INFORMATION SYSTEMS AND INNOVATIVE TECHNOLOGIES IN PROJECT AND PROGRAM MANAGEMENT

Collective monograph edited by
I. Linde, I. Chumachenko, V. Timofeyev

INFORMĀCIJAS SISTĒMAS
UN INOVATĪVAS TEHNOLOĢIJAS
PROJEKTU UN PROGRAMMU
VADĪBĀ

Kolektīvas monogrāfija

I. Linde, I. Chumachenko, V. Timofeyev

zinātniskajā redakcijā

Recommended for publication by the O.M. Beketov National University of Urban Economy in Kharkiv (protocol No. 13 of July 2, 2019)

Information systems and innovative technologies in project and program management [Text] : Collective monograph edited byI. Linde, I. Chumachenko, V. Timofeyev. – Riga: ISMA, 2019. – 369 c.

Authors: Fedorovich O., Kosenko V.; Malyeyeva O.V., Nosova N.Yu., Artiukh R.V.; Kosenko N.; Teletov O.S., Teletova S.G., Grigorenko V.Yu.; Babets I.G.; Pribylnova I.B., Dovgopol N.V., Peresada O.V.; Ramazanov S.K., Stepanenko O.P., Tishkov B.O., Honcharenko O.G.; Hutsa O.M., Ovsiuchenko Y.V., Petrova R.V., Morozova A.I.; Husieva Yu.Yu., Chumachenko I.V.; Malanchiy S.O., Hutsa O.M., Kyriy V.V.; Hutsa O.M., Yelchaninov D.B., Peresada O.V., Dovgopol N.V.; Danshyna S.Yu.; Shendryk S.O., Tymchuk S.O., Shendryk V.V., Telizhenko O.M.; Safronova T.A.; Zarytskyi O.V., Kostenko O.B., Bulaienko M.V.; Tymchuk O., Rach V.; Litvinov A.L.; Chernenko V.P.; Petrenko V.O., Fonarova T.A., Bushuiev K.M.; Rach V.A., Borulko N.A.; Nevliudov I., Demska N., Starodubcev N., Nevliudova V.; Nevliudov I., Starodubcev N., Demska N., Omarov Sh.; Kovtun T., Brashovetska G., Petrova O.; Gybkina N., Sidorov M., Storozhenko O.; Momot T.V., Tumietto D., Chekh N.O.; Timofeyev V., Khrustalev K., Khrustalova S., Yakushyk I., Gopejenko V.; Rossoshanska O.V.; Kovtun T.A., Smokova T.N.; Parzhin Yu., Rohovyi A., Nevliudova V.; Danylovych-Kropyvnytska M.L.; Skoryk G.I.; Hrebennyk N.; Danchenko A.

The monograph presents the achievements of Ukrainian scientists on enterprise management, the use of economic and mathematical modeling, information technologies, management technologies and technical means in the field of enterprise functioning and development and project management at enterprises.

The publication is recommended for professionals in the fields of economics, information technology, project and program management - for undergraduate and graduate students, as well as academics and teachers of higher education.

The articles are reproduced from the original authors, in the author's edition.

CONTENT

INTRODUCTION

The key to successful activity of complex socio-economic and technical systems is their constant updating, adaptation to the changing conditions of the external environment, and appropriate self-regulation of the internal structure, processes, and technoalgies. Scientific and methodological developments offered in the monograph, measures for strategic development, the use of modeling and information technologies, project and program management technologies will all contribute to the improvement of existing processes and the development of new ones. This is what determines the relevance of the studies presented.

