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Practice of applied interdisciplinary research carried out by a geographically distributed think tank

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The paper covers an analysis of the track record of a research project on studying the development strategy for civilian production at the Russian defence enterprises. A distinguishing feature of the research is use of the flexible project approach and lean manufacturing concepts in terms of the interdisciplinary research by a geographically distributed think tank.

Key words: project management, interdisciplinary research, think tank, military industrial complex, conversion, diversification, civilian products, consumer goods.

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Introduction

To ensure high competitiveness of Russian organisations (enterprises, companies) on domestic and international markets, it is required to build an efficient system of interdisciplinary research works that would allow to promptly come to the best strategic solutions on creating new types of products and services, as well as operation processes improvement.

Analysis of the domestic and international research experience of organisations from different industrial branches, including military industrial complex (MIC) enterprises, allows to conclude that one of the decisive factors for research success is an efficient system for research project management. At this, practical issues of managing interdisciplinary research conducted by geographically distributed think tanks using contemporary project management methods (such as Scrum, Agile, PMBOK, P2M, etc.) and possibilities of cutting-edge

communications technologies are not fully captured in research literature [1, 2]. An efficient system of research project management shall be based on contemporary project management methods, management theory and information control systems customised to fit the specific project being implemented and selected based on real project constraints [3].

Obviously, the most difficult stage of the research project management is arranging and holding interdisciplinary research by a geographically distributed multi-faceted think tank. A vivid example of such project is the research of ways to develop civilian production within vertically integrated structures of the Russian MIC enterprises [4]. It was carried out by a think tank that included 10 participants of the Work Team Leader Detection Program of "Almaz – Antey" Air and Space Defence Corporation JSC. These were mostly young specialists and managers of some of the Corporation's subsidiaries. The main result of this think tank work was a monograph covering possible ways to increase civilian production share in the integrated structures of MIC enterprises. Currently, the President and the Government of the Russian Federation pay special attention to this issue [5, 6].

When working on the monograph, the think tank members gained valuable experience in arranging remote team work and managing interdisciplinary research projects. There were 10 specialists of different specialisations in the team, including project management, lean manufacturing, marketing, etc., which allowed to achieve a synergistic effect during synthesis of the interdisciplinary research projects management system. It should be noted that most part of the practices shaped when implementing the project and tested are fit for many purposes and applicable to any project types. Thus, it is highly relevant to summarise and systematise the described project management experience which was gained by the think tank during its joint work and the monograph preparation.

Peculiarities of multi-faceted think tank organisation

A research project "Development of Civilian Production at the Military Industrial Complex Enterprises" was a final thesis for employees of a number of enterprises within "Almaz – Antey" Air and Space Defence Corporation JSC. The thesis was prepared as part of their training on "MIC Enterprise Management" in the Scientific Educational Centre of the Corporation (ANCO AVE "Almaz – Antey" ASD SEC). This training area completed the Work Team Leader Detection Program initiated by the Director General of the Corporation and launched in the Corporation in 2016 [7, 8].

The research project think tank included mostly young specialists and managers of the parent company and Corporation's subsidiaries. The research was managed by 2 experienced advisers, employees of the Corporation.

To fulfil the interdisciplinary research project, specialists of different specialisations were involved into the think tank. An important peculiarity of the think tank was presence of project management experts (they know methods of *Project Management*, *Business Process Management*, *Scrum*, *Agile*, etc.), as well as lean manufacturing experts (*LEAN*, *Kanban*). In fact, the established think tank is similar to a *Scrum Team* – a project team for the *Scrum* project management methodology, and the think tank manager is similar to a *Scrum Master*. The think tank manager's main task, as *Scrum Master* or *Servant Leader*, is to assist each member of the team to develop and perform personal researches providing maximum efficiency, promptly resolve discords, "protect" the team against disturbing factors, facilitate team work focusing on solving first priority tasks, thus arranging comprehensive efficient work of the think tank.

Approach towards think tank work organisation

Following the interdisciplinary research, the think tank members had to achieve the main project goal: prepare the monograph "Development of Civilian Production at the Military Industrial Complex Enterprises".

