Inventive Level as a Basis for the Assessment of Scientific Contribution of Inventors

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The history of invention reveals that the most important inventions were derived from experiments by which their authors contributed to the discovery of previously unknown natural phenomena. So the question arises as to whether those inventors were also scientists? Inventology explains the principles that lead to innovative products with a high degree of invenftiveness. At this level, there is some interweaving between the invention and the discovery. Since discoveries belong under the category of science, it can be concluded that, for example, Nikola Tesla, although he did not write scientific papers, he did earn his scientific contributions in the field of electrical engineering and mechanical engineering, contained in his main inventions, and he did deserve to be ranked as one of the most eminent world scientists.

Keywords: *inventory, Nikola Tesla, innovation, science, inventiveness.*

1. INTRODUCTION

Today's high-end invention in the developed world rests on the teamwork of educated specialists who, with the financial support of their investors, try to come up with new technical solutions in a programmed way. In this sense, the key resources of modern invention are science, technology, education, organization and capital. To unify these resources and explain the principles that lead to innovative products with a high degree of inventiveness, it was necessary to develop and define a specific science - inventology. Inventology is a science about invention [1]. The word inventology is made up of a combination of the term *inventive* that originates from the Latin word *inventire* (meaning *to find*) and the Greek word *logos* (meaning *word, mind, reason, power of thought*). According to inventology, innovations are divided into two categories [1, 2]. The first group belongs to the so-called evolutionary innovations (continuous) that have been achieved by improving the existing technical systems and technologies. They contain the first and second levels of inventiveness, and they are made with no help from science. These innovations represent technical improvements and they are usually protected by a small patent. Another type of innovation are the so-called revolutionary innovations (discontinuous) that are often absolutely new and contain the third, fourth or fifth level of inventiveness. This means that such innovations in themselves have a scientific and potentially high market value. These innovations are protected in the legal sense by the patent and are dealt with by inventology. The main inventions by Tesla were at this very level [3].

According to the current criteria of scientific competence, which are based on the number of published works, an impact to the factor of the journal in which they were published, the number of quotations, etc., Tesla could not be called a scientist. It is well-known that Tesla, like some other inventors, who, by their creative work contributed to the humankind, did not write scientific papers about his discoveries contained in the inventions [4-6]. How is it then possible to claim at all that Tesla, without any scientific papers, was indeed a scientist? On the other hand, if it is accepted that Tesla was only an inventor, then how could he be considered by the Nobel Committee on several occasions as a candidate for the Nobel Prize for Scientific Contribution [6], and the Committee for the Standardization of Physical Units gave him an honor of calling the unit for magnetic inductance after his name-1T (Tesla) [7]?

In today's knowledge society it is illusory to expect to create a strategically important invention or inno–vation of a high degree of inventiveness based on individual inspiration, except in extremely rare cases that deviate from the rules, as was the case with Tesla. During the period in which he created, he succeeded as an individual to generate several revolutionary invent–tions [3-6], which were due primarily to his genius.

The aim of this paper is to explain the significance of Tesla's scientific contribution, which is contained in his innovative work, with the help of inventology. Based on this work, by analogy, it will be possible to evaluate the scientific contribution of many other inventors who, in their innovative work, also indebted humanity, but did not deal with the doctrine in the usual way.

2. THE DIFFERENCE BETWEEN THE INVENTION AND THE DISCOVERY

Patent is the right to protect the invention. In general, in a number of countries, an invention is defined as a solution to a technical problem. This problem may be old or new, but the solution must be new to meet the

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conditions of the invention. Finding something that already exists in nature, and what is most commonly called discovery, is not an invention. Discovery belongs to science. In the invention, human intervention is necessary. For example, if a substance is extracted from a plant that exists in nature, this could be an invention. The invention does not imply the existence of a thing that is complex in nature or necessarily belongs to the domain of high technology. The essence of distinguishing the invention from discovery lies in the fact that the invention is applied knowledge, i.e. knowledge that is used to satisfy a certain human need, while the discovery is pure (unreformed) knowledge. When it comes to inventions, it is important how something works or functions, and for the science, it is an important to explain the mechanism of why it comes to it. Therefore, the reason why patent law excludes discoveries from protection is not in the quality of the novelty that this knowledge contains or in the understanding that the intellectual work needed to come up with it is less than the one needed for the invention, but in the legal-political position regarding the scope of protection and its social consequences [8-10]. The relationship between the invention and the discovery can also be seen in the light of the fact that the invention is preceded by the general knowledge resulting from the discovery. Namely, in order for one knowledge to be invented, it must be in the general form already. This is, however, only a logical trace of things. In terms of timing, it may happen that the discovery and invention coincide, i.e. that the discovery is achieved through the practical application of previously unknown natural laws that exist between certain phenomena. Having in mind the possibility that a person at the same time will come to the discovery and invention based on this discovery, the significance for the patent-legal interests of that person may be the order in which they will publish their results.