The monograph was prepared by the author team: 1. Fedorovich O., Kosenko V.; 2. Malyeyeva O.V., Nosova N.Yu., Artiukh R.V.; 3. Kosenko N.; 4. Teletov O.S., Teletova S.G., Grigorenko V.Yu.; 5. Babets I.G.; 6. Pribylnova I.B., Dovgopol N.V., Peresada O.V.; 7. Ramazanov S.K., Stepanenko O.P., Tishkov B.O., Honcharenko O.G.; 8. Hutsa O.M., Ovsiuchenko Y.V., Petrova R.V., Morozova A.I.; 9. Husieva Yu.Yu., Chumachenko I.V.; 10. Malanchiy S.O., Hutsa O.M., Kyriy V.V.; 11. Hutsa O.M., Yelchaninov D.B., Peresada O.V., Dovgopol N.V.; 12. Danshyna S. Yu.; 13. Shendryk S.O., Tymchuk S.O., Shendryk V.V., Telizhenko O.M.; 14. Safronova T.A.; 15. Zarytskyi O.V., Kostenko O.B., Bulaienko M.V.; 16. Tymchuk O., Rach V.; 17. Litvinov A.L.; 18. Chernenko V.P.; 19. Petrenko V.O., Fonarova T.A., Bushuiev K.M.; 20. Rach V.A., Borulko N.A.; 21. Nevliudov I., Demska N., Starodubcev N., Nevliudova V.; 22. Nevliudov I., Starodubcev N., Demska N., Omarov Sh.; 23. Kovtun T., Brashovetska G., Petrova O.; 24. Gybkina N., Sidorov M., Storozhenko O.; 25. Momot T.V., Tumietto D., Chekh N.O.; 26. Timofeyev V., Khrustalev K., Khrustalova S., Yakushyk I., Gopejenko V.; 27. Rossoshanska O.V.; 28. Kovtun T.A., Smokova T.N.; 29. Parzhin Yu., Rohovyi A., Nevliudova V.; 30. Danylovych-Kropyvnytska M.L., Skoryk G.I. 31. Hrebennyk N., Danchenko A.

The publication is recommended for undergraduate and graduate students, specialists in economics, management, information technology and project management higher education institutions.

3. FORMALIZATION OF THE PROCESS OF FORMING A COLLECTIVE OF DISTRIBUTED TEAMS

Kosenko N.

The actual task of forming professional competences of human resources is considered taking into account the requirements of project activities and the characteristics of the dynamics of virtual teams. The significant differences of the virtual team building comparing with the classic and the existing problems in the field of virtual team building are considered. The method of selecting candidates for a project team was further developed by applying a theory of precedents, which allows one to take into account the professional experience of candidates taking into account the specifics of the formation of distributed teams.

Introduction

In control theory, team processes take place in four main areas: team formation, team development, definition of team roles and the formation of cohesion in the team. All these processes are interrelated and interdependent. In the current economic conditions flexibility, adaptability to rapidly changing market conditions, increasing productivity and ability to grow creatively is essential for the survival of the company. Today, more and more teams are distributed and there is a need to find new tools to engage and maintain relationships with such participants. Small businesses and startups often have to resort to the services of remote employees, which largely reduce the cost of doing business. Successful coordination of such employees fit many general principles of personnel management. Thus, to make the job of this kind of team the most effective, there is a need to use new strategies and modern digital tools in addition to the traditional management methods. According to the latest figures (December 2018) of the international labour organization, approximately 17% of employees in developed countries work remotely, in Japan this figure reaches 37% of the working population and in the U.S. – 32% [1].

There are three key elements in working with a remote team:
− project team;
− customer;
− project manager.

The specificity of distributed teams imposes certain requirements on channels and methods of interaction. When working with remote teams, there are several basic principles of work:

1) The need to stay in a single information field with all participants. The fixing of certain agreements between team members is of fundamental importance here; these agreements must also be agreed with the customers.

2) Systematic feedback collection. When working with remote teams it is necessary to take into account the time limits of work, the difference in time zones, the time for communication.

3) Synchronization between all participants.