Project work was arranged remotely, which was non-conventional for many team members [9]. However, proper goal setting by the management and purposefulness of the team ensured the work completion in full and within the deadlines.

The think tank performed a pretest analysis of the possible project risks resulting in determination of the main risk – comprehensive arrangement of smooth team work and progressive advancing when working on each monograph section. This risk event could cause disturbance of the project team creative work, deadlines disruption and failure to achieve the target efficiency indicators, functions duplicating, false priorities, as well as cause and effect relationship when solving a task set at once, etc. In case of this situation, the think tank manager and project manager on specific areas (monograph sections) play an enormous consolidation role.

Since most of the team members were experienced in implementation of different projects, such risks were successfully prevented and minimised. Thanks to the best practices in project management and arrangement, the most efficient methods and tools, it was possible to ensure the synergistic effect when arranging the research work.

A spiral model was used as the research and methodological basis for the think tank work arrangement. This model was presented by Barry Boehm in 1986 to arrange a software life cycle [10]. In this way, the project managers (*Scrum Masters)* were able to minimize possible arrangement and process risks during the think tank members interaction. In fact, each spiral whorl (cycle) corresponded to a certain version (completed version) of the monograph. Similar to the *Scrum* and *Agile* methods, the cycles (or iterations) were limited by two-four weeks. It should be noted that in case of the *Scrum* methods, a cycle duration (time period to be finished obtaining a specific planned result) is usually called a sprint. Following sprint completion, there was a critical analysis of the obtained results, areas and granularity (level of detail) of further researches were clarified, next sprint work was planned.

Each think tank member was personally responsible for work results with regard to a specific monograph section. Under each sprint, same as in case of the *Scrum* projects, the think tank members were free to make decisions related to the content of the monograph sections developed by them.

Figure 1 shows the described model of the think tank work arrangement on interdisciplinary researches and monograph preparation following the research results (with the *Scrum of Scrums* conventional name).

The main advantage of the selected approach was a significant reduction of the monograph preparation time, as well as an opportunity to show the logically completed team work result to the managers of the Corporation's Work Team Leader Detection Program any time.

Under each sprint (spiral model whorl), the Scrum Masters and think tank members fulfilled a set of interrelated operational business processes. It seems relevant to consider these business processes in more detail.

Initial data analysis and setting the research objective. Under this process, the think tank managers analysed the task, set aims, objectives and areas of the researches, found literature related to the research topic, proposed preliminary report composition and work timeline. The project plan included 8 sections on different research areas, starting from history of the diversification and conversion in our country and ending with rational, planning, implementation