Inventive activity of today has lost the features of individual work and has been transformed into an organized social activity. The findings of inventive work have become a significant factor of global economic development on the macro plan, while their role is crucial in the relationship of the competitors in the market on a micro-plan [8].

2.1 Patentability of the invention

The invention must fulfill several conditions in order to be protected by a patent [11]. The first is that it must be new, i.e. it must include some new features that are not known in the corpus of existing knowledge in the field of technology. This corpus of existing knowledge is called "state of the art." The second requirement is that the invention must include an inventive level, to which a person with an average knowledge in the field of technics could not come to the same conclusion. The third is that the subject of the invention must be suitable for industrial applications. The invention is new (in the terminology of patent law, "novelty exists"), only if it is not described in the "state of the art." What is meant by the term "state of the art" varies from state to state [11-13]. In many countries, the invention described in a printed publication or used anywhere in the world makes the state of the art and thus can eliminate novelty of someone's invention.

It is considered that the invention includes an "inventive level" if, having in mind a certain state of the art, it is not apparent to a person who is an "average expert", that is, a person assessing the value of the patent application. In other words, it should not be possible for an "average expert" to find the invention through their routine work only. The "average expert" is a multi-purpose standard in patent law [11, 12].

With it, it is determined whether the invention is covered by the state of the art, i.e. if it is described precisely and in detail in the application of a patent or a small patent, and whether the invention has an inventive level. There is a subjective test that is difficult to explain and apply. There are a significant number of cases where the examiner and the applicant, or patent agent, do not agree on the inventiveness of a particular patent application, which is why the decision must be brought to court. In a large number of countries, this is not within the jurisdiction of the courts. However, it is not unusual in some countries that the decisions of the Intellectual Property Office or the Institute for Patents Examiners (the so-called "average experts") are changed by a court decision, or that the decision of the lower court is changed by a decision of the higher court. The inventive level of the invention aims to make a qualitative gap between those technical novelties that fall into the zone of continuous and thus expected technical progress, and those that are rapidly shifting the state of the art. Patent protection is reserved only for inventions that represent a qualitative leap in the development of the technics, or for inventions with a certain inventive level. Some examples of what cannot be considered inventive, established by the previous court decisions, are as follows: a simple difference in size, making portable, moving parts, changing materials or replacing them with an equivalent part or function [3]. These procedures are not considered inventive enough to merit a patent. However, they can qualify for protection as small patents, because the requirements of the inventive level as conditions of patentability are somewhat milder.

It was only Altshuller (Rus. Henrih Saulovich Altshuller, 1926-1988) who, by analyzing a large number of patents, found that not every innovation was made with the same inventive value. He proposed five levels of inventiveness [1, 2, 14]:

Level 1 represents a simple improvement of a technical system. For this level of creativity, the know–ledge that exists from the narrow technical field related to the technical system (TS) is enough. Of all the innovations studied, about 32% are of this level of inventiveness.

Level 2 is an invention that involves solving a technical contradiction. This level requires possession of knowledge from several technical disciplines within the industrial branch to which the technical system belongs. About 45% of the studied inventions are of this level of inventiveness.

Level 3 is an invention that requires the solution of a physical contradiction. Knowledge is needed from several industry branches. About 18% of inventions are of this level of inventiveness.

Level 4 includes newly developed technology, which represents a significant achievement and requires the application of knowledge from different scientific fields. Only 4% of the inventions are of this level of inventiveness.

Level 5 represents the discovery of new phenomena and matter. Only about 1% of all the inventions created is of this level of inventiveness.

