



Contents lists available at ScienceDirect

CIRP Journal of Manufacturing Science and Technology

journal homepage: www.elsevier.com/locate/cirpj



Corporate knowledge management in Ramp-up conditions: The stakeholder interests account, the responsibility centers allocation

Julia Y. Yeleneva, Alexander A. Kharin, Konstantin S. Yelenev, Vladimir N. Andreev*,
Olga S. Kharina, Elena V. Kruchkova

Moscow State Technological University "STANKIN", Vadkovsky per., 1, Moscow 127994, Russia

ARTICLE INFO

Article history:
Available online xxx

Keywords:
Knowledge management (KM)
Stakeholders
Ramp-up
Types of knowledge
The responsibility centers for the knowledge management

ABSTRACT

In this paper, based on stakeholder theory and value chain concept integration, a new approach to the corporate knowledge management in a Ramp-up is introduced. With set theory use, the types of knowledge the development of which is in the interest of the stakeholders are conceptually defined.

The paper also includes the description of the approach to definition of responsibility centers for knowledge management, highlights their functionality, provides examples of specific practices and knowledge management tools.

© 2017 CIRP.

Introduction

Russian machine-building enterprises face an urgent need to switch to the production of high-tech products, targeting the civil market that have a high export potential. Diagnosis of the current state of relevant enterprises [1], showed that a key challenge is to ensure the effective management of changes, reducing the "time to volume" with mass Ramp-up on several enterprises within the large holdings. In the previous study [2], the authors examined quality management indicators during the Ramp-up period in the context of individual elements of value-chain. Obtained results enabled us to identify the issue of corporate knowledge management as a priority for further research, since knowledge management is one of the basic factors influencing the process of new products development and the achievement to the planned production capacity.

Literature analysis devoted to the Ramp-up during recent years clearly reflects the gradual formation of the need for conceptual understanding of human capital management issues and the collection of business knowledge.

As the actual article, affecting knowledge management issues, the work of Heine et al. [3] and Stiller et al. [4] should be noted. In that work during the expert focus group the main features of personnel management within the framework of the Ramp-up were considered, in particular, such aspects as knowledge

management, competency modelling, reward systems, leadership development, employee selection, and team development.

As an important hypothesis outlined in the article, it may be noted the Ramp-up success dependence from whether the project team specific acquired competencies are developed in the framework of pre-formed target competency model. Another important thesis is the need for proper selection and adaptation of the management team under the specific objectives of concrete Ramp-up project. The detailed review of the literature given in the analysed article, however, demonstrates low level of conceptual and empirical elaboration on the field of human resources management in the Ramp-up process.

A typical example of purposeful enterprise knowledge management during the Ramp-up is the case of Hyundai Steel. The study Sungwoo [5] clearly showed the dependence of the construction speed, technology and debugging and output on a production capacity of several blast furnaces from knowledge management technologies. In particular, the overlapping strategy was applied in Hyundai Steel, when the new blast furnaces were put into operation so that the teams working on each of the project implementation phase, could move from one blast furnace to the other, transferring the experience and the competence from one project to the next one. In addition, this case has reflected the importance of orientation on external stakeholders in the framework of knowledge management. Permanent intensive feedback from the client (Hyundai Motors) within a single holding company allowed Hyundai Steel to quickly adapt smelting technology and develop specific know-how in the production process.

* Corresponding author.
E-mail address: rector@stankin.ru (V.N. Andreev).

Levitt et al. overviews the learning by doing phenomenon in the automobile assembly plant [6]. Notably the authors consider not only the learning process but also the aspects of knowledge stock formation. On the statistical basis the authors show how learning effect decreases “defect-per-car” ratio and enables to increase the assembling speed. The research provides a clear description of the corporate knowledge importance, however it lacks the description of practical managerial implications.

Thus, as a general approach to the studied problems the authors chose the concept of creating value for the stakeholders. In this regard, the aspects of corporate knowledge management theory were overviewed under the Ramp-up context, several suggestions for a knowledge management organization focused on effective Ramp-up and business value increasing were proposed.

In the Second Chapter of the paper a literature review over knowledge management problem within the framework of resource-based approach and stakeholders theory is revealed.

Chapter 3 represents the allocation of different knowledge types and their characteristics, shows the conceptual approach towards monitoring the interconnections between stakeholders' needs and corporate value creation processes and describes a method of responsibility centers for knowledge management selection.

Chapter 4 provides the practical examples of knowledge management in the Russian machine-building industry and offers a set of knowledge management methods and tools, grouped by the elements of the value chain. The proposed methods are illustrated by the example of “School of the chief technologist” project elaboration.

Finally in Chapter 5 the conclusions and directions for future research are highlighted.

Literature review

With reference to the present study it is reasonable to select several blocks of literature. The first block of literature examines the knowledge management problem within the framework of resource-based view [7–11]. In these works it is emphasized that knowledge at present is the most valuable resource, while it forms core competencies of the enterprise, ensures the effective functioning in an unpredictable market environment and competitiveness.

The theoretical foundations of the company's resource concept were laid by Penrose, who studied the process of economic growth of private firms. She viewed the firm as both an administrative organization and a collection of productive resources, both human and material [7]. According to her opinion, resources alone are never involved in the production process, resources must be transformed into services. Services are the function of the accumulated experience and knowledge of the firm, they determine the face of the firm.

The starting point for the modern resource-based approach to management is considered to be the article “Resource-Based View of the Firm” by Wernerfelt which first pointed out “the usefulness of analyzing a firm in terms of its resources rather than products” and hypothesized that such an approach could become a new paradigm for studying strategies [8].

Prahalad and Hamel in their fundamental work “The Core Competence of the Corporation,” exemplified the leading companies by explaining the merits of the concept of the firm as a portfolio of organizational competencies (abilities) rather than as a portfolio of business units [9].

While Prahalad and Hamel emphasize the importance of technologies and production skills of the corporation, which ensure the production of a wide variety of products and are the core competencies, Stalk et al. consider the skills and business

activity that cover the entire value chain in order to determine the production potential of the company [10].

It should also be noted that the logical continuation of the resource approach to management was the concept of dynamic abilities developed by Teece et al., which supplemented the resource approach with the factor of time [12]. Dynamic capabilities are the firm's ability to integrate, build and reconfigure internal and external competences or resources to address rapidly changing customer and technological environments [12].

There are several examples of the integration of knowledge management and the resource approach to management (the concept of dynamic abilities). For example, Cepeda-Carrion et al. [11] notes that effectively built combination of knowledge management processes like the absorptive capacity, knowledge transfer and knowledge application, allows the company to create exceptional value for consumers. He also postulates that the combination and interrelation between KM processes (absorptive capacity, knowledge transfer, and knowledge application) constitute dynamic capability [11].

Within the first block of literature it is possible to isolate a set of studies devoted to the problems of companies technological capital management. In particular, Grigoriev et al. [13,14] suggests to consider technological capital as total of the two components: the tangible component, including active part of the enterprise fixed production assets (FPA), and the intangible component, aggregating intangible assets (IA), connected with production and production management. The applicability of the concept to the problem of knowledge management is obvious, because the successful growth of knowledge fixed in the form of intangible assets, provides the company with the growth of technological capital (in terms of its intangible component).