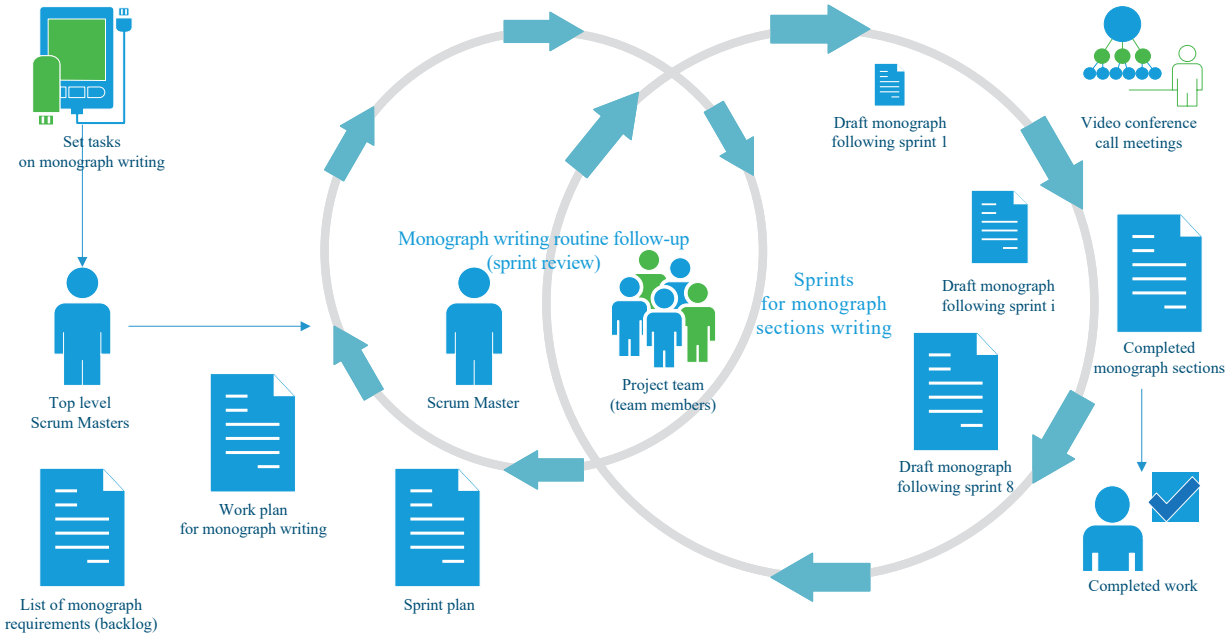

Fig. 1. Model of think tank work arrangement

and financing for the diversification and conversion actions.

System planning of work (sprints) and constant monitoring of their implementation process are the most important factors of success of the project implemented by the think tank. When the project started, planning, monitoring and management of the sprints were done based on a standard *Scrum Board*. During the project implementation, the standard board was replaced by Trello (a special web application) to ensure on-line access to the relevant information on the general progress of project implementation (Fig. 2) for each think tank member.

Figure 2 demonstrates that the *Scrum Board* shows history and status of the sprint tasks, as well as the data on a responsible person. There are the following statuses of the sprint tasks: planned, to do, in progress, done. The online *Scrum Board* makes it possible to quickly plan works for everyone involved in the project and follow up their proper fulfilment. In red are the tasks requiring all the think tank members to be involved in order to address bottlenecks and complete a sprint right on time. In yellow are the tasks being solved and requiring no team assistance to be completed on time. In green are the solved tasks. When drilling down each task, there are the lists of the responsible persons. A red arrow in the left corner indicates the tasks of the highest priority.

The Scrum Board allowed the project managers to constantly monitor work progress and involve more experienced project participants to assist less experienced ones, this way balancing the project resources.

Preparation of the materials on research areas. All think tank members selected the most interesting monograph section for them to further elaborate it.

The first sprint of the project under implementation was collecting information on the research topic. During the first several weeks of the project, the think tank members actively collected and systematized materials on the selected research areas. All the collected materials were placed into a cloud database on the corporate training portal of the Corporation's Scientific Educational Centre. For ease, it will be further referred to as the project database (DB). To ensure consistency and facilitate the work, all the collected information was converted to *.docx. Figure 3 shows the diagram of the collected information scope by the research (monograph) sections.