You can select certain objects of attention, i.e. basic requirements for a project manager who works with a remote team:

− conciseness - the ability to express thoughts briefly and clearly. This is due to the fact that the communication channels are different and have their own characteristics. Application of active listening skills, correct analysis of the information received;

− punctuality - due to the fact that each participant has his own schedule, you need to take into account the importance of communication planning;

− confident use of software;

− propensity to trust - refers to the manager's behavior model and relies on the level of maturity of the team. Additional control of the remote team members is possible.

There are basic project manager tools when working with remote teams, which are especially actively used when you have to work on several projects at the same time:

− questionnaires for communication on control points;

− project acceptance methodology;

− personal task manager / calendar (automated time management);

− schedule of employment / availability.

Analysis of recent research and publications

There is a fairly large number of definitions of the "virtual team", but there are few significant differences in these definitions. As a rule, a virtual team is a small group of people united by a common goal or task, but separated in space and (or) time and interacting with each other through computer technologies.

Despite the huge interest worldwide to the subject of team building and team work, questions of formation of effective virtual teams have been studied insufficiently. Problems of formation and development of distributed teams devoted to a number of foreign and domestic

experts in the field of project management. Available publications can be divided into the following four types:

1. Theoretical works in which the virtual team is seen as a kind of conventional commands and thus, it can be applied the principles and methods of classic team building activities [3-7].

2. The publication, which deals with certain aspects of team building both traditional and virtual teams, but without a systematic relationship with other aspects [5; 8-10].

3. Narrow, practical publication, which is a particular case − history specific success (usually) or failure (less common). They are, as a rule, the question how the methods and principles of teamwork applied in this particular case, universal, and received the results of a representative [11; 12].

It should also be noted that such phenomena as freelance, start-up teams, virtual office, etc., are studied, as a rule, independently of each other; independent studies are carried out for each of these forms, although the principles of virtual team building obviously affect all these forms, each of them may require the formation of virtual teams. The principles of the formation of such teams, their main characteristics and methods should be the same. In the scientific literature, including devoted to team building, there is no separate direction, corresponding to the team building in the network - digital, virtual space. Such a generalized concept is called virtual team building (digital teambuilding) [2].

After analyzing the existing research, the following benefits and risks of virtual teams can be identified. The advantages of a virtual team include the following factors [2]: increased competence; mutual enrichment and supplement; increased creativity; flexibility; use of the advantages of freelance; cost reduction; acceleration of work processes. The risks and problems of a virtual team include the following: a control problem; organization problem; the problem of intercultural, ethnic and social contradictions, political differences; management transformation; the problem of "common language"; team building problems.

The authors [2] highlighted a number of identified and systematized aspects that significantly distinguish virtual team building from the classical one (Table 1).

Table 1 − Fundamental differences between virtual team building and classical team building

Feature	Classic team building	Virtual team building
Use of computer technology and the Internet	With more or less regularity	Permanent
Online communications	Complement personal communication	Replace personal communication
Team core	Leader or idea creator	Communicator or organizer
Control	Possible in any form	Mostly self-control
The role of the psycho-type and competencies of an individual participant	Important, but subject to correction due to team (joint) actions	Paramount importance
Collective decision-making	Possible in any form	Substantially difficult
Leadership	Any form of leadership and authority is possible.	The charismatic form of power is practically impossible, the sole leadership is difficult.
Team spirit	Formed in the process of direct communication and joint action.	Requires special procedures and special efforts
Team composition	Conventionally constant factor	Conditionally variable factor
Team borders	The borders of the organization (team members - employees of the same organization)	Absent

Thus, the problem of the formation of virtual teams and its effective interaction to achieve project goals in a high level of uncertainty and rapid changes of many factors requires further consideration.

