

<https://doi.org/10.15407/sofs2022.02.012>

UDC 001.8:316.77

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## THE FORMATION OF THE CORPORATE SCIENTIFIC ENVIRONMENT

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*Science is a driving force of the development of humanity, and, at the same time, it is an important branch of human activity with the key role of generating new knowledge. Historically, the science is divided into three types: academic, sectoral and university science. Given the situation today, the topical issue for discussion is a new subsection — corporate science, because corporations are well aware of the fact that their competitiveness and, respectively, their future fate depends on the generation of new knowledge. Therefore, corporations undertake the processes related to the cultivation of science and creation of the appropriate scientific atmosphere — corporate scientific environment. Any specific approaches or turnkey solutions for the creation of such kind of an environment are unavailable, which makes the research very relevant now.*

*This paper presents the findings of the research aimed to identify and systematize the components which constitute the landscape of the scientific environment, and to find the determinants or factors which determine the scientific environment based on the general scientific methods of cognition as well as the Hegel's ascending principle. The scientific papers of the leading domestic and foreign scientists served as an empirical base for the research.*

*The research enabled to identify and develop the main determinants which have an impact on the generation of a new scientific knowledge: the existence of the environment of being, scientific*

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Цитування: Shevchenko G.Ya., Bilozubenko V.S., & Marchenko O.A. The formation of the corporate scientific environment. *Наука та наукознавство*. 2022. № 2 (116). С. 12—23. <https://doi.org/10.15407/sofs2022.02.012>

*environment, material covering of scientific environment, common language, scientific communications, motivation and spirit of the organization. It has been substantiated that the organization of almost any scientific environment should go through the development of the above-mentioned components.*

*It has been proven that the development of scientific environment is able to make the company innovative, and thereby to increase its competitiveness. Such kind of transformation requires a complete picture of the processes which occur in the sphere of corporate innovations. The development of scientific environment is based on thinking, which should be noospheric; and the appropriate way of existence is being, but not possession. It is the only kind of thinking and kind of spirit, capable of creating a synergetic effect in the development of human being and biosphere.*

**Keywords:** *science, scientific environment, scientific communication, corporate science, noosphere.*

**Introduction.** Science is a special kind of human being. As a rule, this term implies such determinants as: empirics and theories, the body of knowledge, research vocabulary, goals and the set of actions to achieve them. Science includes scientists and their formal and informal organizations; this makes it a social institute.

One of the fundamental concepts of science is a scientific community. It is rational to divide the community into three groups. The first one, academic science, ensures the development of fundamental research. The second one, sectoral science, works for the development of national economy. The third one, university science, educates professionals for the first two groups.

What all these communities have in common is that they are in the scientific community, which allows them to perform the key function and objective — to generate new knowledge.

This raises an obvious question whether the scientific environment is also needed in the corporations? One of the possible answers is that, on one hand, owing to the globalization of multiple world processes, the circulation of knowledge has accelerated considerably. On the other hand, the above-mentioned scientific groups represent quite conservative phenomenon, and the process of attaining the innovations takes a long time. At the same time, as of now, the large companies everywhere raise questions of new knowledge generation, because their competitive abilities, and therefore their fate, depend on this transformation of the gained knowledge into innovations. As a rule, innovations are created in the firms, which managed, one way or another, to cultivate science and create the respective atmosphere.

As far as, with few exceptions, it is impossible to generate knowledge without the appropriate environment, there is a question about the possibility of creating the scientific environment in the large companies and corporations. For today, this is a problem — creating and supporting the scientific environment in the large companies. Currently, any standard or replicable solutions are unavailable.

Therefore, this paper is aimed to clarify the solutions which are necessary and sufficient in the firm to create its scientific environment capable of generating scientific knowledge. This determines the relevance of our research.