In the first level inventions, the technical system (TS) does not change. At the second level TS changes, but not essentially. At the third level, TS changes essentially, and on the fourth it gets absolutely changed, i.e. a completely new product is created. On the fifth level, the entire TS changes, to which the object belongs, and such inventions are worth enough for their authors to deserve, for example, a nomination for the Nobel Prize. Accordingly, some technical problems can be solved through inventive solutions of different levels of inventiveness (Fig. 1). Altshuller concluded, based on his own research of a huge number of patents that the largest number (about 77%) belongs to the lowest, 1st and 2nd inventive levels. By using the Theory of Solving Inventive Tasks (TRIZ) as a methodology, inventors could improve their inventions by raising them to the 3rd and 4th level of inventiveness, which would increase the value of the invention, and thus its chance to live on the market [1, 2, 8, 14, 15]. From Fig. 1 one can see the existence of equivalences between the invention of the 5th level of inventiveness and discovery. This is the level of creativity at which Tesla made humankind indebted to him.

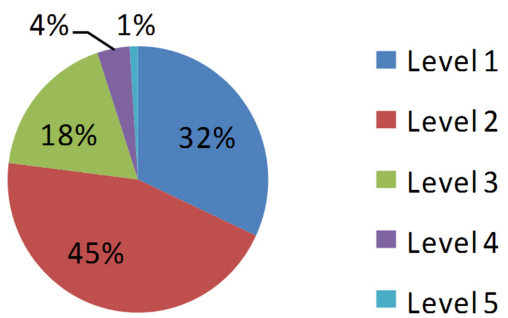

Figure 1. Levels of inventiveness in the inventions (%)

If the invention is the work of an individual and does not represent the result of a team work, then it is very likely that it will represent a technical improvement that can be protected by a small patent and belongs to the solution of the technical problem of the lower inventive level (1 or 2), and the reverse is true. However, the genius of Nikola Tesla deviates from this law, because, as an individual, he managed to achieve more than a number of interdisciplinary teams formed to solve the same technical problem jointly.

The invention must be suitable for making and using in some area of the industry. This means that the invention must obtain a practical form of a device or product that will contain in itself a new material, substance or industrial process or method of work. Under the term *industry* we consider in the broadest sense everything that is different from purely an intellectual or aesthetic activity. An idea itself cannot be patented, unless it is an invention that has industrial relevance. The word "industrial" also includes agriculture. It is indisputable that the main discoveries of Tesla found their industrial application, either at the time in which he lived or after his death.

2.2 Discovery in the inventions of Nikola Tesla

The author of the famous Tesla biography, John O'Neill, 1889-1953, in a book published in 1944, wrote that several Nobel prizes were shared by others for the discoveries that Tesla fathered [16]. Six decades later, physicist Paar (Vladimir Paar, 1942-) claims that at least ten of these awards went into other hands [17]. On Parova's list there is Tesla's discovery of electrons, X-rays, radios, cosmic rays, particle accelerators, induced radioactivity, radar, lasers, etc. Dr. Seifer (1948-), in his book [18], wondered why the magnificent thinker Nikola Tesla as the "father of electricity", "never rece–ived the Nobel Prize even though he was nomi–nated". After studying the detailed legacy stored at the Nikola Tesla Museum in Belgrade, Smithsonian Institute in Washington and Columbia University in New York, he wrote that neither Nikola Tesla nor Thomas Alva Edison ever received the Nobel Prize. And I am amazed that two unparalleled inventors did not become champions of the most distinguished scientific medal, the concerned American concludes: "... it can be said that it is unbelievable that neither of them has ever received it and that no one from that age had discovered what the reason behind this strange historical caprice". Mark Seifer discovered that only in 1937 Tesla was nominated by Professor Ehrhenghte (Felix Ehrenhaft, 1879 - 1952) from Vienna, who previously had propo–sed the candidacy of Albert Einstein, referring to the statute of the Nobel Foundation to reward the older works if they were still significant in present times. His proposal related to Tesla's discovery of high-frequency current and the magnetic field. The Nobel Committee rejected a recommendation stating that these inventions, although genius and the predecessor of electrical engi–neering, had been discovered four decades earlier. Today, it is not a rare case, as is known, that the achievements that have sustained the rehearsal of the time get awarded with a delay. Nikola Tesla and his other discoveries opened the way for the creation of great inventions that were authenticated by the most popular scientific recognition. Thus, in 1903, radar was created that was manufactured only in 1937, and in the same year he disclosed the idea for an electronic microscope whose appearance came 28 years later. The idea for the accelerator of bundles of charged particles was published in 1891, and the first linear model was made in 1932. The widely advertised cosmic rays from 1897, presented to the public in various ways, predicted the latter experimental discovery from 1912. And in the next two ventures he stepped so far ahead of his time that it was just amazing. In 1899, he indicated an induced radioactivity that was carried out 35 years later, and in 1893 he announced a laser-like device whose design was awaited until 1960. And it is clear and generally known that by saying that the images we perceive are the result of a reflex action of the brain on the retina - which is the most widely used definition of television - he was the one who revealed it, significantly before the others. He was convinced that such a techno–logical miracle, called television, was feasible. In 1893 he made a ruby device that, with electric current, stirred and emitted a streak of light as thin as a pencil. Regar–ding its design, the device was like the later developed ruby laser, hence it is quite understandable to assume that Nikola Tesla was, in fact, a laser beam inventor. Interestingly, Guglielmo Marconi (1874-1937) was awarded the Nobel Prize for the invention of radio in 1909. The Nobel Foundation never reconsidered its ori–ginal decision despite the fact that in 1943 the US Supreme Court annulled its patent rights for the invent–tion, giving Tesla [19] the advantage. Most of the above inventions were of the highest, 5th level of invent–tiveness, and they carried scientific discoveries in them.