In its turn, that technological capital is an important driver of the Ramp-up success and has a direct impact on the company's competitiveness on the high-tech markets.

The second block of literature reflects the attempt to formalize and build up the conceptual models of knowledge management [15–20]. For example, Drucker investigates various aspects of applying knowledge in the practical managerial activities. In particular, in 1960, he introduced the terms “knowledge work” and “knowledge worker” [15]. In the book “Post-Capitalist Society” he outlines his views, according to which we enter the “knowledge society”, where “capital, natural resources or labor is no longer the main economic resource”. They have and will have knowledge, and the main role will be played by the “worker who creates knowledge” [16].

In turn, Davenport and Prusak postulate the distinction between data, information and knowledge and suggested ways of converting data into information, and information into knowledge. Summarizing the studies, they propose the following definition of knowledge: “Knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers. In organizations, it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices, and norms” [17].

A step from the knowledge of the individual to the knowledge of organization was made by Senge. Senge believes that many organizations suffer from the “inability to learn.” To remedy this situation and restore lost abilities, he proposes a practical model of the “learning organization”, pointing out that the capacity for both creative (active) and adaptive (passive) learning is a source of competitive advantages [18].

Nonaka and Takeuchi [19] propose to describe the process of new knowledge creating in organizations using the spiral model, consisting of four stages. The model name consists of the first

letters of the names of these stages: socialization (socialization), externalization (externalization), combination (combination) and internalization (internalization). The first phase is the phase of socialization, in which individuals share tacit knowledge. Further, the new tacit knowledge is converted into explicit one (externalization). Explicit knowledge is accumulated at the combination stage, and the final stage (internalization) is the knowledge creation process – the newly created explicit knowledge is absorbed by individuals, thereby enriching their existing tacit knowledge. After it again the exchange of tacit knowledge and the process of knowledge creation continues on a new round of the spiral.

Finally, Wiig [20] proposes the unified concept of knowledge management, where the term “knowledge management” is defined as follows: “knowledge management is a strategy that transforms all types of intellectual assets into higher productivity, efficiency and new value; systematic processes that allow to create, save, distribute and apply the basic elements of intellectual capital necessary for the success of the organization”.

The aforementioned works make significant contribution to essential understanding of the knowledge management problem, but they require additional clarifications as applied to the practical activities of companies and do not cover the issue of stakeholders' participation in the generation of corporate knowledge as a whole and in particular during the Ramp-up.

As an exception the work of Letmathe and Rößler [21] could be mentioned. The authors overview different forms of organizational learning in production Ramp-up. On the basis of thorough literature review Letmathe and Rößler address the key message according to which the consecutive production Ramp-ups cause a knowledge Spillover effects that higher performance. However the authors only indicate the goal of learning resources allocation and management.

The problem of involving stakeholders in the generation of knowledge of the company during a long time was in the sphere of interests of practitioners, and the third block of literary sources is associated with stakeholder's concept.

So, for example, in his work Poetz and Schreier are wondering: “Who would you suggest should be asked to generate ideas: the professional engineers, marketers, and/or designers who work for the company, or its potential customers or users in general? Moreover, who would be able to come up with better ideas?” [22].

The question seems completely logical, given that companies have now developed techniques for effectively involving consumers in their own activities, in particular, in the process of new product development (NPD). One of such methods is the formation of informal networks of loyal consumers and systematic work with them (for example, conduct competitions, as well as actions aimed at increasing loyalty). This allows companies, using the principles of crowdsourcing, to provide a huge influx of new ideas to improve their products (services). Thus the new value for the customer is created.

So, as a classic example is the experience of the companies-developers open-source software (such as Apache or Linux), which is developed exclusively by a community of users rather than professional software developers employed by firms [22]. A number of positive examples of attracting consumer knowledge are also recorded in Dell (which has launched an initiative called Idea Storm, where users from around the globe have been invited to suggest product improvements and new product ideas on-line), Adidas, BBC, BMW, Boeing, Ducati, and Muji [22].

The conducted empirical studies allowed Poetz and Schreier to conclude that both professionals and users provided ideas to solve an effective and relevant problem in the consumer goods market for baby products. The study reveals that the crowdsourcing process generated user ideas that score significantly higher in

terms of novelty and customer benefit, and somewhat lower in terms of feasibility [22]. Thus, the authors make an unambiguous conclusion that crowdsourcing might constitute a promising method to gather user ideas that can complement those of a firm's professionals at the idea generation stage in NPD. Such consumer's involvement allows to conduct Ramp-up in the company most effectively.

Obviously, the consideration of consumers as an example of an external source of knowledge wittingly simplifies the task of analyzing the external “circle of knowledge” of the company, because consumers, according to their “disinterestedness” from the point of view of obtaining knowledge (or minimal costs) and sufficient disunity, seem more convenient object for studying, than other external stakeholders. At the same time, they can also be subjected to appropriate analysis, provided that research models are supplemented by factors of material (or non-material) stimulation and the presence of a single management principle.

Another direction of engaging a particular group of stakeholders to generate organizational knowledge was to involve them in projects to improve the environmental situation in a certain locality. For example Lederer et al. describes the experience of attracting local stakeholders in Clean Development Mechanism (CDM) waste composting projects, ongoing in lower income countries, international organizations [23].

As local stakeholders stand out city authorities and politicians, locally operating NGOs, waste collectors and pickers or waste producers, who play crucial role in the success of CDM waste composting projects. Active involvement of local stakeholders in projects that allow to collected information and knowledge exchange, to create a new organizational knowledge of the project participants, increases the efficiency of planning and implementation CDM waste composting projects, including during the Ramp-up period.

In the presented examples, the interaction of the company-initiator of knowledge creation with one group of stakeholders and attracting relevant knowledge is considered. Obviously, this, on the one hand, does not allow us to take advantage of the opportunities for the co-creation of many participants, and, on the other hand, simplifies the existing operating conditions for companies. In this regard, Kazadi et al. proposes an approach presupposing co-creation with multiple stakeholders simultaneously [24]. At the same time, in his work he focuses on a focal firm integrating on its own specific capabilities (e.g. networking capability, absorptive capacity, etc.) stakeholder knowledge and receiving such benefits as access to unique resources and knowledge bases, and raises new challenges because of the diverse characteristics, interests and goals of the different stakeholders involved [24].

As an example illustrating the participation of stakeholders in the process of creating corporate knowledge, Kazadi et al. adduces the involvement of non-profit organizations to collect private information about the results of the use of certain medications in the treatment of patients. Due to the confidentiality of such information, access to it is a valuable resource for pharmaceutical companies [24].

The analysis of literary sources made it possible to establish that the greatest attention for the researchers and practical interest currently causes the focal firm, which attracts knowledge of stakeholders for value co-creation, especially in Ramp-up period. A separate research problem is the definition of the optimal composition of participants, as well as the amount and type of knowledge involved. In addition, it seems relevant to form a set of methods and tools for knowledge management in these conditions.