**Literature review.** The scientific research is defined as a complex system, including a combination of all social, material, organizational and psychological conditions, and constantly evolving interaction between all participants of R&D

process, aimed at the effective development of scientific creativity, culture of scientific research, personal qualities and professional skills, competencies and self-realization of employees and students in the scientific sphere [1]. Quite a general definition is given, which not only fail to answer the question how to develop a scientific environment, but also to give an idea of the landscape of such environment and of the factors that take part in this landscape.

In the current situation, knowledge attracts the attention of business, as it is considered as the assets, raising the question of their rapid circulation. There is a question what it is that enables the creative resonance at the moment of collective work and implementation of their own research plans [2]?

Two factors are identified: external (something that brings the researchers together in one team) and internal (creating the conditions for the manifestation of creative resonance).

The social attitude can have an impact on the networking among researchers in different ways. On one hand, addressing social and economic problems and developing scientific areas attract the gifted and ambitious persons. On the other hand, a conservatism of the scientific environment, in terms of new ideas, directly affects the cohesion of the advocates of the idea, who will be able to team up, and further, the scientific school can be created based on this group.

The value and communicative components should be related to the scientific culture. The participants of the group, who share similar values, form a general behavior model in the research.

The common culture is manifested in common presentation of goals, organization of activities and unanimity of the validity of results (verification).

Such corporations as: IBM Corporation, F. Hoffmann-La Roche AG, Astra-Zeneca plc. are a vivid example of the companies which create the in-house scientific environment. Such kind of modernization enabled the companies to become the most productive in terms of research.

For example, IBM Corporation has about 3,000 scientists, who work in 12 laboratories all over the world (USA, Japan, China, India, Brazil, Australia, Israel, Kenya, Ireland, Switzerland). Apart from applied research, such as relational databases, artificial intelligence, blockchain and supercomputers, the corporation also encompasses fundamental areas of research. IBM, founded at the beginning of the last century, has produced six Nobel laureates, including the Nobel Prize in Physics for the Invention of the scanning Tunneling microscope (1986) and the discovery of superconductivity in ceramic materials (1987) [3].

**Novelty of the problem statement and/or obtained results.** The roots of scientific-technical and technological progress lie in a qualitative leap in the cognition and the use of the laws of nature [4]. This leap is so colossal that the science is evolving and, in fact, in many cases, has already evolved into a powerful productive force, and it is the basis of modern production. The achievements of many companies and corporations are based on the outcomes and results of scientific research. This research is, for the most part, carried out by academic scientists

and, further, using different schemes of technology transfer and their commercialization, were used in the companies [3, 5, 6]. At the same time, many corporations are beginning to realize that the acceleration of the progress will require transferring quite a substantial part of the research related to innovations to the corporation itself. Here, the main question that arises is what should be transferred to or organized in the corporation and which way in order that such transformation could become and researchers could deliver scientific outcomes, more related to practice and within an acceptable timeframe, while remaining a “torch”, illuminating a promising way forward or the alternatives of such way for the organization.

The problem is to create and maintain the scientific environment in the large companies. Clear approaches are currently unavailable.

**Results and discussion.** According to the apt and quite right remark made in [7, p. 315]<sup>1</sup>, “two forms of science exist in the modern world. The first one (‘science by form’) is an activity with some kind of external indicators: publications, participation in the conferences, degrees and titles, etc. The second one (‘science by content’) is more related to existential human traits and the search for the truth”. Although, in both cases, in our opinion, scientific environment, way of thinking and teamwork is a foundation for the development. However, the science itself does not generate knowledge — science explains and systematizes it [8]. And we should agree with this interpretation of science.

It is noted in [9, p. 18] that “...scientific environment is a habitat of scientists, educators and pupils. A scientist in any discipline is evolving under special conditions and surrounded by colleagues, and the environment itself is being developed and generates new knowledge. Moreover, the fact that a new knowledge was generated can be confirmed only in the scientific environment”. And multiple publications, communications, scientific research and researchers — all these things create the scientific environment [9].

