

Assessment of an R&D Organisation's Human Resource Capabilities for the Purpose of Innovative Projects

Beata Poteralska*

Lukasiewicz Research Network - Institute for Sustainable Technologies
Radom, Poland
beata.poteralska@itee.radom.pl

Adam Mazurkiewicz

Lukasiewicz Research Network - Institute for Sustainable Technologies
Radom, Poland
adam.mazurkiewicz@itee.radom.pl

Abstract—Human resource capabilities are one of the key resources required for R&D organisations to carry out projects aimed at the development and implementation of innovations. Decisions on whether or not such innovative projects may be carried out are conditional on the assessment of the human resource capabilities R&D organisations have at their disposal. The use of this type of organisational capabilities facilitates ongoing implementation of innovative projects and supports the strategic decision-making processes regarding future directions for human resource capability building. The main objective of this article is to propose a set of methods for the assessment of an organisation's human resource capabilities.

Keywords—human resource capabilities; R&D organisation; organisational capability assessment methods

I. ORGANISATIONAL CAPABILITIES – CONCEPT AND CLASSIFICATIONS

A great majority of innovations originate from projects carried out by specialised R&D organisations, be it research projects or commercial projects commissioned by business entities. To be able to develop and implement innovations, R&D organisations need to have relevant capabilities. While considering existing capabilities theories, including resource-based theory and dynamic capabilities [1, 2] the authors propose their definition of organisational capabilities and focus on its selected type, namely human resources. A capability is defined as a potential, ability or capacity [3]. Literature on organisational sciences and management most commonly focuses on the concept of organisational capabilities [4]. Organisational capabilities are expressed in terms of an organisation's all resources that can be utilised and applied to achieve the goals planned [5]. These include an organisation's assets, organisational processes, information or know-how which allow the development and implementation of an operational strategy directed at improving the efficiency and effectiveness of an organisation's operations, also in economic terms [6].

The authors define organisational capabilities as a condition of an organisation's strategic and operational resources and competences that enables the performance of the tasks planned and shapes the organisation's future development [7].

Organisational capabilities include the resources and competences of a given organisation [3]. The most common taxonomy divides the resources into individual generic groups. All organisation's resources are most frequently divided into two groups of assets, i.e. tangible and intangible assets [8, 9]. However, organisational capabilities may also be classified without indicating the tangible or intangible nature of the organisation's assets [4, 10-12]. The authors suggest a following classification of organisational capabilities [7]:

- financial capabilities (originating from an organisation's own resources or from third-party resources);
- physical and material capabilities (i.e. organisation's property plant and equipment in which the research infrastructure, research apparatus/equipment and materials are also included);
- human resource capabilities (expressed in terms of e.g. headcount, employment structure and staff education, qualifications and experience);
- information and management capabilities (expressed in terms of e.g. an organisational structure, management procedures, brand or intellectual property laws).

Regardless of the classification used, and no matter if the taxonomy of organisational capabilities distinguishes between tangible and intangible assets (the latter of which are sometimes referred to as the 'intellectual capital'), or between financial, physical and material, human resource, and information and management capabilities, the vast majority of authors agree that the key component of organisational capabilities are in fact the human resource capabilities, as they drive innovations and development [13-15].

Human resource capabilities are understood as the capabilities of an organisation's long-serving and mission-oriented employees who exhibit appropriate level of teamwork skills, creativity, qualifications, motivation, competences and intellectual capabilities [16, 17]. Human resource capabilities are a mixture of knowledge and expertise, skills, innovative approach and individual abilities of an organisation's employees that are indispensable to the efficient performance of tasks [18]. This is a set of potentials of individual members

of an organisation expressed in terms of their physical, psychic, intellectual and moral features – shaped through their predisposition, talent, know-how, skills, motivation, health condition and energy levels – which facilitate the activity and development of individuals [19].

Human resource capabilities are particularly important in industries characterised by dynamic changes, innovativeness and by the highly changeable internal and external environment. The capital based on the expertise and skills of employees, to a greater extent, has helped business entities generate added value. There are estimates suggesting that human capital constitutes approximately 50% of the entire intellectual capital [20]. Human resource capabilities are of key importance in R&D organisations engaged in the development of technological innovations.

II. ORGANISATIONAL CAPABILITY ASSESSMENT – SCOPE AND METHODS

The allocation of an organisation's resources critical to its organisational capabilities, the selection of resources, and the decisions regarding their use for the purpose of innovative processes, or for the purpose of maximising on business opportunities, are essential elements of an organisation's strategic management [21]. An organisation needs to identify and estimate the resources required to enable given projects to be carried out [22].

The assessment of organisational capabilities takes into account both the organisation's internal (dispositional) capabilities and the external (situational) capabilities, on which the achievement of the goals planned and the implementation of operational strategies depend. Organisation's internal capabilities result from the possession of or access to physical and material, financial, human and information and management resources (expertise, brand, know-how). External capabilities are understood as opportunities emerging in the environment in which a given organisation operates, which have a material impact on the achievement of the goals planned (e.g. advantageous location, proximity to clients, new client needs) [4].

