

PROGRAMMING ENGINEER PROFESSIONAL DEVELOPMENT FROM MULTI-ASPECT VIEW

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Abstract. Programming specialists are more and more demanded by modern information society. On the one hand – these are the employment opportunities offered by the labour market, when the specialist proves his or her professionalism and competitiveness, on the other hand – it is also considerable challenge, because the continuous development of technologies, including information technologies, actualizes the necessity for the lifelong professional development and improvement in order to become a marketable, thus also competitive specialist. The ecological and synergetic approach ensures new perspectives for the research on the specialists' professional development and career growth, serving as the philosophic-methodological base for the interdisciplinary studies. The aim of the research is to substantiate theoretically the programming engineer professional development as a lifelong self-determination and self-organization process within the context of career development, creating the methodological base for further studies. The professional development is a lifelong process that does not end after obtaining of formal education and professional qualification. It is the self-determination process, within which the important aspects are the programming specialist's motivation, professional self-improvement, self-education, self-assessment of own professional proficiency and self-management of own career. The professional development is a multi-stage and multi-level cyclic process as a result of which the programming specialist can turn from a beginner into a highly level professional. At the same time, it is a nonlinear process, because the programming specialist's professional development might have its rise and fall.

Keywords: career growth, experience, IT company, programming engineer, professional development, professional self-determination.

Introduction

Programming specialists are more and more demanded by modern information society. On the one hand – these are the employment opportunities offered by the labour market, when the specialist proves his or her professionalism and competitiveness, on the other hand – it is also considerable challenge, because the continuous development of technologies, including information technologies, actualizes the necessity for lifelong professional development and improvement in order to become a marketable, thus competitive specialist.

Continuous self-perfection, self-determination of professional development and career are important preconditions of professional success. Ecological approach determines that nowadays the specialist's professional development takes place in the changeable environment. Cognition of oneself and environment, following the changes and innovations in the field of professional activities and in the society on the whole is an important basic principle of professional self-determination. Readiness for changes characterizes nowadays the successful individual of knowledge and information society, who can survive in the changeable environment of professional activities.

Russian scientist, academician A. Asmolov [1] has emphasized the idea that only a strong personality, ready to live and work in the continuously changing world, can surely develop his own behavioural strategies, think independently and unconventionally, making a moral choice and being responsible for this to oneself and society; such personality can make its life and the lives of others meaningful, interesting, and happy.

More opportunities to realize themselves as specialists have people with high level qualification and flexibility in thinking, communication and professional activities. Rapid social and market globalization processes are new challenges for both specialists and employers. In the modern European labour market it is not sufficient for the specialist to have only the already obtained education, because it does not ensure professional stability and sustainability; therefore, one of the requirements is continuous professional improvement and, if necessary, even retraining, if there have been used all opportunities provided by the field of previous professional activities. According to this aspect, the modern society becomes a society of risk and venture demanding for flexibility in specialists' thinking and actions, because retraining alone does not guarantee marketability in the

labour market [2]. In order to ensure professional development and activities in the changing labour market, it is important for the programmers to know the specialists of which programming languages are the most demanded by employers. It is necessary to have knowledge of the specificity, use of programming languages, when determining the fields of the programmer's professional activities according to the specificity of the programming product to be obtained. It is important to possess critical thinking, forecasting abilities, as well as to perform continuous self-reflection in order the programming specialist could ensure his flexibility and mobility in the labour market, which, in its turn, facilitates his competitiveness, including marketability and employment.

Marketability and employment as an indicator of a programming specialist's competitiveness may be analyzed and evaluated according to two aspects: 1) *according to inner aspect*: marketability and employment, which depends on the knowledge and competences of a particular personality as a specialist, as well as on the totality of human qualities, including the factor how much other people enjoy the communication with the particular specialist, how much the specialist himself is motivated to enter the labour market, having evaluated the existent opportunities; 2) *according to external aspect: the marketability and employment, which is determined* by the conditions of the labour market, namely, if there are vacancies in the labour market, then each representative of this profession has the determined marketability of the environment and there are more employment opportunities, but, if the factors of external environment change, i.e. alongside with the reduction of the number of workplaces, the competitiveness of the specialist of particular profession decreases, and thus he also loses employment opportunities. Therefore, the professional development of an engineer as the specialist of his field shall be evaluated according to the aspects of continuous professional education, professional self-improvement, which is a lifelong process, as well as according to the career development aspect within the framework of an information technology (IT) company.