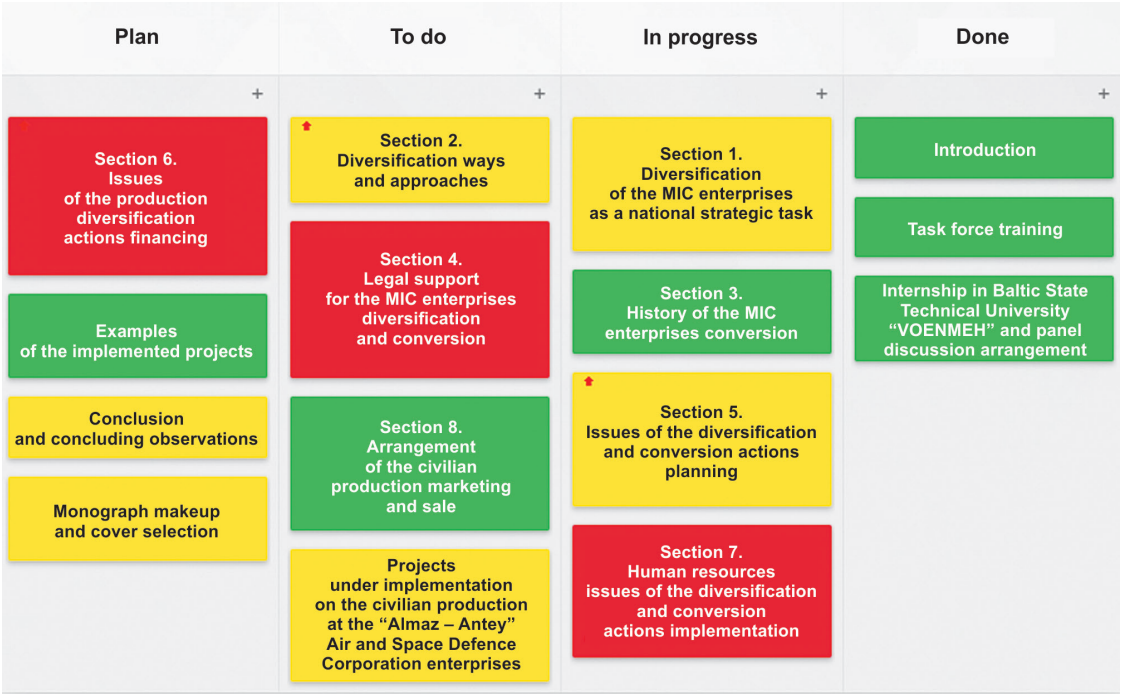

Fig. 2. Online Scrum Board for project progress monitoring

Analysis of the diagram in Fig. 3 allows to conclude that the least elaborated issues in the research literature are planning, arrangement and financing of the diversification and conversion actions.

The DB in-depth analysis revealed that the average size of one *.docx reference source is approx. 25 MB. Each member used 10 to 22 training and guidance material sources for the monograph. 15 to 60 % of the collected material content was used for the monograph depending on the research specifics of a section. Some of the research areas (monograph sections) were rather specific. Thus, systematisation of the information collected for such sections was significantly hampered. For example, arrangement of the diversification and conversion actions was troubled due to significant difference between the domestic and foreign approaches.

Each section was broken into sub-sections, and there were the tasks for these sub-sections which were fulfilled during the sprints covering 1 to 4 weeks.

Each monograph section was elaborated within a separate sprint during the project life. Each sprint covered managers' lectures on the key areas of the research. A corporate training portal was used for these lectures which took 15–20 minutes. Initially, the managers held facilitated training workshops to ensure proper goal setting and project understanding for all the members. Gradually, the managers' overview lectures were shortened when a set of the main sprints on the monograph's text preparation started (about 2 months following the project start).

Figure 4 shows 1 sprint progress.

Main sprints taking on average 3 weeks each took place in March – August 2020. Under each sprint, persons responsible for the sections prepared the research materials and uploaded them into the project DB. As noted above, the authors of the sections determined for themselves how to fulfil the set sprint tasks and planed their work in line with such plans.

Each section includes not more than 12 % of the information copied from a reference source. It was closely monitored by the project managers. Following each sprint, the material prepared by the think tank members was checked for plagiarism.

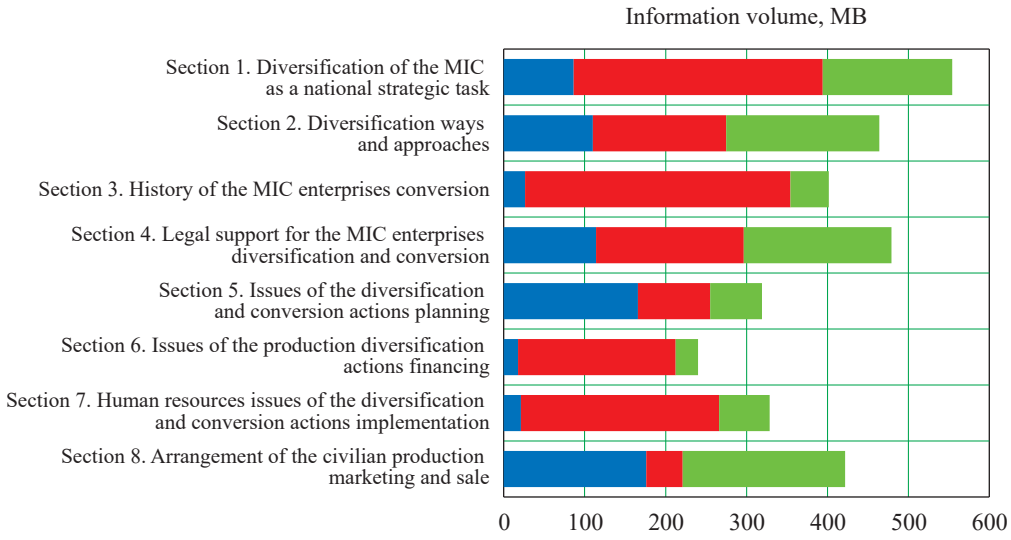

Fig. 3. Information scope in database by research sections
– January; – February; – March