In this regard, it is obvious that it is expedient to develop a model for integrating stakeholder knowledge into the company's knowledge, which allows to systematically and holistically present

the process of creating new knowledge, built on a network principle and providing the opportunity to effectively produce products and services on the basis of unique capabilities of focal firm.

The basic postulate of the stakeholder theory is that the enterprise, formulating and achieving the purposes of its activity should take into account the interests of various stakeholders, which form a certain informal coalition [25]. There are certain relationships that can take place between different stakeholders: co-operation (due to the coincidence of their interests) or the competition. The competencies in the field of interaction with stakeholders are the key managerial competences that form the dynamic capabilities of the enterprise [12].

Ackoff examines the relationship of the company with its stakeholders in terms of six kinds of exchanges taking place [26]:

- money exchange for the employees work;
- money exchange for goods and service providers;
- exchange of goods and services to consumers money;
- exchange of money which would be paid later for the money received now from investors and lessors;
- exchange of money which are paid now for the money to be received later from the debtors;
- exchange of money for goods and services (for example, water, scavengery, police protection) and the government public service.

Furthermore, Ackoff concludes that all the company's possible relations with its stakeholders could be reduced to two processes: the company consumes itself and makes consumption possible (due to the production of goods and services, as well as money provision).

Noteworthy stakeholder's classification is proposed by Streltsova and Zaika [27]. In particular, there are three types of external stakeholders:

- from the market environment (suppliers, competitors, distributors, shareholders, which have economic relations with organization, and therefore effect on the consumer value creation);
- from a socio-political environment (public authorities, local governments – they, in particular, define the national regimes of intellectual property protection, and public organizations and their associations);
- from the technological environment (owners of new knowledge, competences, competitive technologies that affect the new knowledge generation and its diffusion, the spread of new technologies, the adoption of new industry standards, thus, determine the speed of organizational knowledge obsolescence).

While building knowledge management system focused on the stakeholders interests during the Ramp-up, it becomes crucially important that the stakeholders themselves could be recognized as a source of new knowledge for the company and the corporate departments, that share the responsibility for the Ramp-up process.

That is why within the framework of the corporate knowledge management during the Ramp-up we decided to begin with the establishment of the correspondence between the parameters of the stakeholder's needs and the characteristics of the processes implemented in the framework of primary and support activities of the company (according to the classification Porter [28,29]).

The review of contemporary studies in the field of stakeholders theory reflects the interpenetration of the theory of stakeholders and the theory of value chain management.

The recognized expert Freeman et al. [30] points out that stakeholder theory in itself enables to redefine the approach to value creation. Hein et al. [31] views the stakeholders under the industrial symbiosis point of view which highly correlates with the value chain development concept. However authors focus on the value flows and the focal organizations without analysis of the role of structural divisions of the companies in the process of value creation. Tantaló and Priem [32] highlight the mechanism of cooperative (with stakeholders) value building and try to systemize multi-attribute utility functions, that guide the decision making of different stakeholders.

Most closely to the problem of knowledge management in the context of value chain management and stakeholders theory approached Schenkel et al. [33]. That author investigates the role of stakeholders in closed loop supply chains, using the value based approach and strategic success factors approach. Notably, that article distinguishes primary stakeholders who are involved in the value chain and secondary stakeholders like NGOs, and local societies.

While identifying the types of value creation in closed loop supply chains Schenkel indicates the presence of information value, that is able to drive the value creation process throughout other types of value (economic, environmental and social, customer values).

Importantly, the set of case-studies presented in Schenkels study shows that information creates value only if it enables to change the product or the supply chain processes and is shared and used among both the corporate departments and primary stakeholders.

Basically, the analysis of the relevant literature shows, that despite the presence of a considerable number of publications that cover collectively the issue of stakeholders and value chain management there is an uncovered niche of knowledge management during the ramp up process within the value chain and stakeholders theories framework.

Logically, following the value chain the company communicates with different groups of stakeholders. The communication involves both primary and support activities. For example, the primary activity “purchasing and supply” obviously involves the suppliers as stakeholders, that are also involved in communication with the company through the support activities (e.g. procurement and technological development).

Conceptual overview of the approach

In addition to the unilateral satisfaction of needs of stakeholders the process of value creation in each link of the chain involves the transfer of the knowledge from stakeholders to the company through the relevant structural units.

Following the aforementioned example, we can specify that suppliers of raw materials and components can be viewed as sources of valuable marketing information, stimulate the introduction of innovative technologies, promote effective technological solutions especially during the Ramp-up period.

It is obvious that the implementation of performance improvement processes during the Ramp-up can efficiently achieved through the introduction of knowledge management system. Thus, initially the management needs to understand which processes in the value chain affect the stakeholders' needs, how do they do it and also what knowledge could be perceived from the stakeholders along the value chain.

The establishment of this compliance can be visualized by means of a formalized description of the system – “stakeholders – the processes in the company”, using the set theory.

The totality of the needs of different stakeholders can be expressed in the form of $A = \{A_1, A_2, \dots, A_n\}$, where A_i ($i = 1; n$) – the

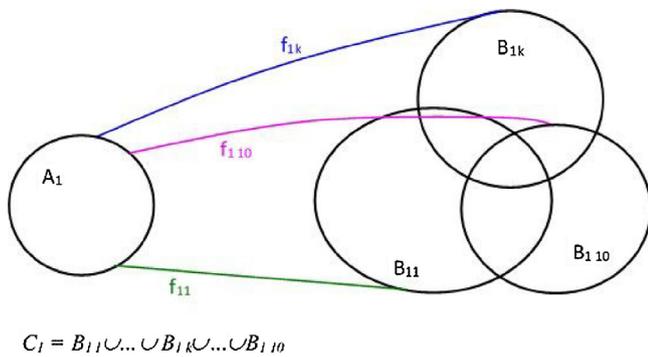


Fig. 1. Visual display of the plurality of interconnection needs of stakeholders and a number of process parameters of main and auxiliary activities of the company.

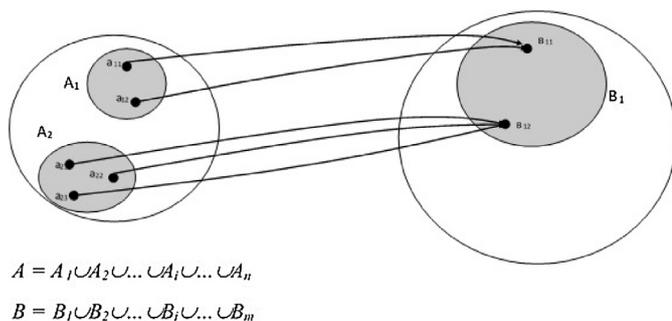
set of parameters needs of different categories of stakeholders, n – the number of categories of stakeholders (in this case $n = 7$, as we added to Ackoff's categories of stakeholders, such categories as, "shareholders" and "management", but omitted the category "debtors").

The set of features implemented in the company's processes are also represented in the form of $B = \{B_1, B_2, \dots, B_m\}$, where B_j ($j = 1; m$) is the set of parameters characterizing the processes implemented by the primary and support activities of the company and meet the interest of i -th group of stakeholders.