The *aim of the research* is to substantiate theoretically the programming engineer's professional development as a lifelong self-determination and self-organization process within the context of career development, thus creating the methodological base for further studies.

Materials and methods

In the modern educational theories there have two transcendental scientific paradigms emerged: *ecological paradigm* and *synergetic paradigm*, which complement each other and provide perspectives for the interdisciplinary studies. These both paradigms result also in conceptual approaches: *ecological approach* and *synergetic approach*.

Ecological approach ensures in the social sciences the wholeness view on an individual's development within the interaction with his life and action environment, which is a complex multi-level, multi-context and multi-functional interaction system, where an individual is a complex, self-developing, self-evaluating, self-organizing, live system developing in the changeable environment. Particularly important for the professional development of engineers, including programming engineers, is the environment of professional education and improvement and the environment of professional activities (for example, IT company) [3-7].

In its turn, *synergetic* approach enables to view an engineer's personality in the social sciences (including social synergetics, social pedagogy, synergetic acmeology) as a complex self-developing, self-organizing and self-evaluating system, which I. Prigozhyn [8; 9] named *an open dissipative structure*, the viability and competitiveness of which depend on the factor how much an individual is ready to cognize the changeable environment and to change under the conditions of changeable environment. In the field of programming, an interaction between a specialist and the varied programming language and the environment of tools, which is not only the environmental context of professional activities, but also a semantic field, is very topical. It is important for each programming engineer to answer a question, whether he is opened to innovations in the field of professional activities, whether he is ready for cooperation and joint actions within the framework of a team for achievement of common goals, for example, within the framework of a programming project. Here, the concept of *synergy* is actualized in the engineer's professional activities, which was introduced by H. Haken [10; 11].

Methods of the research: 1) studies, analysis and evaluation of scientific and methodological literature; 2) reflection of experience.

Results and Discussion

Professional development is a very multidimensional concept. This concept comprises several aspects: a psychological aspect (for example, personality's professional direction and development), a pedagogical aspect (lifelong and life-wide education, including self-education for professional self-development and self-improvement), a career management aspect, a business management aspect etc.

Professional development is substantiated as a multistage process, where every stage of life activities comprises several stages characterized by new totality of tasks and skills to be acquired, and this totality forms the professional stand. The professional development is closely related to the formation and development of professional identity. The professional development is a multi-cyclic process, where every new developmental stage brings new formations of professionalism or new qualities of an individual as a personality and also as a specialist, which manifest through professional activities. The professional development is related to the totality of regularities, different types of mechanisms and driving forces that help the personality in the process of professional education, as well as, as a result of it, to perform professional activities in a more qualitative manner from the professional formation, when the professional aims are only being set, to the end of professional biography [12-15].

Professional development in the human ontogenesis is viewed as a socialization process, where an individual masters several roles, including a particular role of a performer of professional activities in the work environment. The professional development takes place in the interaction with the environment of professional activities. The main driving force of professional development is striving for integration into the social environment, work environment by identifying oneself with the particular social group and work environment as a system. In the different cultural and historical, and individually biographic contexts, the professional development begins with *professional self-determination*. In its turn, professional self-determination begins with *the choice of a profession*, which is influenced by the striving of the personality towards one or several fields of professional activities [16-18].

The programming specialist's professional development comprises a lifelong process of professional self-determination, which begins with the choice of a profession in the IT sphere, obtaining of professional education and qualification and continues as the process of career self-management, including the process of professional self-improvement, continuing education and self-education. Not only education, but also the direction of personality/professionalism (motives, aims, values, attitudes, interests, needs etc.) is very important for the professional development.