The author, speaking about the scientific environment, most probably meant the universities, because that’s where scientists, educators and pupils live together. Under previous conditions and, even more so, under present conditions, it is “science by form” that is firmly rooted and thrives at the universities. If we talk about scientific institutions like academic institutions of the Academy of Sciences, the situation is slightly different there, as they have almost no students. And “science by form” is present there to a lesser extent, and “science by content” to a greater extent. Of course, other interpretation of this statement is also possible: educator is the same scientist, and pupil is his young follower gaining experience. Although, after all, the author meant the first version of our interpretation, probably, meaning not only the Russian, but also Ukrainian reality, and even a broader version, including even Western reality. What is important for us is that corporations are interested in “science by content”, because new knowledge is generated only within this science and the appropriate scientific environment, and further this knowledge

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<sup>1</sup> English translations here and below were made by G.Ya. Shevchenko and O.A. Marchenko.

is used to create innovations which, in fact, make the phrase “science is productive force” [10—12] more comprehensible and provided with more practical content.

That is, innovations can emerge only based on new knowledge. Which, more likely, will be gained and updated in “science by content”, than in “science by form”. It is a very important conclusion in terms of the development of any corporation, if, of course, it seeks to develop itself and stay ahead of its competitors. Of course, we mean the innovative development. It becomes evident that in order to enable the emergence or, rather, systematic emergence of innovations, it is necessary to develop, generate or, rather, systematize and generate new knowledge before that. And innovations can emerge and systematically emerge only, as minimum, subject to availability of scientific environment and “science by content”, if it is not about their single, but about systematic development. Therefore, the subject of our further research is the scientific environment and its analysis in terms of possibilities for its creation and further generation of knowledge in the corporate conditions.

And the first question we would like to answer is how we can move from the general description and understanding of the problems of creating the scientific environment to its formalized form, enabling more or less clearly to define and describe this process of developing the scientific environment and try to guideline the activities — some kind of a roadmap.

In fact, we would like to answer two questions: what constitutes the landscape of the scientific environment and what determinants or features define the scientific environment? To that end, we propose to use the following methodical approach, which has already been tested by us in [13], and partially mentioned and considered in [14, 15].

1. A qualitative “contemplative” analysis of the problem and the factors, features and notions which are present in it.

2. The landscape of the problem, i. e., all the factors and features that may have an impact or which “surround” the problem, is described based on the analysis of the problem and goals of the research.

3. In this landscape, we select or identify the determinants, i.e., the factors that, in the researchers’ opinion, are decisive in influencing or defining the features of this notion, and further their justification or proof that they are like this is carried out.

4. The analysis of the problem and collected experimental material on the topic [16—20] enabled to describe the landscape in the following way: it is research fellows, postgraduate students, R&D tools, service and support personnel, themes and style of research and publications, common terminology and its understanding, seminars, face-to-face communication, conferences, articles, joint journals and websites for viewing, ideology or spirit (“banners”) of this organization or cell of organization, the presence of leader where the principle of being, and not the principle of possession prevails in his life, struggle for leadership, competitiveness, including conflict intensity, curiosity, career incentives, freedom of creation and

thought. It is very important to stress a keen observation of Erich Fromm that the empiric anthropological and psychoanalytic data evidence that the possession and being are two main ways of human existence, and the prevalence of one of them determines the differences in individual nature of people and types of social nature [21]. It is the principle of being as a type social nature that determines the development as well as further successful existence of scientific environment at any organization.

It is the landscape of the described problem. All this together develops scientific environment. The subsequent analysis of this landscape, conducted in terms of its structuring, enabled to identify and develop the following determinants, which are mandatory present and obviously influencing the generation of scientific knowledge: (i) scientific environment, (ii) material shell of scientific environment, (iii) common language, (iv) scientific communications, (v) motivation, (vi) spirit of the organization which embodies the principle of being, and not possession.

The identification of the above stated factors enables us, to a certain extent, to turn to formal description of the scientific environment, to abstraction, and namely to write the following formalized expression for the scientific environment:

HC = <Scientific environment, Material shell, Common language, Scientific communications, Motivation, Spirit of the organization>.