In each element of A it is possible to put an element of B , since any administrative decision and its implementation, leading to a change in any parameter of primary or support activities of the company, or maintenance it at a certain level, is the reaction of management on the state of the value chain, which reflects the interests and preferences of stakeholders. Thus, any element of the set B has the inverse image in the set A (Fig. 1).

Each subset A_i ($i = 1; n$) of A can be associated with elements B_j , and each set of A set corresponds to a set of subsets of B_{ik} ($i = 1; n; k = 1; s$), where s – the number of elements of the value chain (five elements for the primary activities and the five elements for support activities) ($s = 10$). Graphically, this is shown in Fig. 2.

Fig. 2 shows how the parameters of needs of one group of stakeholders (e.g. investors) are displayed on a plurality of process parameters of primary and support activities of the company, that is, ten subsets are associated with a plurality of $A_1 - B_{11}, \dots, B_{1k}, \dots, B_{110}$. In this case f_{ik} ($i = 1; n; k = 1; 10$) is a way to display some limitations that arise when establishing correspondences (f_{11} corresponds to a mapping through an element of the value chain "incoming deliveries", f_{1k} – displays through the k -th element of the value chain and f_{110} – displays through the element of the value chain "relations with public authorities").



$$A = A_1 \cup A_2 \cup \dots \cup A_i \cup \dots \cup A_n$$

$$B = B_1 \cup B_2 \cup \dots \cup B_j \cup \dots \cup B_m$$

Fig. 2. Visual display of subsets A_i stakeholder needs into subsets B_{ik} process parameters of main and auxiliary activities of the company on the elements of the value chain.

The sum of all sets of parameters that describes primary and support activities of the company $B_{11}, \dots, B_{1k}, \dots, B_{110}$ defines plurality of C_1 , which characterizes common to all ten elements of the value chain process parameters of primary and support activities related with parameters of stakeholder group A_1 needs.

Similarly, correspondence may be established between other sets A_i and B_{ik} ($i = 1; n; k = 1; s$), which will result in the collection of sets C_i ($i = 1; n$).

Analysis of the sets C_i showed that each of the data sets will include a set of indicators that characterizes the management by certain types of knowledge in the company. These indicators will be equally responsible for the parameters of stakeholder needs, manifested through the elements of the value chain of the company.

Analysis of separate types of knowledge (generation and transfer of which should be established on a systematic basis during the Ramp-up period), was conducted in the present study in compliance with the classification proposed by Skyrme and Amidon [34]. According to that classification, corporate knowledge in Ramp-up can be divided into the following semantic groups: *what, who, how, when, where and why*.

The formalization of knowledge from the position of the follow-up activities is presented in Table 1.

Development and implementation of a company's strategy using the proposed approach is a dynamic process that requires constant monitoring of the internal and external environment, an assessment of own abilities in relation to the tasks, the identification of gaps in knowledge and competence, and the identification of mechanisms to eliminate gaps of data and the development of appropriate behavior.

Also as part of this approach, special emphasis is placed on a permanent generation of new knowledge: minor improvements and minor decisions arising in the course of daily work, the successive changes that are implemented at all levels of the organization. All this together can lead to the generation of new knowledge and increase the Ramp-up speed. Thus, the contribution to the process of developing and implementing Ramp-up could be made by almost any employee who knows the relevant information. It is only necessary to implement appropriate organizational support of the process.

Within the developed approach we propose to allocate knowledge management responsibility centers in accordance with the previously defined types of knowledge in the company.

Such action is justified by the need to distribute responsibility for corporate knowledge management (in particular, in terms of planning and the results of the report) between the divisions of the company. Such approach allows to:

- determine which company's divisions are actually responsible for the generation of a particular type of knowledge;
- objectively assess the results and operational departments to coordinate actions;
- creates an effective system of motivation of employees to perform tasks during Ramp-up.

In order to allocate the knowledge management responsibility centers of an enterprise the value chain concept will be used.

Business units that implement primary activities require, accumulate and create knowledge associated with the production, sale and service of the product. The key determinants that form the request to the knowledge management system for primary activities will be: the consumer properties, quality and production costs, time of manufacturing and launch. For the support activities related determinants will be: the quality, time and cost of primary activities. Based on the above-mentioned provisions the model of

Table 1
Classification of knowledge in the field of Ramp-up.

Types of knowledge	Characteristics of types of knowledge
Know what	The main meaning of knowledge. It is commonly accepted “facts”, as well as experience and access to training. The concept of the future state of the real or ideal object, in particular, the planned results Ramp-up (target product description and its parameters)
Know how	Knowing how to perform actions. Part of this knowledge is manifested in organizational procedures, but in practice it mostly has an implicit in character and is in people’s heads. New methods of modernization processes are born out of practice faster than is reflected in the instructions and procedures. Mastering the knowledge of “how” (know-how) depends on the skills and experience to the development and improvement of which takes time
Know who	Knowing who can solve the problem. Like other categories of knowledge are based to some extent on the judgment and the ability to assess the skills and strengths of the other person. Example – personnel involved in a corporate network are a natural source of such information. They may not know how to solve the problem, but they know who can solve it
Know when	The sense of time, knowledge of timing of certain operations in the framework of an integrated project. In accordance with the above-mentioned example of the steel industry (Sungwoo), the time-management competence can be crucial in the implementation of Ramp-up
Know where	Knowing where to perform the action. Drivers of change are increasing their exposure or reach a critical mass in certain places, where, for example, people with specific qualifications concentrate
Know why	It involves the wider context and vision than previous types of knowledge. It involves understanding of the true relationships and interdependencies underlying the individual phenomena and processes. Such knowledge, for example, allows professionals to begin solving unstructured problems in most appropriate ways (often contrary to established procedures)