An important stage of a programming specialist's professional development in the lifelong process are the studies at a higher education institution, when the prospective specialists form their professional identity, their competence of professional activities, as well as obtain the experience of self-reflection and self-improvement, while undergoing training at IT companies. The readiness of prospective and new, just graduated specialists for the independent professional activities is a result of professional development as an indicator, which has taken place during the studies; at the same time it is also a precondition of successful professional development in the future. Psychological readiness manifests through motivation to perform independent and responsible professional activities and to continue professional development; in its turn, competencies based readiness is a kind of resource, a pre-start condition, a complex formation of the synthesis of the personality's qualities, manifestation of different abilities through professional activities [19; 20].

There are several directions of professional development of prospective and new specialists, which may be related to the engineering specialists [21]: 1) development of professional direction and necessary abilities; 2) professionalization and improvement of psychic processes and conditions; 3) rise of independence and responsibility level; 4) rise of claim level in the field of the profession; 5) ethical, esthetical and mental development; 6) self-education and development of the qualities necessary for the professional activities; 7) rise of initiative and creativity level; 8) formation of psychological readiness for the independent professional activities.

Professional self-determination does not end only with the choice of a profession and obtaining of initial professional education; this process (like professional development) lasts for a lifetime, while an individual is still an active subject of professional activities [22; 23].

Professional self-determination, professional development and experience of professional activities are closely interrelated. Professional self-determination and professional development take place within the process of vocational education, professional self-improvement and professional activities, as a result of which the experience is obtained. In its turn, the experience is the basis/support of professional development and a significant influential factor of professional self-determination. Only on the basis of the experience of professional activities an individual can evaluate, whether the chosen profession ensures satisfaction for him, whether it is the sphere he feels comfortable in becoming a self-sufficient and self-realizing personality. The experience is obtained in the particular environment of professional activities; therefore, the experience has contextual nature.

The experience is a way to cognize the reality, and it is based on the application of an individual's practice in one or another manner. *The practice* is a peculiar result of activities, which is characterized by: an individual's attitude system, the content of life activities, which is directly (immediately) experienced and gone through. The experience is the subject's inner acquisition formed during the real actions and remaining forever irrespective of the fact, whether it is an individual or the mankind in general. As a result of the interaction between the individual's experience and the surrounding reality, including other people and oneself, the individual's inner world outlook, the totality of views are developed. During the experience obtaining process there is a link between the personality and the environment developed. It is the experience, where subjectivization (inner taking possession), interiorization (reflection in the individual's psyche) and conceptualization of everything cognized and experienced takes place. The experience is not only the result of the developmental stage of a particular individual as a personality and a specialist; it is also the process, where the new experience makes new layers, supplementing and/or replacing the old experience. The experience is dynamic and changing [24-26].

The specialist's satisfaction or dissatisfaction with the choice of his professional activities and career depend on the fact, how successful or negative this experience of professional activities is.

There are indications identified proving that an individual is not aware of his calling yet. A. Zhalyevich [27] points out the following indications proving that an individual has not found himself yet and is not aware of his life and professional calling: inner dissatisfaction from the actions, success and even high-level achievements and his performance results; feeling that his life is meaningless, empty, spent for different useless things; continuous change of workplaces and spheres of activities: an individual does not stay at the same place for a long period of time – he is searching for his place; lack of happiness, joy, moral satisfaction in everyday life; problems in the life (at work, regarding affairs, health, relations): signals that something should be changed in the life; failure, fiasco, failure while fulfilling some work or project, even if the individual has done everything correctly, reasonably, has worked hard and dutifully; many aspects (people, acquaintances, conditions, personal thoughts) of his life directly or indirectly show that an individual is involved in the affairs, which are not his; there is a feeling that the life lacks something important giving sense to the life; there is a feeling that the life itself creates inconveniences for the individual and points out that the individual should choose another path, take another direction; there is confusion like we face when standing at the crossroads. An individual shall only learn to see the indications of successfully found mission and the moment, when there shall be something changed in one's own life.

The previously analyzed conclusions drawn by A. Zalevics are closely related to the conclusions drawn by the US psychologist A. Maslow on complaining and meta-complaining, which have been characterized in his *The Theory of Motivation and Meta-motivation* [28].