General provisions for the formation of distributed teams

To effectively operate a virtual work team, a clear statement of purpose is needed, i.e. desired end result. Of course, the presence of a specific goal is necessary for any type of organization, but for virtual work teams, this principle is fundamental. Here the goal is what unites people and holds them together until the work is completed. At the same time, it should be clear, articulated and shared by all team members. After all, there are far fewer opportunities to clarify it, clarify in the process of working with virtual employees than with direct interaction. The virtual work team works within the framework of this task, without being distracted by any extraneous moments. Such an organization of work determines the main features of the interaction. All information exchanged between the participants relates

exclusively to questions and problems within the framework of the task. The scope of interaction and its quality here are limited by technical means. At the same time, satisfaction with the work of members of virtual work teams is connected precisely with the position of a person in the business structure of such a team. Since all the interaction here is focused on the task, for each member of the virtual work team, first of all, it is important how other team members evaluate their business qualities.

The process of forming a staff of virtual teams can be represented as follows (Figure 1).
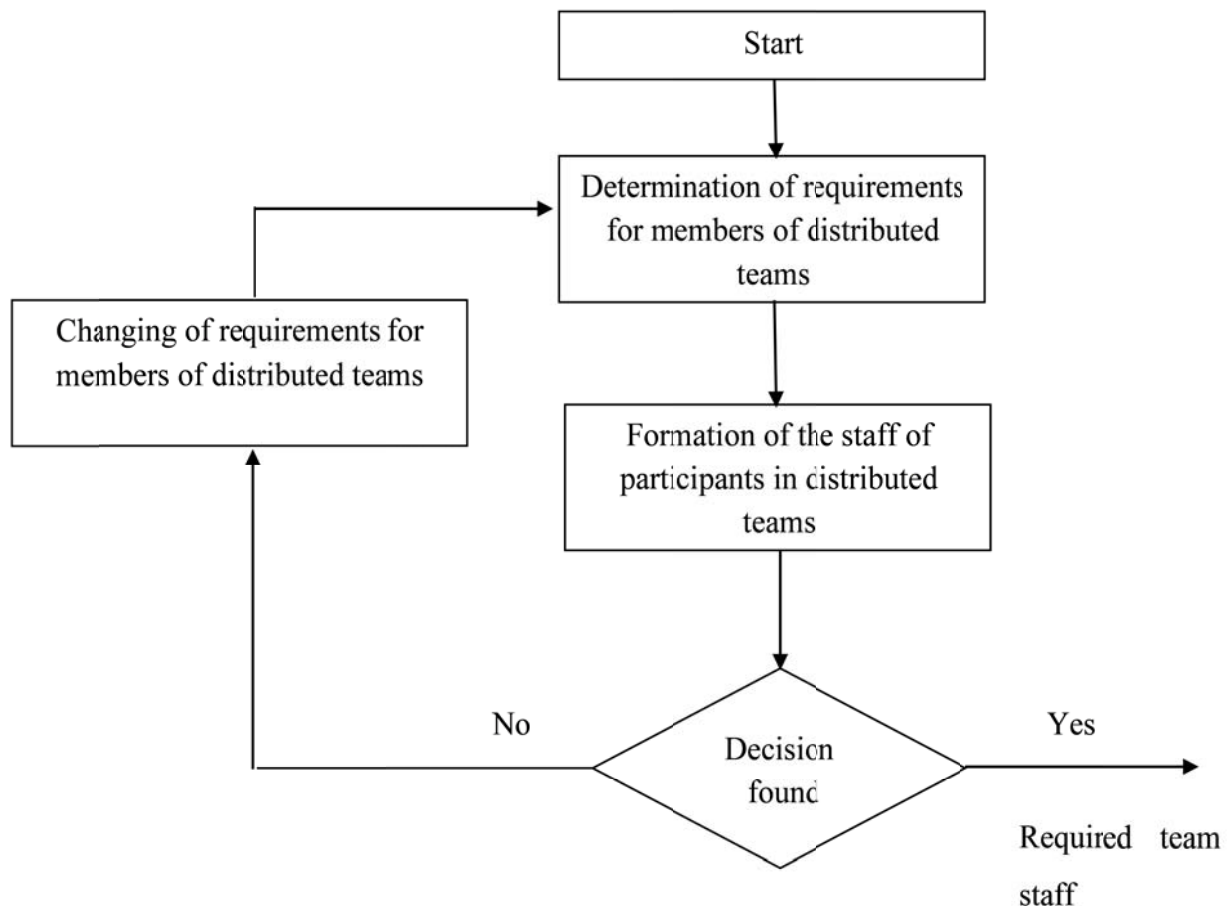
Fig. 1 - The process of forming the staff of virtual teams