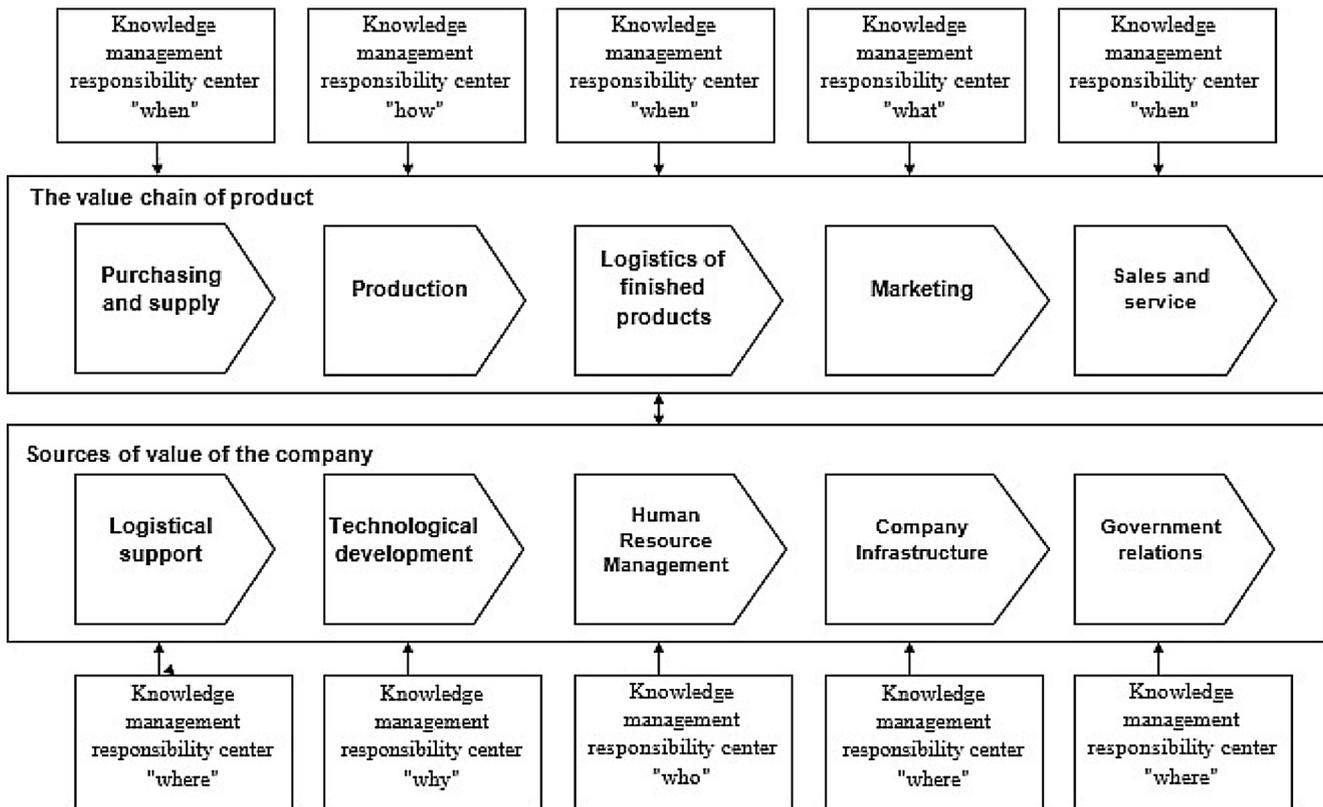


Fig. 3. Model “The selection of responsibility centers for knowledge management in the value chain of the company”.

knowledge management responsibility centers allocation in the value chain of the company was elaborated (Fig. 3).

Consider the responsibility centers for knowledge management identified within the framework of the model:

1) Knowledge management responsibility center “what” This center is responsible for working with information about customer’s current and future needs and the ways of its transfer to the reference for engineering company’s services. The accumulated knowledge, in turn, should allow to achieve such goals as

increased visibility and prestige of the company, the creation of new and expansion of existing markets, etc. Respectively, the subsystems of the knowledge management center should be oriented on a similar job. The center’s efficiency could be indirectly determined by the degree of customer satisfaction in relation to the dedicated resources of the center.

In the case of Ramp-up, the importance of knowledge management tasks on the block “what” repeatedly increases. Core business units are necessary to ensure the timely delivery of

marketing information about consumer properties of the new product from the stakeholders, to involve consumers in the systematic communication with the company on quality issues.

2) Knowledge management responsibility center “how”. In this center the management is responsible for systematic work on knowledge management, aimed at ensuring production capacity and production with the set value and quality characteristics in a timely manner, as well as the continuous improvement of the process. The effective functioning of this center may be indirectly determined by using the following indicators: profitability, product profitability, the duration of the production cycle, the proportion of new products.

During the Ramp-up the block “how” basically means the extremely fast and efficient debugging the technologies for required volume of products with regard to resource and competency limitations. Critically important is the adjustment of horizontal connections and the use of knowledge-sharing technologies, in particular, Scrum-sessions.

3) Knowledge management responsibility center “who”. The center must have the information and generate new knowledge that in combination enables the effective selection, development and use of the company’s staff. Effective functioning of the center, in particular, is the key to the success of all the other centers in terms of providing the necessary expertise. The effective functioning of this center can be indirectly determined by labor productivity in the company. While preparing for the Ramp-up within the block “who” the matters of recruitment and training of management team and key employees implementing Ramp-up should be primarily addressed.

4) Knowledge management responsibility center “when”. Knowledge management in the framework of this center is often reduced to ensure access to the knowledge of the moment of simultaneous access to supply networks and value chains, giving the company the opportunity to save money on incoming shipments and to have additional profit to sales. In this case functioning efficiency can be determined indirectly through the return on sales and the cost of inbound deliveries. In the case of Ramp-up unit responsible for the block “when” may also be adopted by the central project management authority, determining the schedule of individual works on projects in a single schedule.

5) Knowledge management responsibility center “where”. Knowledge management in the framework of this center in the general case is reduced to provision of information about the procurement’s sources (in the broadest sense) and the availability of knowledge about the ways of their acquisition. In this case

functioning efficiency can be determined indirectly through the rhythm of deliveries, availability of long-term leases, consulting services, licensing agreements, etc. The centers responsible for the knowledge management “where” in the Ramp-up can be considered as statements of knowledge, carrying out search and formalization of best practices under the articulated problems of specific units.

6) Knowledge management responsibility center “why”. The integrated areas of activity in which knowledge management is conducted in this center include product improvement and perfection of the production process. Understanding of the underlying fundamentals of the processes and phenomena of the real world and working out on their basis of new (improvement of existing) technologies requires special training and knowledge management tools. The center’s effective functioning can be estimated indirectly using innovative management indicators (the rate of innovation, the costs of innovation, including the introduction of technological, organizational and marketing innovations, etc.). Knowledge management on the block “why” is designed to give the essential answers regarding the design of all Ramp-up process, its synchronization and association with the development of other processes within the company, or a few Ramp-up projects within the holding structure.

Comment on a few key features of this model are listed below:

Firstly, there is a relationship and exchange of information between all the knowledge management responsibility centers. At the same time in different situations the same center can acts as a customer and as a consumer of information.

Secondly, the presence of a particular hierarchy. Thus, inherent in the value chain separation for the primary and support activities transferred to the knowledge management responsibility centers, which correspond to them.

It is necessary to note that if we present knowledge management as the process of transformation of inputs (unstructured data) to the output results of knowledge (as a product with a value), then the effectiveness of management should be defined as the ratio of the result and the incoming resources, that is, as the value of the knowledge increments (Fig. 4). According to this ratio is calculated the functioning efficiency of each center for its specific type of knowledge.