There may be three vectors identified in the specialist's professional development [29]: 1) personality development vector (from the holistic view on a specialist), which ensures self-perception and self-development of oneself as a personality; 2) introspective-analytical vector, which characterizes the specialist's reflexive attitude towards oneself, self-analysis and self-evaluation, as a result of which self-management of professional development takes place; 3) purposeful action vector

indicates the manifestation of a specialist's professionalism in the active, self-directed or self-motivated activity.

J. Prjazhnikova [30], the specialist of professional development, finds that an individual, when choosing his or her career, does not think only about his or her future profession, position, but is more concerned about his or her way and style of life in general.

Several authors of publications [13-15; 31-35] see the specialist's professional development and career development as a multistage process, where each stage of professional development improves also the professionalism level. The conclusions drawn by these scientists could be related to the programmer's multistage professional development.

For instance, the US scientists N.L.Gage and D.C. Berliner [32] elaborated the substantiation of the five-stage professional development: the beginner's level; the highest beginner's level; the competency level; the proficiency level; the expert's level.

The model of the development of professionalism, elaborated by Russian scientist V.Bodrov [34], has something in common with the model elaborated by D. Berliner. The scientist emphasizes the following levels of professional development: professional knowledge; professional experience; professional competency; professional usefulness; professionalism.

Canadian programming specialist R. Hein [33] sees the programmer's professional development as a multi-level process, where the programmer, thanks to continuous professional self-improvement and self-education, takes the path which leads from a beginner to a high-level professional whose professionalism enables to perform an expert's functions in the field of programming.

Russian scientists N. Nikitina, O.Zheleznyakova and L. Petuhov [36] describe professionalism as a totality of an individual's personal qualities necessary for successful professional activities.

The experience proves that the field of professional activities, as well as the environment of professional activities, to great extent, determine, which features, qualities the specialist shall have as a representative of particular profession in order his professional activities would be successful.

N.Kuzmina [37], the representative of acmeology, finds that, according to acmeology view, professionalism is a totality of the high-level personal and business qualities of a personality as the professional performance subject, including the high-level creativity, adequate level of claims, explicit motivation sphere and values orientation, which is oriented towards the continuous improvement of personality.

Australian software developer S. George [38], on the basis of her experience in programming, identifies several indicators characterizing a programmer as a professional: reliability, teamwork, management and self-management, communication, professional self-improvement, personal interest in diminishing the risks of non-quality performance and great responsibility.

Business analyst in IT field and programming specialist J. Bennett [39] finds that a proficient programmer is characterized not only by thinking necessary for a programmer, including systemic thinking, knowledge of programming languages, optimal code writing skills, but also by his entrepreneurship skills and business management competency enabling him to hold relatively high positions in IT company, ensuring his competitiveness.

The results of the theoretical research and the authors' experience testify that in order to ensure own competitiveness, the programming specialist has two ways to his/her professional improvement: 1) through the increase of his or her competency level, thus also professionalism, by obtaining experience and working in one of the fields of programming for a long period of time, has higher level knowledge of any of programming languages; 2) by developing his/her multi-competencies and obtaining programming specialist's experience in several fields of programming, acquiring several programming languages and obtaining own experience of diverse professional activities. The first way ensures recognition, marketability, thus also competitiveness in the particular field of programming. The second way ensures mobility and flexibility regarding the provision of employment in the changeable environment of the labour market.

The programmer's professional performance is both the precondition of professional development and the result. The quality of professional activities, as well as the quality and applicability of the

product created as a result of professional activities are the main indicators of programmer's professionalism.

The career development may be planned differently. The career development plan envisages stages of an individual's professional development: improvement of qualification, "position stairs" etc. Several authors have focused on the programmer's developmental opportunities at an IT company [30].

For example, Russian programming engineers A. Nikitin and D. Lyapin [35] in their book "Programmer's Path: From 100 USD to 100 000 USD per Month" emphasize the programmer's career development opportunities, where the specialist's motivation to improve professional skills and thus become an expert in the field of programming and also a leader of a programmers' team is very important: the new, the new advanced; the developer/junior programmer; the developer/programmer; the senior developer/senior programmer; the functional architect; the project manager.

Several IT companies have developed the models for evaluation and certification of professional conformity, thus motivating their employees for the professional career and improvement, which is directly related also to the position and remuneration.