The task of forming virtual teams is currently the least theoretically worked out, this is primarily due to psychological and social factors. In general, the task of selecting specific participants for remote teams consists of two stages. At the first stage, based on the project objectives, it is necessary to determine the range of potentially competent employees, and at the second stage, the selected virtual team is formed from the selected candidates. These tasks are closely interrelated and are solved on the basis of a deep system analysis of the goals and objectives of the project. In this case, the composition of a particular group of employees is completed taking into account the requirements arising from the nature and number of questions posed to the team.

The formation of a staff of virtual teams is understood as the task of choosing from some set of specialists (candidates for a team) the persons most competent in the circle of questions under consideration, and drawing up a workable remote team from these candidates. This task should be considered as a specific type of professional selection, in which by the degree of professional suitability is understood the degree of competence of the candidate.

Formalization of the distributed teams' formation process

The formalization of the processes of preparation and formation of virtual teams is a necessary condition for the transition from subjective opinion to regulatory rules and models that ensure the reproducibility, reasoning and effectiveness of decisions made.

The selection of candidates for the virtual project team is proposed to be done on the basis of an analysis of the experience of their work in past projects that are close in content to the planned works. At the same time, unlike some well-known methods, the criteria for evaluating candidates should include criteria that characterize not only the subject (work specialization), but also the content of specific types of work within general competence. Thus, the composition of potential performers is formed, which can be considered as candidates for inclusion in the staff of distributed teams.

A formalized presentation of the above can be formulated as follows: if a description of a certain object $s \approx s_j$ is given and there is a correct description of it $l_j \approx \langle s_j, r_j \rangle$, then it can be argued that r_j is a similar (approximate) technical solution of a given description of the object, and the performers of these works have experience in performing the planned works.

The algorithm for forming the list of employees of virtual teams within the framework of the theory of precedent theory with experience in similar subjects can be represented as consisting of the following stages:

Stage 1. Formulate a description of the object of the new task in the form of its characteristics and parameters (technical specifications).

Stage 2. Determine the metrics of measuring the similarity of works.

Stage 3. Access to the database of the warehouse of precedents.

Stage 4. Search for a reference situation, within the specified proximity interval.

Stage 5. Selection of candidates (projects in which candidates participated, were successful).

Stage 6. Determine the professional characteristics of applicants for a given list of characteristic indicators.

The description of the object of new task should be concise, unambiguous and informative. In addition, the description of the object should specify the name of the adopted classification, purpose and values of the criteria for each characteristic. This is necessary for successful, effective work with the database of precedents.

When solving the task of searching for related work, a list of analogues with a different degree of similarity with the project under development is formed in accordance with a given measure of similarity in the form of a weighted measure of proximity of a pair of objects l_p and lq:

$$d_{pq} = \left[\sum_{j=1}^{n} W_i^2 \left(x_{pj} - x_{qi} \right)^2 \right]^{1/2}.$$

To determine the work and the corresponding list of potential performers, the analyst must describe the work of the planned project in terms of the concepts of existing categories. Thus, a search is made for similar types of work and an initial list of candidates for a project is formed from the list of executors of these works. Procedures for the implementation of these works are based on the sequence of the following steps, logically derived from the goal:

1) a description of the planned work, in the language of presentation of situations;

2) search for related works in the range of a given measure of similarity;

3) determination of the list of executors as potential candidates for a project with certain experience of similar works in the past.