Each responsibility center for knowledge management communicates with certain group of stakeholders and absorbs the dedicated information and implements it in the corporate knowledge management system. Routinization of knowledge absorption and transmission procedures is often hampered by the rapid change of internal and external factors in the period of

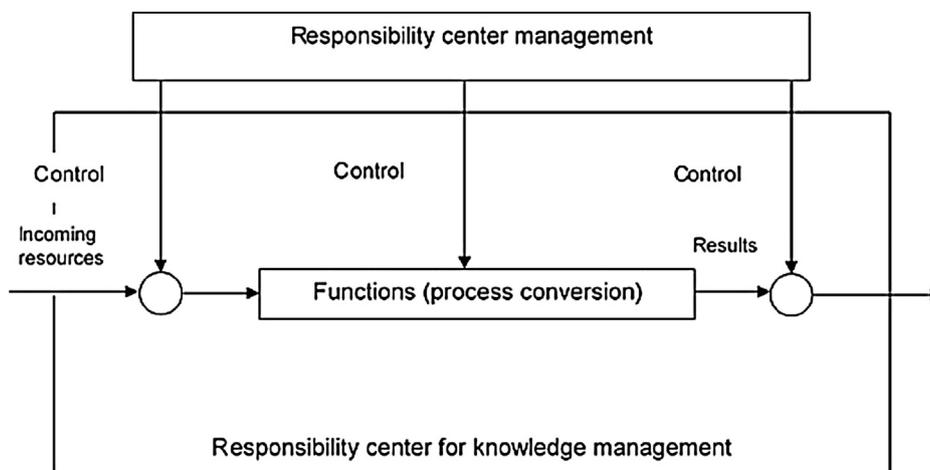


Fig. 4. Responsibility center functioning model for knowledge management.

the Ramp-up. However, it is possible to define the general framework of responsibility center functioning. The center of responsibility “what”, which is critically important in the period Ramp-up should have the highest possible degree of integration with customers as stakeholders, mainly focusing on communications with so-called “innovators” and “early adopters” [35]. Adapting and transmitting signals from consumers in the production subsystem, the knowledge center “what” creates additional value for consumers, who get fast response to their queries.

The knowledge centers “when” and “where”, that are situated at the beginning of the value chain mainly focus on communication with suppliers. That knowledge centers accumulate information about the pool of suppliers, available stock, prices, conditions of deliveries. Subsequently, forming a partnership relations with a supplier that knowledge centers maximizes value for both parties, increasing the rhythm and accuracy of supply with the improvement of production technology and demand growth, and help to avoid the “bullwhip effect” in the supply chain [36]. The centers “when” and “where” also donate the relevant information to the corporate knowledge management system and thus provides the additional information for the responsibility center “How”.

The knowledge center “how” aggregates the most substantial body of knowledge concerning production techniques and process. It is also mostly integrated into the corporate information system and its daily functioning and adoption during the Ramp-up phase. Collecting, interpreting and transferring the best practices from different production sites and departments (accordingly, from personnel and management as the stakeholders) that knowledge center helps that stakeholders to increase productivity and achieve production targets efficiently. Anyway, that knowledge center is highly integrated with the center “who”, that closely works with staff at the general and personal level.

With the increasing digitization of production systems the role of HR management grows considerably as well as the necessity to communicate with the staff as the stakeholders. The knowledge center “Who” creates value for staff as stakeholders by ensuring the compliance between requirements of the value chain links and the competencies of personnel.

Knowledge management responsibility center “why” mainly focuses on strategy, benchmarking, innovations and cost-efficiency aspects of Ramp-up. That center stays in touch with corporate top-management, owners, state authorities, non-profit organizations, universities, start-ups, engineering and R&D centers. The systematic work of that center is to create value for the listed above stakeholders by synchronizing the strategic vector of corporate development with the fundamental needs of stakeholders. For this purpose, the primary goal of that center is to form the basic limitations for corporate knowledge management system development.

Practical implications

As part of the approach development, we analyzed the experience of a number of leading Russian engineering companies in the field of corporate knowledge management. The research was held together with public organization “Russian machine builders Union”.

In particular, it was found that in Russian companies brightly expressed three-level perception model of the knowledge management is formed:

- knowledge management in the form of staff development (the minimum necessary measures for knowledge management);
- consolidation of corporate knowledge not only in the form of tacit knowledge of employees, but also in organizational

procedures – regulations, instructions, documented methods of work (forming the minimum necessary organizational capital of the company);

- systemic perception of knowledge management problems to be solved by the formation and development of a specialized structure that is responsible for this area in the company.

Further analysis showed that the most effective structure, decisive in the company’s knowledge management problem is the corporate university. On the basis of comparative analysis of corporate universities – parts of leading engineering companies (holding companies) in Russia, we have identified the following typical functions of these structures:

1. Staff ensuring the development and implementation of breakthrough projects and development programs, as part of the company’s strategy.
2. Organization of the discussion of the key goals and objectives and development of joint research programs and projects for their decision.
3. Organization of activities for the exchange of experiences and best practices with other companies – representatives of high-tech industries.
4. Diagnosis and assessment of employees of the enterprises in the corporation. Formation (selection and training) of personnel reserve for projects and programs in key management positions in the company.
5. Formation of clubs and professional societies that allow to develop informal horizontal communication channels within the organization.
6. Inventory of knowledge and best practices in priority areas in the company, in the country, in the world. Creating infrastructure for the exchange of knowledge, the formation of a knowledge management system.
7. Translation of the modern principles of the organization of work within the company (e.g., in the production – “Lean” project management – approaches developed by the PMI, in the management of the lifecycle – the PLM, etc.).

Thus, the corporate university, performing both functions of a repository of knowledge, a platform for the exchange of ideas and best practices, as well as being a tool for knowledge translation in the company, to the greatest extent meets the interests of stakeholders, and represents the highest level of development in the knowledge management awareness.

The conducted analysis suggests the hypothesis that the greatest success in the knowledge management can be achieved while using a corporate university and dedicated to the company’s knowledge management responsibility centers. Wherein corporate university activities must be carried out to target (on request and taking into account the specific features of the responsibility centers).

Generalized, corporate university product line which can be used to provide Ramp-up process by the knowledge and competencies, includes:

- *Lectures and consultations.* As a product and the work in this area should be established working groups and a team of associates (including various stakeholders).
- *Design and analytical session.* The purpose of such events is the selection and allocation. This format is used when it is necessary to solve a non-trivial task and form a management reserve to implement solutions in practice.
- *Experience transfer session.* This type of event is one of the forms of the formation of personnel reserve. During the session, all the participants analyzed the experience of his work, trying to bring

it to others, to fix in regulations, as well as the identification of possible forms and methods of using the identified third-party experience in their jobs.

- **School or workshop.** To carry out activities involved employees of the company (or third-party consultants) who are carriers of a unique experience, have achieved considerable success in their field and possess recognized competence.
- **Evaluation.** This type of event assumes the selection of suitable candidates for vacant positions in a competitive environment, as well as popularizing the individual activities.
- **Team building.** A set of measures aimed at formation of informal relations in the team, allowing to increase the quality of communication between individual members of staff.

Examples of specific practices and knowledge management tools, grouped by selected earlier types of knowledge and aimed at meeting the needs of stakeholders, are presented in Fig. 5.

As an example of the type of knowledge management “how” in the Ramp-up process with using a mechanism of corporate university we considered the format of “Chief Technologist Schools”, organized with the participation of the authors of the study within the framework of the leading Russian aerospace holding company. It should be noted that in the medium-term planning of staffing requirements for the implementation of a number of Ramp-up projects HR department revealed a deficit of competence and staff in the field of complex processes debugging and effective metal processing of new products using a mixed fleet of machine tools (from universal machines and to the modern 6-axis machining centers). In order to determine the frame-

competency deficit 2 focus groups with key technologists of enterprises within a holding company were conducted. Then profiles for the representatives of personnel departments of individual companies belonging to the holding were formed.