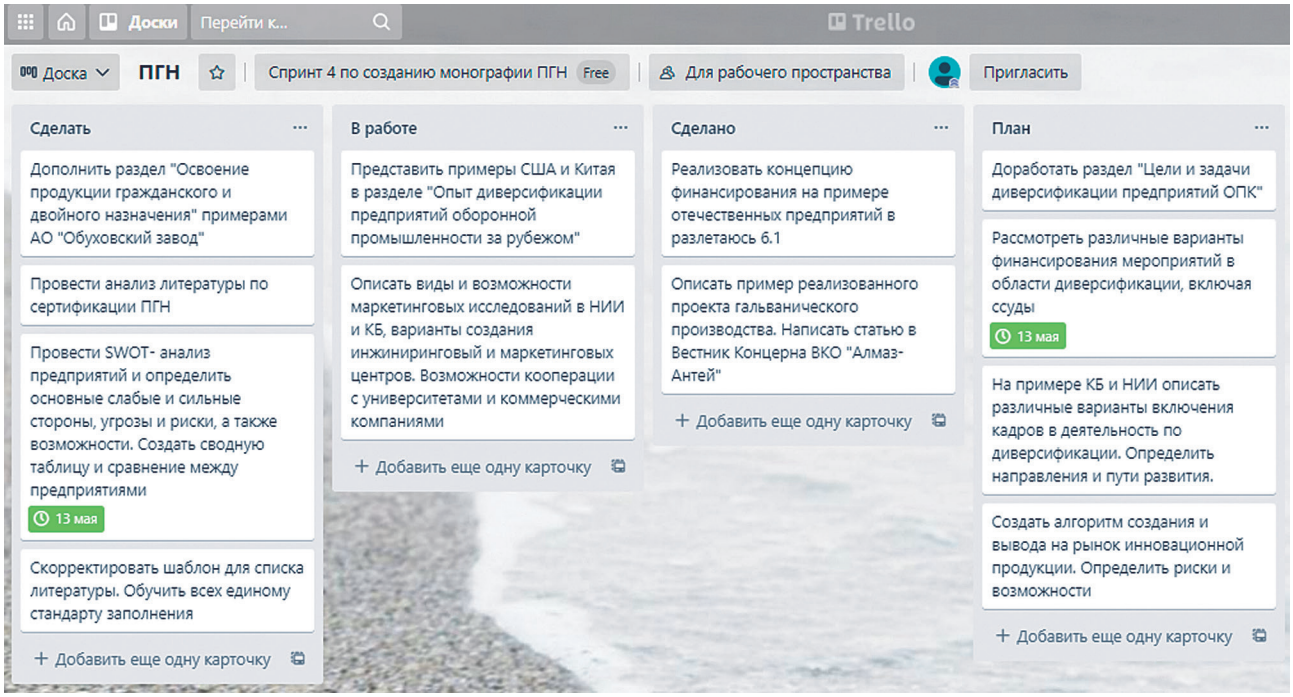

Fig. 4. Online Scrum Board for project sprint progress monitoring

For this, the Antiplagiat plagiarism detection system was used. Should the plagiarism percentage exceed the allowed value, the author of such section had to re-elaborate it. It allows formal evaluation of the think tank members efficiency, which can be conditionally measured with A4 sheets uploaded into the project DB. The results of the project participants’ work within specific areas (monograph sections) are presented in Fig. 5 and Table 1 as the rate of work.