The choice of the proximity measure is considered to be the key point on which the search for suitable use cases depends. In each specific task, the choice is made on the basis of its own set of rules, taking into account the objectives of the project. The proximity of objects is determined by the relationship of similarity between them.

Formally, the formulation of the task of forming candidates for a virtual team can be represented as follows. Let:

$V = \{v_1, v_2, \dots v_n\}$ – a set of applicants for the formation of candidates in the virtual team;

$P = \{p_1, p_2, \dots p_m\}$ – a set of functions that can be performed by the command.

Each applicant is characterized by a variety of characteristics: $R_{Vi} = \{r_1, r_2, \dots r_k\}$ and the ability to perform functions: $F_V = \{f_1, f_2, \dots f_t\}$.

$K = \{k_1, k_2, \dots k_m\}$ – set of preset coefficients for the corresponding function.

The reserve coefficient [13] determines the minimum required number of candidates capable of implementing these functions. Possibilities of applicants to the virtual team are summarized in Table 2. [13].

Table 2 - Applicants abilities to perform relevant tasks

A V	a_1	a_2	...	a_m
v_1	L_{11}	L_{12}		L_{1m}
v_2	L_{21}	L_{22}		L_{2m}
v_n	L_{n1}	L_{n2}		L_{nm}

L_{ij} – element of the matrix, which shows the ability of candidates to perform certain functions. If the i-th applicant is able to perform the j-th function, then L_{ij} = 1, otherwise L_{ij} = 0.

Determining a specific qualitative staff of a virtual team is a weakly formalized task, the solution of which is based mainly on the subjective assessments of project managers. The difficulty of determining general recommendations on the qualitative composition of candidates is due to the need to take into accounted the specific goals and objectives of the project.

In a number of practical situations, procedures for evaluating candidates are decided on an individual basis. In this case, it is assumed that the professional training of a specialist is known and satisfies the requirements of the organization. In this case, a portrait of an "ideal" specialist is formed with the parameters of his professional characteristics that meet the conditions and requirements of the work performed. After determining the required characteristics of the applicant, these characteristics of x_i are compared with those in the recruitment of the "ideal" employee. The candidate is tested according to the composition of the characteristics of the "ideal" employee x_e for typical types of work. For each characteristic, the magnitude of the discrepancy $\Delta X_i = x_{ie} - x_i$ is determined and the individual characteristic of the degree of proximity of the candidate and the "ideal" employee is determined:

$$P = \sum_{i=1}^{n} a_i \Delta X_i$$

where a_i significance coefficients of comparison characteristics, $\sum_{i=1}^{n} a_i = 1, \leq a \leq 1$. The values of the coefficients a_i are set by experts depending on the type of work and other special requirements affecting the value of the coefficients of significance.

Thus, the system of selection of candidates to the project team was considered according to the degree of closeness of the planned work and analogues of past developments

based on the theory of precedents. The application of the principles of analogies makes it possible to increase the efficiency and shorten the term for selecting candidates for inclusion in the project team. According to the specific tasks of personnel management, the approaches under consideration can be used when it is necessary to select one best candidate from the list of applicants.

Conclusions

Considering the features of the life of virtual teams, it is necessary to note the great promise of such organizational forms due to their obvious advantages. First of all, virtual work allows you to combine the intellectual efforts of specialists, far removed from each other. The use of virtual work teams allows you to reduce time costs due to the possibility of round-the-clock work on the project, if you involve specialists living in different time zones. Experts predict that in the near future, virtual work teams will seriously compete with traditional organizational forms**.**

The issues related to virtual team building are considered, in particular, a method of forming teams is proposed, the participants of which work away from each other.

The professional competencies of human resources are a key factor in project effectiveness. Therefore, it is important to form these competencies taking into account the project specifics and peculiarities of interaction between distributed groups. The formation of project professional competencies has its own specifics in the process of managing a virtual team. Thus, competencies determine the effectiveness of project activities of members of distributed teams. A set of professional competencies is modeled for each project role. Consequently, the development of virtual teams takes place, including through the development of professional competences of the project's human resources.