These profiles were built using closed questions with single and multiple choice. The main block of questions was devoted to the assessment of demand for a particular competence, level of its current presence in the company, the perceived complexity of the acquisition of competences deficit in the medium run. On the basis of the data obtained a competences deficit Card was formed, enabling to fulfill the block “how” during the Ramp-up.

The next step was the holding of expert discussion of mechanisms of knowledge transfer between the companies of the holding. For this purpose the specialized meeting of the Council of Chief technologists machine-building enterprises of aerospace industry was held.

As a result of activities a structural and functional model of “Chief Technologist School” was developed as a corporate knowledge management system kernel on the block “how”. The basic unit of the “School” was formed on the basis of academic institutions and engineering association which is the part of the holding. This structure enabled to provide the additional information from several groups of stakeholders (industry practice, academics), to form a mechanism of independent evaluation of qualification and consolidate infrastructure development opportunities and personnel competencies. The engineering center was defined within the holding as a responsibility centre for knowledge management block “how”, its work plan was adjusted.

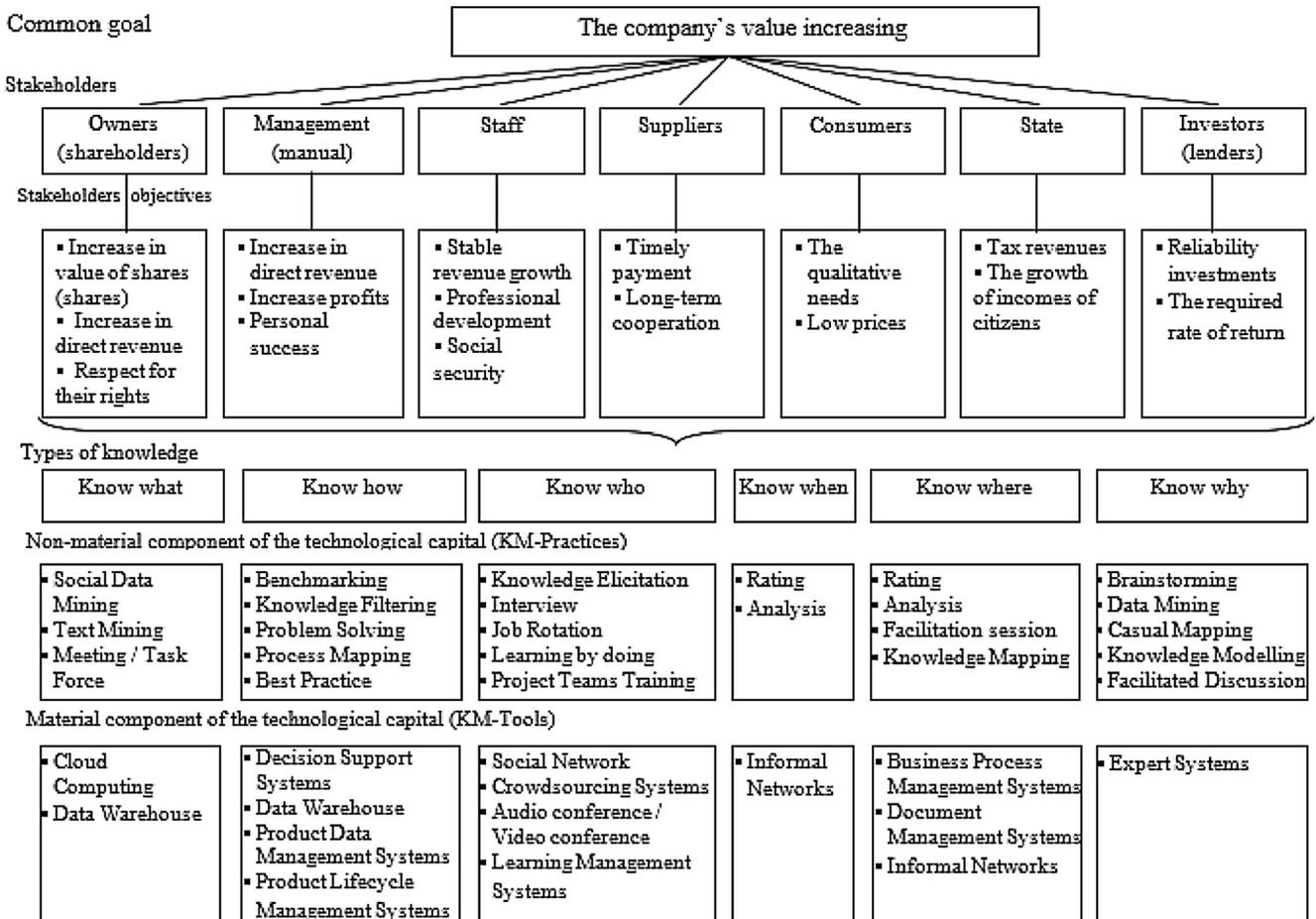


Fig. 5. Examples of specific practices and knowledge management tools.

A separate area of work in the field of knowledge management was the formation of short-term courses in the temporary project teams of technologists and designers. This format has allowed to work out methods of dealing with the information barriers that prevent communication designers and engineers during the Ramp-up.

Conclusion and discussion

The relatively small part of literature devoted to knowledge management in the implementation of Ramp-up makes this area especially attractive for research.

The attempt to conceptually describe the knowledge management issue and show the practical experience of improving the system in terms of Ramp-up made in this article could be one of the starting points for further more detailed studies.

The approach proposed in this paper aims to enhance the effectiveness of corporate knowledge management by building an appropriate structure and consolidation of the centers of responsibility functions of collecting, processing, generation and transfer of knowledge on specific to them types of knowledge. Total corporate knowledge management system in this case should be a unified information infrastructure to provide interconnection of individual responsibility centers for knowledge management and organizational platform to enable stakeholders to participate in this process.

Discussion component of this study is to initiate the debates on specific organizational knowledge management activities within the allocated responsibility centers. In particular, very promising are the issues of development of specific methods of collecting, processing, generation and transfer of knowledge with regard to the individual responsibility centers, as well as issues of assessing the effectiveness of their operation.

Also, the proposed category of “technological capital” offers a vast field for research. It is obvious that the development of specific managerial tools for this type of capital is an actual scientific and practical task for today and for the foreseeable future, which means that research in this area will be successfully continued.