3. INVENTOLOGY

The development of all technical systems is moving in the direction of increasing the degree of their ideality. When this ideal is known, then it is logical to start from an ideal final solution, not from an initial problem. Ideal is always related to the maximum utilization of material and energy resources that are located within the system, in its subsystems and the supper-system [1]. After all, the most natural solutions are given by nature itself [20]. In nature, there is no waste as such, because everything is used and becomes part of the endless processes. When an ideal system is achieved, its mass, dimensions and energy capacity will tend towards a zero, and the ability to execute the main useful function will not be diminished [1, 20]. This path to the ideal of a technical system is full of barriers that comprise technical and physical contradictions. Technical contradiction arises between certain subsystems of the technical system or its parameters. If one of the subsystems is improved by known methods, then the other subsystem or its parameters are inadmissibly worsened. In such a situation, a compromise solution or optimization is usually required. However, inventology is not satisfied with compromise, but is seeking the ideal final solution to the technical problem [1]. A clear formulation of a technical contradiction can already indicate the direction of finding a solution, or in the end, help in allocating subsystems or their properties that are in mutual conflict. The conflict sufield (**Su**bstance + **Field**) suggests a search for a solution that is directed to a continuous analysis [1]. Any technical system can be described by some of the 39 basic parameters (mass, speed, power ...). 40 principles and the contradictory matrix are used in order to solve technical contra–dictions [1]. The principles are actually instruments used to solve technical contradictions in technical systems. Physical contradiction is a physical, chemically or geometrically contradictory requirement that relates to one of the elements of a conflicting supposition. As a rule, the tendency to solve physical contradiction leads to the change of only one element of the conflicting supfield, which extensively concretizes the task and drastically reduces the number of variants of the possible solution of the problem. In order to make changes to the subsystem in the right direction, in which contradictory physical requirements are established, it is necessary to know the laws of development or evolution of TS. To solve physical contradictions in the TS, four groups of separation principles are used: separation in space, time, system structure and separation by phase transitions [1]. If the problem is exempt from redundant elements and if there is a sufficiently clear contradiction within it, then the ideal final solution can be formulated immediately, in direct relation to the element that is to be changed. If the problem is not clear, then one must first find and outline the contradiction it carries in itself then define the cause of the problem and formulate an ideal ultimate solution for it. Any technical contra–diction contains at least one or more physical contra–dictions, where appropriate resources are used to remove them. Available resources can be divided into six different groups: substance resources (material), field resources (energy), space resources, time resources, information resources and functional resour–ces [1]. Material resources or substance resources are all substances that exist in different aggregate states (solid, liquid, gaseous, plasma, vacuum), their combi–nations, and also all technical and natural objects. Field resources or energy resources are all forms of energy, physical fields, and also all forces and interactions between material objects. Spatial resource is the total free space in the operational zone, in other parts of the system and in the system as a whole. These include the cavities, the spacing between the components, the characteristics of the geometric shapes, the internal structure of the components, etc. Time resources are time intervals before, during or after the studied conflicting event, which can be used to prevent, neut–ralize or correct its negative consequences. Identifi–cation and use of information resources in the system, the subsystem and in the environment should be realized through the available information on the status and properties of substances, fields, space, about possible changes in the flow of information. To solve the technical problem it is necessary to identify and use all available functional resources in the system, the subsystem and the environment. It is clear from the above that resources are what enable the solving of the task. It is necessary to compile a list of resources already in the system or easily accessible from the system. When generating a solution to a technical problem (at the last step of each iteration), the resource search starts from that very list. The algorithm for solving inventive tasks (Rus. abr. ARIZ) serves for a comprehensive innovative problem solving and includes a series of steps that direct the innovators towards an ideal final solution [1, 21]. The use of ARIZ is recommended for fundamental analysis of TSs through its components, resource functions and technical con–tradictions, that is, in the phase of problem analysis, then for solving complex tasks using 40 innovative principles and the principle of separation within the search for solutions, and finally, in a comprehensive search for solutions in order to overcome competition through the patent protection system.