Figure 5 shows that the work on the monograph was started with the second sprint, since the first sprint was dedicated to information collection and systematisation within the research areas. The eighth sprint was held to prepare the final monograph revision. Based on the analysis of the data in Fig. 5, we can make a conclusion on performance of each think tank member.

The table analysis revealed that section significance and content depend on a specific topic.

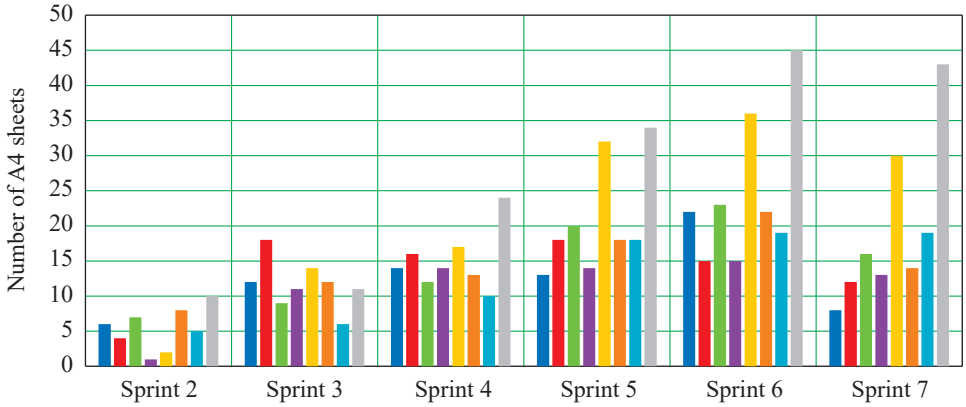

Fig. 5. Number of A4 sheets provided by think tank members following each sprint
– MIC enterprises diversification as a national strategic task; – diversification ways and approaches; – practices of the MIC enterprises diversification abroad and in the USSR; – legal support for the MIC enterprises diversification and conversion; – issues of the diversification and conversion actions planning; – issues of the production diversification actions financing; – human resources issues of the diversification and conversion actions implementation; – arrangement of the civilian production marketing at the MIC enterprises

For example, writing the relevant reference data in a section is not the same as legal analysis of the diversification support. The largest discrepancy (–7) is found in the section "Practices of MIC enterprises diversification abroad", due to information shortage.

During the research, the think tank members used the project DB to study their colleagues' materials when getting ready to discuss each sprint's results (intermediate results of the project).

Thus, following the first sprint on the monograph text preparation, the think tank members noted the need to ensure software consistency to work on the project.

Research materials discussion. Discussion of the project's intermediate results by the managers and think tank members was arranged on a weekly basis during the weekend using video conference calls on the corporate training portal of the Corporation's Scientific Educational Centre.

Table 1

Members performance by sprints

Monograph section title	Average performance in A4 sheets	Variation in terms of average value in A4 sheets
MIC enterprises diversification as a national strategic task	13	0
Diversification ways and approaches	14	1
Practices of the MIC enterprises diversification abroad	6	–7
Practices of the MIC enterprises diversification in the USSR	9	–4
Legal support for the MIC enterprises diversification and conversion	11	–2
Issues of the diversification and conversion actions planning	22	9
Issues of the production diversification actions financing	15	2
Human resources issues of the diversification and conversion actions implementation	13	0
Arrangement of the civilian products marketing at the MIC enterprises	17	4
Marketing studies	11	–2

During the discussion, each think tank member was able to present their own vision of the development ways (strategy) for the civilian production at the MIC enterprises. At this, different initial level of awareness of the studied processes was the main difficulty of the think tank joint work arrangement. It was due to the fact that the think tank members represented enterprises which are significantly different in terms of corporate structure, manufactured product items, basic technologies and mass production. It should be also noted that the think tank members lacked practical expertise in the conversion issues. Thus, ensuring the same basis, i.e. the same level of the think tank members' understanding and basic knowledge on arranging civilian production (non-core products manufacturing) at the MIC enterprises was the main task of the project managers for the first research stage workshops. However, an efficient algorithm making it possible to introduce the diversification and conversion issues to the project participants and enhance their creativity was elaborated when interacting during the workshops. In fact, each workshop turned out to be a kind of brainstorming to discuss relevant issues of concern on development of the civilian production at the MIC enterprises. Table 2 shows an example of the main issues of concern, solutions proposed during brainstorming, and their capturing in the monograph. At this, it is important to note that the discussion participants considered the proposed solutions from the perspective of their own enterprise having proper notion of its operational peculiarities. Thanks to this approach, unified algorithms to address the issues of concern related to operation conversion and diversification, which are proper for the most part of the Corporation's enterprises, were elaborated.