The method of selecting candidates for a project team was further developed by applying a theory of precedents, which allows one to take into account the professional experience of candidates taking into account the specifics of the formation of distributed teams.

References

1. Malov, D. How to work with a remote team [Kak rabotat' s udalennoy komandoy]: available at : https://indigo.co.ua/kak-rabotat-s-udalennoy-komandoy

2. Makarchenko, M.A., Pavlova, O.N. (2018), "Features of transforming classical team building into virtual in the context of digitalization", *St. Petersburg State Polytechnical University Journal. Economics*, No. 11 (1), P39–53. DOI: 10.18721/JE.11104

3. Belbin, R.M. (2012), *Management Teams: Secrets of Success and Reasons for Failure* : Per. from English, Moscow : Kivits, 240 p.

4. Dyer, Jr. W.G., Dyer, J.H., Dyer, W.G. (2013), *Team Building: Proven Strategies for Improving Team Performance* : 5th edn, San Fran. : Jossey-Bass, 304 p.

5. Berry, G.R. (2011), "Enhancing Effectiveness on Virtual Teams: Understanding Why Traditional Team Skills are Insufficient", *Journal of Business Communication*, Vol. 48 (2), P. 186–206.

6. Zander, L., Zettinig, P., Ma, Kela K. (2013), "Leading Global Virtual Teams to Success", *Organizational Dinamics*, Vol. 42 (3), P. 228–237.

7. Adair, J. (2015), *Effective Team-building: How to Make a Winning Team*, PanMacmillan, 180 p.

8. Charlier, S.D., Stewart, G.L., Greco, L.M., Reeves, C.J. (2016), "Emergent Leadership in Virtual Teams: A Multilevel Investigation of Individual Communication and Team Dispersion Antecedents", *The Leadership Quarterly*, Vol. 27, P. 745–764.

9. Ford, R.C., Piccolo, R.F., Ford, L.R. (2017), "Strategies for Building Effective Virtual Teams: Trust is Key", *Business Horizons*, Vol. 60 (1), P. 25–34.

10. Blagov, E.Yu., Gilenko, E.V., Bashlykova, A.S. (2016), "Differential of cultural measurements as a method for analyzing intragroup processes in cross-cultural teams" ["Differentsial kul'turnykh izmereniy kak metod analiza vnutrigruppovykh protsessov v kross-kul'turnykh komandakh"], *Bulletin of St. Petersburg University. Series 8: Management*, Vol. 2, P. 98–126.

11. Olaisen, J., Revang, O. (2017), "Working Smarter and Greener: Collaborative Knowledge Sharing in Virtual Global Project Teams", *International Journal of Information Management*, Vol. 37 (1), P. 1441–1448.

12. Bisbe, J., Sivabalan, P. (2017), "Management Control and Trust in Virtual Settings: A Case Study of o Virtual New Product Development Team", *Management Accounting Research*, Vol. 37, P. 12–29.

13. Kryuchkovsky, V.V. and others (2011), Introspective analysis. Methods and means of expert assessment: Monograph [Introspektivnyy analiz. Metody i sredstva ekspertnogo otsenivaniya: Monografiya], Kherson : Grin DS, 168 p.

Scientific publication

INFORMATION SYSTEMS
AND INNOVATIVE TECHNOLOGIES IN
PROJECT AND PROGRAM MANAGEMENT

Collective monograph
edited by I. Linde, I. Chumachenko, V. Timofeyev

INFORMĀCIJAS SISTĒMAS
UN INOVATĪVAS TEHNOLOĢIJAS
PROJEKTU UN PROGRAMMU VADĪBĀ

Kolektīvas monogrāfija
I. Linde, I. Chumachenko, V. Timofeyev zinātniskajā redakcijā