If the invention is the work of an individual and does not represent the result of team work, then it is highly probable that it would be a technical improvement protected by a small patent and would belong to the lower inventive level (first or second) solution of the technical problem, and vice versa (Fig. 2) [1]. The grandeur of Nikola Tesla's work is precisely because he deviates from the above described rule.

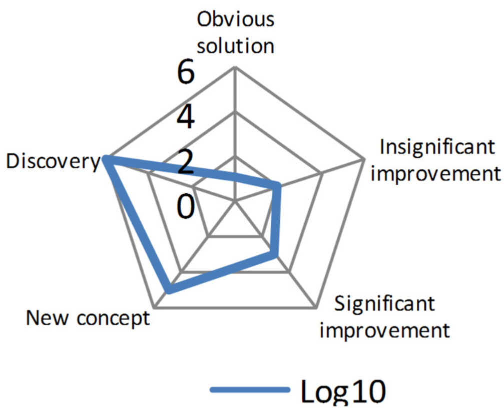

Figure 2. Levels of inventiveness in the inventions (%)

The possibilities of inventology are not limited to solving innovation tasks. In engineering practice it is often necessary to confront the scientific-research tasks, in which one should try to find and explain the causes of an observed phenomenon. Research tasks often arise from the exploitation of the experimental models of a device, when the constructor faces the unexpected behavioral patterns (both positive and negative). Such tasks also arise in conquering the production of proto–types, in detecting the cause of the scrap, etc. In order to avoid the necessity of placing many hypotheses and seeking explanation, it is recommended to apply the principle called "inversion of a research task". The principle applied is that instead of the basic question "how to explain", it necessarily turns to the question "how to reproduce this phenomenon". In this way the transformation of the research into the inventive task occurs, and as a result of its solution a series of hypotheses will be obtained. These hypotheses should be checked by setting appropriate experiments in order to confirm or reject them. In this way, the method of inversion enables the use of inventology in solving scientific and research tasks or problems. It was precisely by this methodology that Nikola Tesla was guided [3]. Unlike most other inventors of the period in which he lived, who worked according to the method of trial and error, Tesla had his own specific path from the idea to the patent. What distinguished him from others was his incredible visualization power that the virtual objects he imagined he could actually see as real [3]. He claimed that he had constructed his inventions in his spirit, and that he could monitor how they function, that he could reveal their defects, eliminate them and devise their various variants based on a common principle. He could also precisely determine the type of material and the dimensions of the components of their devices.

This method of work, which contributed to Tesla reaching his epochal work, largely conforms to the basic principles of present-day inventology.

However, in solving such tasks, there are a number of particularities. While when solving ordinary inven–tive tasks, the use of resources is always recommended, yet not mandatory, only existing resources need to be used to solve inverse inventive tasks [1]. This require–ment is conditioned by the fact that the technical sys–tem, in which the effect to be explained is already present, already exists. On the example of an electro–magnetic alternating current motor, as one of the most important Tesla inventions for which patents were obta–ined, it was found to be based on the discovery of the rotational magnetic field from 1882 as an existing reso–urce, which is only one of several epochal discoveries that he came upon dealing with is innovation.