Identification of bottlenecks and search for the best solutions based on the brainstorming prevented risks and ensured right solutions within the shortest possible time. The brainstorming method was used almost constantly, especially prior to a new sprint start.

As noted above, the think tank members were from different corporate structures of the Corporation's subsidiaries. During the workshop, they got quite a comprehensive insight about other enterprises' operation specifics. Therefore, during the research materials discussions, the project managers prepared specific assignments on information collection, systematization and provision regarding the studied issue in terms of professional interests and duties of each think tank member.

Materials follow-up revision and research results execution. When finishing makeup of each draft section of the project, it was reviewed by each think tank member to provide improvement proposals and recommendations. The most difficult point of this work stage was to elaborate a consolidated opinion – the authors were quite reluctant about editing of their texts. The main difficulty was to prune the materials of almost all the sections of the conducted research to be within the set limited scope of the monograph under preparation avoiding loss of its practical and informative value. The only way to fulfil this task was to refine the language and ensure impeccable proofreading and editing. Style had to be aligned as well when consolidating the entire monograph. To do it all together is troublesome, so this work was done by the think tank manager at the final stage.

Research materials evaluation. During this stage, the project participants took part in subject-matter research conferences and workshops, published articles on the research fields in the main Russian peer-reviewed journals, presented intermediate research results at the meetings of winners of the Corporation's Work Team Leader Detection Program [11–15].

It should be stressed out that the project covers not only theoretical studies but also practical recommendations on conversion and diversification of the high-technology defence enterprises starting

Table 2

Example of the issues of concern under discussion and found solutions

Issue of concern	Solution found by brainstorming	Found solution was captured in the monograph
Where to find materials on diversification abroad?	1. Use Google Translate to look through foreign books. 2. Analyse articles of the Russian researchers. 3. Find reports on civilian production by years and make conclusions on diversification based on them. 4. Send a letter to a foreign company requesting materials on diversification.	No No Yes No
How to analyse risks associated with the civilian products?	1. Using a conventional risk assessment same as for the military products. 2. Enterprise profiles and account for their capacities, as well as initial search of clients are required	No Yes
What certification types for the civilian products shall be considered?	1. Russian. 2. European. 3. US.	Yes No No
Where to find information about current practices of the civilian production development at the defence enterprises?	1. Internet. 2. Call communications department. 3. Visit enterprises. 4. Literature.	Yes Yes Yes Yes
What product type shall be used as a basic one for production at the MIC enterprises?	1. Knowledge-intensive. 2. Simple. 3. CG. 4. Complex.	Yes No No Yes

from searching for an idea (market analysis, competitive bidding, etc.) and ending with a marketing project arrangement and product line extension. These recommendations were evaluated by the Corporation's subsidiaries and used as a project basis [11–15].

Recommendations on arranging research by a geographically distributed think tank

The gained experience of implementing the Development of Civilian Production at the MIC Enterprises project by the geographically distributed think tank allowed to compile some recommendations for similar work arrangement, specifically, interdisciplinary research. The main recommendations are as follows:

1. Project timing and, if required, material provision dates shall be determined at the planning stage. It is better to provide "half-baked" material on time, than "perfect" material after project completion.

2. Each think tank member should select a research (monograph) section in which they are mostly interested to further elaborate it.

3. Each think tank member should be personally responsible for provided material, i.e. it is not allowed to have several responsible persons. It is beneficial for enhancing discipline and responsibility level of the members.

4. Prior to start preparing research material (text of the monograph sections), it is reasonable to ensure that a unified software, including its version, is used in the project.

5. One of the effective methods for remote work is to arrange joint discussion of specific issues of concern. The team manager shall be responsible for discussion preparation, i.e. agenda elaboration, preliminary selection of the input data, etc., as well as discussion moderation.