For instance, the IT company "Luxoft Personnel" [40] has published a model of a programmer's career development at the company: a trainee; a programmer; a leading or senior programmer, who has also a mentor's responsibilities; head of a programmers' group/a functional architect/a project designer; a project manager; a development director; the IT company's director.

Basing on the ecological and synergetic approaches, and own experience as well, the authors of this article can say that the programming specialist's professional development, including career development at the company, mostly depends on two significant preconditions, namely: 1) is the programming specialist as a personality and a specialist ready for the continuous process of self-development, self-improvement; 2) is he ready to align his personal aims of professional development and career development with the interests and aims of the IT company, where he is working, thus ensuring *balance* between the *ego-centred* and *eco-centred* values orientation, thinking and actions; besides, the aligning of the aims of personal career development and the aims of the organization might manifest differently, for example, like proposals, innovative and rationalization thinking/actions etc.

Through applying *synergetic paradigm* and *the theories of the non-linear development of open systems: acmeology* [37; 41; 42], *synergetic approach in education/pedagogical synergy* [8; 10; 11; 43-46], *social synergy* and *synergetic acmeology* [47], it is important to draw a conclusion that **professional development is a non-linear process** and that the professional formation and development of every individual has its rises and declines, which are influenced not only by the factors resulting from the personality, but also by the environmental factors that may have both facilitating and hindering functions.

For instance, N. Panova [48] identifies several cyclic stages in the specialist's professional development, foreseeing both professional development up to the peak of professionalism and the decline of professional activities. The scientist has identified 4 stages of professional development in a human life: 1) acquisition of profession, professional adaptation and readiness for independent professional activities; 2) *acme* – developed professional competence; 3) professional self-realization and professional maturity; 4) stagnation as a decline of professional development.

Russian representative of psychology science L.Mitina [49] also finds that a specialist can reach a peak in his professional development followed by stagnation and professional decline. The scientist identifies three stages of professional development: professional development, professional formation and the stagnation stage.

In their turn, V.Bryansky and V.Pazharsky [47], the representatives of social synergetics and synergetic acmeology, on the basis of synergetic paradigm and the theories of the non-linear development of open systems in social sciences, find that in the individual's development there are several peaks of achievements, rises in the professional performance and also several declines, conditions of stagnation. Thus, how the specialist as a professional can leave such stagnation condition behind, can find strength for a new leap forward, for a new developmental stage, proves his competitiveness [50; 51].

The theory of the non-linear development of open systems enables to study and describe the programming specialist's professional development as *the target-oriented, self-organizing and self-evaluating process* influenced by: 1) *inner factors* – the specialist's inner resources and developmental potential (knowledge, skills, competencies, including attitude, values, interests, motivation for professional development, obtained experience, different abilities, including the ability to cognize and evaluate own strengths and weaknesses, the ability to notice the self-realization opportunities in the changeable environment etc.), as well as 2) *external factors*: opportunities and conditions for professional development in the labour market, industry, IT company. Self-evaluation of programmer's professional proficiency enables, by means of reflection, to become aware of one's own imperfections and shortcomings, which should be addressed in the nearest future in order to ensure one's continuous professional improvement.

The specialist's disposition of thinking, his view on his own professional performance and professional development are very important. German expert – manager T. Peters [52] generalized and grouped human dispositions into two groups: the conventional and the new disposition, which are described in Table 1. It is obvious that the new disposition is more constructive, in order to implement it, the person needs to understand the self-improvement and self-control idea. The disposition in thinking is based on reflection, and, as a result, the specialist faces self-evaluation and self-assessment. The significance of reflection, including self-evaluation, for the personality and professional development have been studied and theoretically substantiated by several scientists [53-56].