4. CONCLUSION

To unify the key resources of modern invention and explain the principles that lead to innovative products with a high degree of inventiveness, from third to fifth level, it was necessary to develop and define a specific science - inventory. Inventology deals with inventions that come systematically, in a scientifically organized manner, and are based on the application of the Theory of Solving Inventive Tasks (rus.TRIZ). The inventions thus created have a very high potential market value. They are mainly the result of a team work involving specialists from different fields who, in a multidiscciplinary way, solve the same technical problem jointly. By studying Tesla's most important inventions, it can be concluded that he used a methodology of innovative creativity, very similar to inventology, only based on his own intuition and a huge accumulated knowledge in the field of electrical engineering and mechanical engineering, and that this was his way of creating inventions.

What is important to point out in this and similar cases are that these are inventions of levels 3 to 5 of the inventiveness and at these levels of inventiveness there is intertwining between science and inventiveness. It is precisely this area that inventology deals with.

Therefore, it can now be said that Tesla was at the same time an inventor and scientist. His case, however, is an exception to the rule, to have the invention of the highest inventive level achieved without the teamwork of experts from different fields. That's why everything that Tesla created as an individual can be considered a work of a genius.

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REFERENCES

[1] Rajić, D.: *Inventologija*, Autorsko izdanje, Beograd, 2017. (In English: Rajic, D.: *Inventology*, Author’s edition, Belgrade, 2017).

[2] Rajić, D., Kamberović, Ž. i Žakula, B.: *Kreativni inženjering*, IC TMF, Beograd, 2016. (In English: Rajić, D., Kamberović, Ž. and Žakula, B.: *Creative Engineering*, IC TMF, Belgrade, 2016).

[3] Rajić, D., Čabarkapa, O. i Šarboh, S.: Procena naučnog doprinosa Nikole Tesle na osnovu kriterijuma inventivnosti njegovih pronalazaka, Inovacijama do održivog razvoja 2017, Beograd, Fakultet za primenjeni menadžment, ekonomiju i finansije, ISBN: 978-86-84531-30-0, Zbornik radova, pp 528-537, 2017, (In English: Rajic, D., Cabarkapa, O. and Sarboh, S.: Evaluation of the scientific contribution of Nikola Tesla based on the criteria of inventiveness of his inventions, Innovations for sustainable development 2017, Belgrade, Faculty of Applied Management, Economics and Finance, ISBN: 978-86-84531-30-0, Work compilation, pp 528-537, 2017).

[4] Šarboh, S.: The patents of Nikola Tesla: towards the definite catalog, Belgrade: Nikola Tesla Museum; pp 119-127, 2007.

[5] Šarboh, S.: Novootkriveni patenti Nikole Tesle, 23rd Telecommunications forum TELFOR 2015, Serbia, Belgrade, pp 41-44, 2015. (In English: Sarboh, S.: Newly discovered patents of Nikola Tesla, 23rd Telecommunications Forum TELFOR 2015, Serbia, Belgrade, pp 41-44, 2015).

[6] Šarboh, S.: The patents of Nikola Tesla, World Patent Information No 32, pp 335-339, 2010.

[7] Tesla unit of energy measurement, written by: the editors of Encyclopedia Britannica, https://www.britannica .com/science/tesla, 24.01.2018.

[8] Rajić, D. i Čabarkapa, O.: Inventologija i tržište, XLIV SYM-OP-IS 2017, Zlatibor ISBN: 978-86-7488-135-4, Zbornik radova, pp 225-230, 25-28. 09. 2017, www.symopis.vggs.rs. (In English: Rajic, D. and Cabarkapa, O.: Inventology and Market, XLIV SYM-OP-IS 2017, Zlatibor ISBN: 978-86-7488-135-4, Work compilation, 225-30, 25-28. 09. 2017, www.symopis.vggs.rs).

[9] Rajić, D. i Čabarkapa, O.: Inventologija, Inovacijama do održivog razvoja, Beograd, Fakultet za primenjeni menadžment, ekonomiju i finansije, ISBN: 978-86-84531-30-0, Zbornik radova, pp 519-527, 7.12.2017. (In English: Rajic, D. and Cabarkapa, O.: Inventology, Innovations for Sustainable Development, Belgrade, Faculty of Applied Management, Economics and Finance, ISBN: 978-86-84531-30-0, Work compilation, pp 519-527, 7.12.2017.