6. It is advisable to arrange the research progress discussion once a week at exactly defined time. Each think tank member shall be given 3 minutes maximum to report on the weekly progress, and 5 minutes shall be allocated for

discussion, after which the meeting shall proceed to another report. Such procedure emphasizes the report importance and requires that a team member be prepared and report on the results succinctly.

7. The project manager shall decide on the research development ways considering the materials provided by the project participants, get into specifics or propose collecting additional materials.

8. The think tank members shall have free access to the information and data related to the project subject matter and not requiring access to the data constituting a state or commercial secret.

Conclusion

Analysis of arrangement and performance of the interdisciplinary research on the civilian production development ways at the MIC enterprises which was performed by the geographically distributed multi-faceted think tank resulted in the following conclusions.

1. A complex interdisciplinary research can be successfully implemented by a think tank of young managers and specialists from different enterprises related to a vertical operation hierarchy. The remote information technologies can be used for this purpose.

2. Well-minded work management and coordination by the think tank manager, which is targeted to ensure fulfilment of personal tasks by each think tank member within the set deadlines, is an important factor impacting research efficiency and results.

3. The monograph preparation being the ultimate goal of the interdisciplinary research was quite reasonable from the methodology prospective, since it ensured not only clear and unambiguous setting of the implementation deadlines but also presentation of the results as a monograph section list, each think tank member being appointed responsible for a specific section.

4. Use of the Barry Boehm's spiral model as the research and method basis of the think tank work made it possible to implement the project within a quite tight schedule in a relatively small number of cycles – sprints. Ultimately, there were eight sprints.

5. Availability of the constantly increasing cloud database on the corporate training portal of the Corporation's Scientific Educational Centre made the research arrangement significantly easier in general and ensured efficient individual work of the think tank members working remotely. At this, intermediate results of personal research of the project participants were available for all the think tank members.

6. Thanks to the video conference service on the corporate training portal of the Corporation's Scientific Educational Centre, which was used to jointly discuss the ongoing results when performing the research, each think tank member was able to express their own opinion, discuss it in detail and come to a consolidated solution. In fact, each joint discussion turned out to be a kind of brainstorming.

7. Feasibility and reliability of the statements articulated within the research were confirmed in terms of evaluation: intermediate research results were presented at subject-matter research conferences and meetings of winners of the Corporation's Work Team Leader Detection Program. The research results were published in the main Russian peer-reviewed journals.

It is important to note that the think tank research resulted in one of ten monographs published under the Corporation's Work Team Leader Detection Program. The monographs preparation was enabled thanks to high professional level and major focused work of *Ya. V. Novikov*, Director General of the Corporation, Candidate of Economic Sciences, *G. V. Kozlov*, Deputy Head of the Administration for Director General – Head of Secretariat of the Corporation, Doctor of Physical and Mathematical Sciences, Professor,

S. E. Eroshin, Deputy Director of Scientific Educational Centre of the Corporation, Candidate of Engineering Sciences, as well as managers and specialists of the Corporation's subsidiaries who facilitated the research.

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Опыт проведения прикладных междисциплинарных исследований территориально распределенным творческим коллективом

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Проведен анализ опыта выполнения научно-исследовательского проекта по изучению стратегии развития производства гражданской продукции на предприятиях оборонно-промышленного комплекса России. Особенностью данных научных изысканий стало применение концепций гибкого проектного подхода и бережливого производства к междисциплинарному исследованию, проведенному территориально распределенным коллективом.

Ключевые слова: управление проектами, междисциплинарное исследование, творческий коллектив, оборонно-промышленный комплекс, конверсия, диверсификация, гражданская продукция, товары народного потребления.

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Область научных интересов: инженерные расчеты, методы проектирования сложных технических систем, системный анализ, промышленная автоматизация, управление проектами, методы и средства цифровой трансформации предприятий высокотехнологичных отраслей промышленности.

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Область научных интересов: аэродинамика и динамика полета летательных аппаратов, авиационные и космические системы, организация производства в аэрокосмическом приборостроении, оценка влияния факторов природной среды на эффективность функционирования сложных технических систем.