It should be noted that, if we could “measure” these components and have specific measures for them, then we would have an opportunity to consider the scientific environment in a kind of 6-dimensional space and, moreover, we would have the grounds for comparing the scientific environment in different organizations.

Below we are going to elaborate on the proposed determinants.

### *1. Scientific environment*

These are, above all, research fellows and postgraduate students – the critical intellectual asset or component of any scientific community. This should also include all the participants supporting research works, including the service and auxiliary personnel and the communication system between the participants of scientific environment, the so called scientific communication which will be discussed later.

### *2. Material shell of the scientific environment*

Modern laboratories of today where a new knowledge is born, changing the face of the worlds and affecting the fate of humanity, are inconceivable without high-precision devices, reagents, computers, various electronic devices, modern software, libraries, etc. (all that is called material and technical base for research). Although, in order to give birth to this knowledge, not only material and technical facilities will be required, but also to carrying out experiments and tests leading to the manifestation of empiric phenomena.

### *3. Common language*

The mandatory components of the scientific environment also include a common language: this category includes theme and style of research and publications, common terminology (thesauri and glossaries), way of thinking, categories, notions, used symbols and their meaning. It becomes impossible to interact within

the scientific community without speaking a common language. Therefore, the formation of such language is one of the first and most necessary requirements for creating the scientific environment. In future, it is the availability of such language that will enable to develop one's own scientific platform and school: language, system of views, and approaches to problem-solving, and it will lead to the establishment of such concept as "beauty of relations", built on a sense of tolerance within the team, which is critical for innovative activities [22].

#### *4. Scientific communications*

Scientific communications are some kind of "nervous" tissue of the scientific environment: they cover seminars, face-to-face communication, even in smoking rooms, conferences, papers, journals, social networks in science, web services [20]. When creating the scientific environment, special emphasis should be laid on developing a scientific communication system as a framework for the scientific environment. The system of communications implies the availability of common language, knowledge, expectations and understanding of the goals. The intensity of communications is directly related to motivation and minimization of the number of different barriers impeding the generation of new knowledge, and it produces synergetic effects. Finally, new synergetic effects produce so called indirect communications, the ones of the researcher with intelligent web services and systems [23].

Scientific communications of today are an analysis of interaction, taking into account its new elements — the Internet and its services for data analysis and processing [24]. The key goal of scientific communications is to facilitate knowledge mining from empirical data, and to systematically specify and explain it, to work on an increase in explicit and implicit knowledge [25].

#### *5. Motivation*

There are no technical systems which are able to generate knowledge themselves. P. Lebedev, a Nobel Prize laureate and an outstanding Russian physicist, said that "my bookshelf knows much more than me, but it is me who is physicist, and not the bookcase" [26, p. 291]. At the "input" and "output" there is a human armed with a unique "device", such as brain. As far as, in terms of the sphere of scientific labor, these functions serve to create various intelligence products — new hypotheses and theories, observation of facts, their rational verification, etc., a pivotal role in the activities of a human being engaged in science is assigned to cognitive processes and his mental abilities. Also, it should be said that it is not thinking that thinks, but a human being — an integral entity, in whose action system, the mental actions, notwithstanding all their importance, are not the only ones. Any creative thought is driven by motivational forces, which are usually defined by such terms as enthusiasm, passion, involvement in the problem, love for truth, etc. Motivation includes different aspects: career, competitive, struggle for leadership, financial, curiosity, etc. The idea, cherished by a scientist, should become personally meaningful for him, in order that he could dedicate his energy for the sake of this idea, and sacrificed other values, time, health and, sometimes, even life. Even having the

highest mental abilities and the most brilliant talent, the entity will not be able to make significant contribution to knowledge fund without motivational intensity. “With no interest, thinking becomes futile and pointless!” [27, p. 78].