Table 1

The conventional and the new disposition regarding professional activities and development

The conventional disposition	The new disposition
I do everything needed.	I do my job well and I like it.
I work hard, the manager is satisfied with my performance.	I am sure of my abilities and I will continue to proceed.
The manager/the colleagues involved me in this project. I will have to scarify my free time.	I was interested in this project. I acquire new knowledge and skills, and I will work in a group together with proficient people.
I have a good knowledge of my job, I have rich experience.	The life continues, I am interested in the new things, I am ready to acquire advanced knowledge and skills.
In order a person would be promoted, he or she needs to try too hard.	I am ready to fulfil new tasks, I am ready to use my energy, because I know – the results will bring also the remuneration.
I like my job.	I enjoy working together with my colleagues.
I am proficient in my field.	If the fulfilment of new tasks requires acquisition of new methods and technologies, learning of one more foreign language – I do it with enthusiasm, because I see the sense and the new life quality in it.

Since the IT field develops very rapidly and dynamically, the introduction of the latest technologies in all spheres of human activities is closely related to the continuous educational process within the context of lifelong learning. It is particularly related to a programmer as the IT specialist. The programmer's continuous education is an important means for professional development; it is a way, precondition and also – to a great extent – a result of obtaining the experience of professional activities, which shall be characterized and evaluated not only within the context of the environment of professional activities, but also within the contexts of lifelong education and development of lifelong career.

It is possible to identify two directions of professional and career development in the career theories: 1) lifelong professional development, continuously improving oneself as a personality and also as a professional (the career going *horizontally*); 2) career development upwards within the framework of the company (the career going *vertically*), which greatly influences the programming specialist's satisfaction with his or her professional activities, as well as affects his or her welfare and

quality of life. However, the experience shows that the programming specialists can direct their career in three directions: 1) *horizontally* 2) *vertically*; 3) *start up*. The third direction combines both career going horizontally and vertically, because, in order to commence own business in the field of programming and/or to implement own creative and innovative plan through an independent project, the programming specialist shall continuously improve his/her professionalism both in the field of programming and business management, acquiring several social roles and functions in the field of professional activities.

Conclusions

1. The ecological and synergetic approach ensures new perspectives for the research in the specialists' professional development and career growth, serving as the philosophic-methodological base for the interdisciplinary studies.
2. The programming specialists' professional development comprises a lifelong process of professional self-determination, which begins with the choice of a profession in the IT sphere, obtaining of professional education and qualification and continues as the process of career self-management, including the process of professional self-improvement, continuing education and self-education.
3. The educational and self-educational experience, including self-directed learning skills and the experience of professional activities in the IT sphere, is the basis for further professional and career development.
4. In order to ensure own competitiveness, the programming specialist has two ways to his/her professional improvement: 1) through the increase of his or her competency level, thus also professionalism, by obtaining experience and working in one of the fields of programming for a long period of time, has higher level knowledge of any of programming languages; 2) by developing his/her multi-competencies and obtaining programming specialist's experience in several fields of programming, acquiring several programming languages and obtaining own experience of diverse professional activities. The first way ensures recognition, marketability, thus also competitiveness in the particular field of programming. The second way ensures mobility and flexibility regarding the provision of employment in the changeable environment of the labour market.
5. Professional development is a complex and nonlinear process consisting of several stages with a cyclic nature, with its rise and fall.
6. It is possible to identify two directions of professional and career development in the career theories: 1) lifelong professional development, continuously improving oneself as a personality and also as a professional (the career going *horizontally*); 2) career development upwards within the framework of the company (the career going *vertically*), which greatly influences the programming specialist's satisfaction with his or her professional activities, as well as affects his or her welfare and the quality of life. However, the experience shows that the programming specialists can direct their career in three directions: 1) *horizontally* 2) *vertically*; 3) *start up*. The third direction combines both career going horizontally and vertically, because, in order to commence own business in the field of programming and/or to implement own creative and innovative plan through an independent project, the programming specialists shall continuously improve his/her professionalism both in the field of programming and business management, acquiring several social roles and functions in the field of professional activities.
7. The programming specialist's professionalism is an integral entirety of his/her many qualities, where competency is important in several spheres, not only in programming.
8. The programming specialist's professional development is a self-organizational process of professional development influenced by: 1) personality's subjective or *inner factors* – the specialist's inner resources and developmental potential (knowledge, skills, attitudes, values, interests, motivation for professional development, obtained experience, different abilities, including an ability to see the self-realization opportunities in changeable environment etc.), as well as 2) environmental objective or *external factors*: professional development opportunities and preconditions in the labour market, industry, IT company.

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