/2014_Fr%C3%BChjahr/Helbing_futurICT_Economy4.0.pdf)
- <sup>25</sup> Thus, Helbing makes a significant generalization of the starting concept, including it in the framework of a broader, international research project titled "FuturICT" (ICT - Information and Communication Technology) co-financed by the European Union, which is aimed at investigating complexity on the social level, among others, the issue of migration, health, criminality, sources and utilization of energy. See: <https://futurict.inn.ac>
- <sup>26</sup> At least, this is what one of the hypotheses concerning the subject says; See: P. Godfrey-Smith, *Complexity and the function of mind in nature*, Cambridge University Press, Cambridge 1996.
- <sup>27</sup> See: Plan rozwoju elektromobilności w Polsce „Energia do przyszłości”, Ministerstwo Energii, Warszawa 2017; online access: <http://www.me.gov.pl/Innowacyjnosc/Elektromobilnosc> [viewed on 2.11.2017].

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**Professor Lidia Białoń, Warsaw Management University, Poland** — the head of the Department of Marketing and Entrepreneurship at Warsaw Management University. Her scientific interests are focused on the subjects of innovative activity management and marketing, especially innovation marketing. She has worked in many positions associated with university management — from head of department, through dean to vice-rector. Among her numerous publications devoted to the subject of marketing and company management, the one titled "Zarządzanie działalnością innowacyjną" (Managing innovative activity), Wyd. PLACET, 2010, is definitely noteworthy.

**Konrad Werner, Ph.D., Faculty of Philosophy and Sociology, University of Warsaw** — works at the University of Warsaw, Poland (Institute of Philosophy), where he is running a research project in experimental philosophy. He obtained his PhD in 2013 from the Jagiellonian University in Krakow. He is interested first of all in so-called "aspectual shape" or perspective-dependency of perception and knowledge. His articles concern epistemological, ontological as well as logical aspects of this issue. Still in connection with it, he has recently directed his attention toward evolutionary origins of cognition and sociality.



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