#### *6. Spirit of the organization (culture of the school)*

The spirit of the organization is its ideology, its banner and symbols. The organization’s leader is often responsible for the creation of its spirit. It is the leader who energizes the team, generates its interest, teaches to see and think. In this case, the leader, consciously or unconsciously, is guided by the principle of existence, which was essentially called by Erich Fromm a principle of being, as opposed to the principle of possession. The principle of being means, on one hand, zest for life and genuine affiliation to the world, and, on the other hand, “to be” means real existence of something or someone that exists; it ascertains his or its authenticity and genuineness. The statement that someone or something exists is related to the essence of a person or thing, but not to his or its appearance [21].

As a rule, the leader is a passionate personality. If he fails to pass the baton, then the scientific school declines, and the scientific environment, instead of the habitat, becomes the environment of being. It is the leader who creates and maintains the atmosphere in the team, teams it up and creates common values. At the same time, a leader is not a human of ordinary being, guided by the will for self-preservation and procreation, and not only a person of borderline being, guided by the will for power and will for cognition and creativity. It is a person of meta-borderline being, which is highly motivated by the will for tolerance, love and co-creation [28, 29].

E. Rutherford was such kind of leader who drawn people to himself and inspired them with ideas. Starting from Manchester University, he began to develop his own school, and further young and ambitious physicists as interns [16].

N. Bohr wrote, “A large number of young physicists from different countries of the world teamed up around Rutherford, attracted by his exceptional gift as physicists and rare ability of an organizer of scientific team. Notwithstanding that Rutherford was always consumed with the progress of his own works, he had enough patience to listen to every of these young people, if he felt that they had any ideas, however modest, in his opinion, they seemed to be” [30, p. 216].

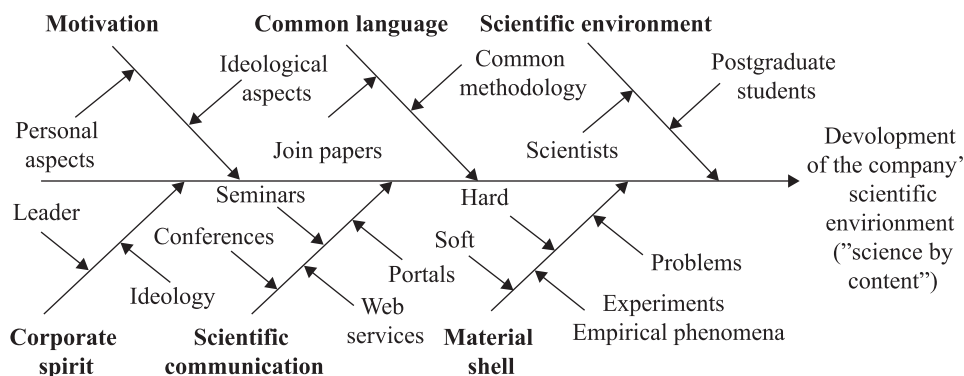
American physicist S. Devons noted that “Rutherford radiated intellectual power, which exclusively attracted young researchers to him” [31, p. 38].

In our opinion, these are necessary (and, probably, sufficient) conditions for the creation of scientific environment in the corporation or any other organization, capable of providing such conditions.

Based on our analysis and justification, we can make a plausible assumption that the organization of almost any scientific environment should take place through the development of above-stated components.

In fact, we described the components of a certain process, which implementation should bring the environment under test (in this case, the company or its unit, for example, scientific or research department) to the desired state, i. e. the





The formation of a scientific environment at company level

Source: Developed by the authors.

state of scientific environment. In this case, in order to assess the impact of one or another components and their constituents, the tool called by Ishikawa “fish skeleton” can be used as it was proven in practice [32]; at the same time, it should also be kept in mind that its use implies not a short-term solution, but a long-term one.

In our case, dealing with process approach, it is more about maintaining the processes; notions such as “to improve” and “to activate” are typical for this approach, without reference to measurable results. The scheme or map of this approach has a simple structure: there is a target process and surrounding processes which have a certain impact on it. The process map or scheme of the formation or development of the scientific environment is shown in Figure.