[10] Matthews, D. et al.: Priručnik za nastavu o patentima, Zavod za intelektualnu svojinu, Edukativno informativni centar, Beograd, 2012. (In English: Matthews, D., Omland, N., Pollard, T., Bendl, E., Brandt, I., Feinaugle, R., Imbernon, L., Rodriguez, L., Untermann, N. and Weinberg, E.: Manual for Teaching about Patents, Intellectual Property Institute, Educational Information Centre, Belgrade, 2012).

[11] Marković, S.: *Patentno pravo*, Nomos, Beograd, 1997. (In English: Markovic, S.: *Patent Law*, Nomos, Belgrade, 1997).

[12] Besarović, V.: *Intelektualna svojina, industrijska svojina i autorsko pravo*, Čigoja štampa, Beograd, 2000. (In English: Besarovic, V.: *Intelectual Property, Industrial Property and Copyright,* Čigoja print, Belgrade, 2000).

[13] Zakon o patentima („Službeni glasnik RS", br. 99/11 od 27. decembra 2011. godine) (In English: Patent Law („Službeni glasnik RS", no. 99/11, 27th Dec 2011).

[14] Rajić, D., Žakula, B. i Jovanović, V.: *Uvod u TRIZ ili kako postati kreativan u tehnici,* SIG, Beograd, http://www.sigonline.rs/files/File/knjige/uvodutriz.pdf, 9. 5. 2017. (In English: Rajic, D., Zakula, B. and Jovanovic, V.: *Introduction to TRIZ or how to become creative in technics*, SIG, Belgrade, http://www.sigonline.rs/files/File/knjige/uvodutriz.pdf, 9/5/2017).

[15] Livotov, P. and Petrov, V.: *TRIZ innovation and inventive problem solving*, Innovation Knowledge Company, Berlin, 2013.

[16] O'Nil, Dž.: *Nenadmašni genije – život Nikole Tesle*, Jugoslovenski zavod društva za širenje naučnih saznanja Nikola Tesla, Beograd, 1993. (in English: O' Neill, J.: *Unparalleled Genius - The Life of Nikola Tesla*, The Yugoslav Society Institute for Dissemination of Scientific Knowledge Nikola Tesla, Belgrade, 1993).

[17] http://dnevnik.hr/vijesti/hrvatska/vladimir-paar-cetvrtaznanstveno-tehnoloska-revolucija-bit-ce-po-uzoru-na-teslu, 10.05.2017.

[18] Sajfer, M.: *Čarobnjak - život i vreme Nikole Tesle, biografija jednog genija*, Stylos art, Novi Sad, 2012. (In English: Seifer, M.: *A Wizard – Life and Time of Nikola Tesla, a Biography of a Genius*, Stylos art, Novi Sad, 2012).

[19] Marconi Wireless Tel. Co. v. United States 320 U.S. 1, 1943, https://supreme.justia.com/cases/federal/us/320/1/case.html - 29.01.2018.

[20] Rajić, D.: *Kreativna ekologija*, Autorsko izdanje, Beograd, 2016. (In English: Rajic, D.: *Creative Ecology*, Author's edition, Belgrade, 2016).

[21] Petrović, M., Miljković, Z., Babić, B.: Integration of Process Planning, Scheduling, and Mobile Robot Navigation Based on TRIZ and MultiAgent Metho–dology, FME Transactions 41, pp 120-129, 2013.

ИНВЕНТИВНИ НИВО ПРОНАЛАСКА КАО ОСНОВ ЗА ПРОЦЕНУ НАУЧНОГ ДОПРИНОСА ПРОНАЛАЗАЧА

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Историја проналазаштва показује да су најзначајнији проналасци проистекли из експеримената помоћу којих су њихови аутори допринели откривању дотад непознатих природних феномена. Стога се поставља питање да ли су ти проналазачи уједно били и научници? Инвентологија објашњава принципе помоћу којих се долази до иновативних производа с високим степеном инвентивности. На том нивоу долази до преплитања између проналаска и открића. С

обзиром да открића припадају науци, може се закључити да је нпр. Никола Тесла, иако није писао научне радове, својим научним доприносима из области електротехнике и машинства, садржаним у његовим главним проналасцима, заслужио да стане у ред најеминентнијих светских научника.