References

- [1] Grigoriev, S.N., Eleneva, Y.Y., 2013, Personnel Training for the Defense-Industrial Complex of Russia: Problems and Ways of Their Solution. Higher Education in Russia, 6:3–11.
- [2] Yeleneva, J.Y., Prosvirina, M.E., Yelenev, K.S., Andreev, V.N., 2016, Quality of Enterprise Management During Ramp-Up Preparation and Launch: Concept and Evaluation Method. *Procedia CIRP*, 51:13–18. <http://dx.doi.org/10.1016/j.procir.2016.05.015>.
- [3] Heine, I., Beaujean, P., Schmitt, R., 2016, Improving Production Ramp-Up Through Human Resource Methods. *Quality Management Journal*, 23/1: 7–19.
- [4] Stiller, S., Falk, B., Philipsen, R., Brauner, P., Schmitt, R., Ziefle, M., 2014, A Game-Based Approach to Understand Human Factors in Supply Chains and Quality Management. *Procedia CIRP*, 20:67–73. <http://dx.doi.org/10.1016/j.procir.2014.05.033>.
- [5] Sungwoo, B., 2016, Hyundai Steel's Ramp-Up Strategy and the Learning Effect. *Annals of Business Administrative Science*, 15:163–174.
- [6] Levitt, S.D., List, J.A., Syverson, C., 2013, Toward an Understanding of Learning by Doing: Evidence from an Automobile Assembly Plant. *Journal of political Economy*, 121/4: 643–681.
- [7] Penrose, E.T., 1959, *The Theory of the Growth of the Firm*. John Wiley, New York
- [8] Wernerfelt, B.A., 1984, Resource-Based View of the Firm. *Strategic Management Journal*, 5/2: 171–180.
- [9] Prahalad, C.K., Hamel, G., 1990, The Core Competence of the Corporation. *Harvard Business Review*, 68/3: 79–91.
- [10] Stalk, G., Evans, P., Shulman, L.E., 1992, Competing on Capabilities: The New Rules of Corporate Strategy. *Harvard Business Review*, (March/April)57–69.
- [11] Cepeda-Carrion, I., Martelo-Landroguez, S., Leal-Rodríguez, A.L., Leal-Millán, A., 2017, Critical Processes of Knowledge Management: An Approach toward the Creation of Customer Value. *European Research on Management and Business Economics*, 23/1: 1–7. <http://dx.doi.org/10.1016/j.iedeen.2016.03.001>.
- [12] Teece, D.J., Pisano, G., Shuen, A., 1997, Dynamic Capabilities and Strategic Management. *Strategic Management Journal*, 18/7: 509–533. [http://dx.doi.org/10.1002/\(SICI\)1097-0266\(199708\)18:7<509:AID-SMJ882>3.0.CO;2-Z](http://dx.doi.org/10.1002/(SICI)1097-0266(199708)18:7<509:AID-SMJ882>3.0.CO;2-Z).
- [13] Grigoriev, S.N., Yeleneva, J.Y., Golovenchenko, A.A., Andreev, V.N., 2014, Technological Capital: A Criterion of Innovative Development and an Object of Transfer in the Modern Economy. *Procedia CIRP*, 20:56–61. <http://dx.doi.org/10.1016/j.procir.2014.06.144>.
- [14] Grigoriev, S.N., Yeleneva, J.Y., Andreev, V.N., 2014, Technological Capital Value Growth as a Criterion and an Outcome of Enterprises Innovative Development. *Actual Problems of Economics*, 151/1: 150–162.
- [15] Drucker, P.F., 1991, The New Productivity Challenge. *Harvard Business Review*, 69/6: 69–79.
- [16] Drucker, P., 2011, *Post-Capitalist Society*. Routledge, Abingdon Oxon.
- [17] Davenport, T.H., Prusak, L., 2000, *Working Knowledge: How Organizations Manage What They Know*. Harvard Business School Press, Boston, MA.
- [18] Senge, P., 1990, *The Fifth Discipline: The Art and Practice of the Learning Organization*. Doubleday/Currency, New York.
- [19] Nonaka, I., Takeuchi, H., 1995, *The Knowledge Creating Company*. Oxford University Press, New York.
- [20] Wiig, K., 1993, *Knowledge Management Foundations: Thinking about Thinking: How People and Organizations Create, Represent, and Use Knowledge*. Schema Press, Arlington.
- [21] Letmathe, P., Rößler, M., 2016, Spillover Effects of Learning for Production Ramp-Ups. *Procedia CIRP*, 51:111–115. <http://dx.doi.org/10.1016/j.procir.2016.05.091>.
- [22] Poetz, M.K., Schreier, M., 2012, The Value of Crowdsourcing: Can Users Really Compete with Professionals in Generating New Product Ideas?. *Journal of Product Innovation Management*, 29/2: 245–256.
- [23] Lederer, J., Ogwang, F., Karungi, J., 2017, Knowledge Identification and Creation Among Local Stakeholders in CDM Waste Composting Projects: A Case Study From Uganda. *Resources Conservation and Recycling*, 122:339–352. <http://dx.doi.org/10.1016/j.resconrec.2017.03.005>.
- [24] Kazadi, K., Lievens, A., Mahr, D., 2016, Stakeholder Co-Creation During the Innovation Process: Identifying Capabilities for Knowledge Creation Among Multiple Stakeholders. *Journal of Business Research*, 69:525–540. <http://dx.doi.org/10.1016/j.jbusres.2015.05.009>.
- [25] Freeman, R.E., Wicks, A.C., Parmar, B., 2004, Stakeholder Theory and “The Corporate Objective Revisited”. *Organization Science*, 15/3: 364–369.
- [26] Ackoff, R.L., 1981, *Creating the Corporate Future: Plan or Be Planned For*. John Wiley & Sons, Inc., New York.
- [27] Streltsova, N., Zaika, M., 2012, Building a Corporate Knowledge and Competence Management System by Collaborating with Stakeholders. *Siberian Financial School*, 5:65–73.
- [28] Porter, M., 2005, *Competitive Advantage: How to Achieve Good Result and Ensure Its Stability*. Publishing House “Alpina Business Books”, Moscow.
- [29] Scott, M., 2000, *Cost Factors: Guidelines for Managers on Stating Cost Creation Levers*. Olimp-Business CJSC, Moscow.
- [30] Freeman, R.E., Wicks, A.C., Harrison, J., Parmar, B., Colle, S., 2010, Stakeholder Theory: The State of the Art. *Academy of Management Annals*, 4:403–445. <http://dx.doi.org/10.1080/19416520.2010.495581>.
- [31] Hein, A.M., Jankovic, M., Feng, W., Farel, R., Yune, J.H., Yannou, B., 2017, Stakeholder Power in Industrial Symbioses: A Stakeholder Value Network Approach. *Journal of Cleaner Production*, 148:923–933.
- [32] Tantalo, C., Priem, L.R., 2016, Value Creation Through Stakeholder Synergy. *Strategic Management Journal*, 37/2: 314–329.
- [33] Schenkel, M., Krikke, H.R., Caniels, M.C.J., van der Laan, E., 2015, Creating Integral Value for Stakeholders in Closed Loop Supply Chains. *Journal of Purchasing & Supply Management*, 21:155–166.
- [34] Skyrme, D.J., Amidon, D.M., 1997, *Creating the Knowledge-Based Business*. Business Intelligence Ltd., Wimbledon.
- [35] Bass, F.M., 1969, A New Product Growth Model For Consumer Durables. *Management Science*, 15:215–227.
- [36] Bray, R.L., Mendelson, H., 2012, Information Transmission and the Bullwhip Effect: An Empirical Investigation. *Management Science*, 58/5: 860–875. <http://dx.doi.org/10.1287/mnsc.1110.1467>.