**Conclusions and prospects of future research.** Innovations can emerge only based on a new knowledge [33]. Innovation is not an economic category, but it depends on the intellectual and scientific development of the company, and, moreover, the whole society in general. The latter is defined by the proper concept of the strategy of its development. In other words, the formation of scientific environment represents an extremely complex process, which has its objective and subjective prerequisites, but does not fall within the ideology of “result-based management of scientific activities”. It is the word “environment” that is the key one here, and used in that sense; if we are speaking about management, the word “self-organization” is more appropriate.

The development of scientific environment can become one of the tools for transforming the company into the innovative one, which will enable to increase the company’s competitive ability and to enhance its image. Moreover, we need a full and accurate picture of what is going on in the company. Concerning the kind of components that should be added to transform the company into the innovative one will be the subject of our next research and future publications.

At the same time, we would like to remind that the development of scientific environment and transformation of the company into the innovative one are used as a bases — human thinking and spirit, and thinking is a tool for human cognitive

activities, which should be “sharpened” in a certain way as “noospheric”, if we want to develop human civilization towards “smart” technologies, which will not threaten, but help to biosphere, and will not harm it, and the spirit should be “sharpened” towards being instead of possession. That is, the development towards “noospheric civilization”, where the life and activity is based on harmonious relationship with nature, humanistic scientific, spiritual-cultural and technological innovations to overcome global challenges and wars [34]. A. Gore, former vice-president of the U.S., in fact, writes the same: “Mind should be separated from ‘selfishness’ of an individual who uses it, and aimed at the public good” [35, p. 333]. That is why we attach such great importance to their formation and development, which should be reflected in the development of the respective scientific environment, because the previous types of thinking as a tool for the cognitive activity and spirit, aimed to possession, led all mankind to a dead end.

That is, we can say that “noospheric” thinking and spirit of being is a bridge between innovations and social development.

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Received 30.03.2022

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## ФОРМУВАННЯ НАУКОВОГО СЕРЕДОВИЩА У КОРПОРАЦІЇ

Наука — рушійна сила людства, важлива, але водночас складна галузь людської діяльності, головним завданням якої є генерація нового знання. Історично склалося так, що наука поділяється на три види: академічна, галузева та вузівська. У сьогоdnшній ситуації актуальним для обговорення питанням є новий підрозділ — корпоративна наука, оскільки корпорації добре розуміють, що їхня конкурентоспроможність, а відтак і подальша доля залежать від генерації нового знання. Отже, корпорації здійснюють процеси, пов'язані з культивуванням науки і створенням відповідної наукової атмосфери — наукового середовища корпорації. Конкретні підходи чи готові рішення стосовно створення такого середовища відсутні, що обумовлює актуальність дослідження.

В статті викладено результати дослідження, спрямованого на виявлення та систематизацію компонентів, що входять до ландшафту наукового середовища, знаходження детермінантів наукового середовища на основі загальнонаукових методів пізнання, а також гегелівського принципу сходження. Емпіричною базою дослідження є наукові праці провідних вітчизняних і зарубіжних учених.

Дослідження дозволило виявити та сформулювати основні детермінанти генерації нового наукового знання: наявність середовища буття, наукове оточення, матеріальна оболонка наукового середовища, спільна мова, наукові комунікації, мотивація та дух організації. Обґрунтовано, що організація практично будь-якого наукового середовища має відбуватися через формування наведених вище компонент.

Доведено, що формування наукового середовища здатне зробити компанію інноваційною і відтак підвищити її конкурентоспроможність. Для забезпечення подібної трансформації потрібно мати повну картину процесів, що відбуваються у сфері корпоративних інновацій. Основою для формування наукового середовища є мислення, яке має бути ноосферним, і відповідний спосіб існування — буття, а не володіння. Тільки таке мислення і такий дух здатні створювати синергетичний ефект у розвитку людини та біосфери.

**Ключові слова:** наука, наукове середовище, наукова комунікація, корпоративна наука, ноосфера.