The organisational capability assessment may – depending on the needs – include the following two:

- the assessment of an R&D organisation's capability as a whole to identify the resources the organisation has at its disposal and the organisation's potential capabilities. Such assessment is performed for the purpose of analysing the operations of an R&D organisation as a whole, to support in-house management processes by means of identifying its present capabilities and the areas in which the capabilities should be further built;
- the assessment of an R&D organisation's capabilities performed for the purpose of decision-making processes regarding undertaking particular research and implementation projects, their commencement and performance.

The literature offers several methods for the assessment of organisational capabilities, particularly the organisational capabilities of businesses [9, 23]. Among them, there are methods that can also be used for the purpose of assessment of organisational capabilities of entities other than businesses, e.g. R&D organisations. Organisational capability assessment methods include, among others, the Hofer and Schendel's resource analysis and the business intellectual capital measurement methods.

The Hofer and Schendel's resource analysis consists in the identification and assessment of existing capabilities of a business (financial, physical and material, human and information and management), with concurrent consideration of the business functions, i.e. manufacturing, marketing, finances, management or research and development. The analysis allows the assessment of volumes of resources assigned to individual functional areas of a business and of the correctness of such allocation from the point of view of the goals and tasks of a given business.

On the other hand, intellectual capital measurement is, nowadays, used in business [24–27] and in R&D organisations [28, 29] alike. Intellectual capital measurement may be performed using, e.g. methods based on market capitalisation or on the return on assets (ROA), methods for direct intellectual capital measurement, or score card methods enabling assessment of an enterprise's intangible assets. Even though the majority of the methods cited are mainly used to measure the intellectual capital of enterprises, the score card methods may also be applied in R&D organisations as they allow the independent selection of measurement indicators corresponding to the specificity of such organisations' operations. Identification of the condition of intellectual resources and intellectual capital development process in R&D organisations is of particular importance, given the primary area of operations of such organisations focused on the generation, development and implementation of innovations.

III. HUMAN RESOURCE CAPABILITIES – ASSESSMENT METHODS

Identification of human resources and competences required for the development of a given innovation is a necessary starting point for deciding on the development of an innovation. Once such human resources and competences have been identified, an assessment of their availability in an R&D organisation is performed. For that purpose, the authors propose a set of methods including the Hofer and Schendel's matrix of functions and resources [23] supplemented with intellectual capital measurement indicators used in the score card method, and with the matrix of individual employees' competences (members of executive teams) may be used.

The suggested matrix of functions and resources of an R&D organisation takes into account the human resource capabilities used for the purpose of such organisation's functions including: research and development, prototype manufacture, marketing, management, accounting (Table I).

TABLE I. HUMAN RESOURCE CAPABILITIES OF AN R&D ORGANISATION DETERMINED USING THE HOFER AND SCHENDEL'S MATRIX OF FUNCTIONS AND RESOURCES (SOURCE: THE AUTHORS BASED ON [23])

Function performed/Type of a capability	Research and development	Prototype manufacture	Marketing	Accounting	Management
Human resource capabilities	With regard to each function performed: condition of human resource capabilities, including headcount, age, education, map of competences, areas of expertise, qualifications, hours worked on a given project, fluctuation rate, etc.				

Analysis based on the Hofer and Schendel's matrix of functions and resources allows one to: obtain information on the volume and characteristics of resources assigned to individual functional areas of an R&D organisation, assess the correctness of their allocation, and to indicate potential needs as regards the supplementation of its capabilities.

Such assessment is supported with the calculation of indicators describing the condition and characteristics of an organisation's capabilities, e.g. indicators describing the condition of the human resource capabilities of an R&D organisation with reference to the personnel engaged in the research and development work. The set of indicators is each time composed individually, depending on the aspects selected for an in-depth analysis.

The use of the matrix of functions and resources and of the set of indicators enables the human resource capabilities of an R&D organisations to be assessed both with reference to the capabilities of the entire organisation or its individual organisational units. The analysis of the availability of own R&D personnel or third-party employees with relevant experience and competences adapted to the scope and requirements of the research project analysed constitutes an initial, yet essential stage of the assessment. Positive results of the aforementioned stage of assessment allows one to move to the next stage consisting in the analysis of the availability of the human resource capabilities for the performance of supporting functions (e.g. accounting services, marketing). The availability of the human resource capabilities required for the performance of substantive and supporting tasks determines whether or not a planned innovative project can be launched and carried out.

The second dimension of human resources capabilities assessment concerns their assessment for the needs of undertaking individual research projects aimed at the development of innovations. The commencement and implementation of individual specific research projects must be preceded with an in-depth analysis of competences of employees likely to be engaged in the performance of individual project tasks. This requires the development of a map (matrix) of competences covering the qualifications (including knowledge and skills), social competences, attitudes and conduct of individual employees likely to be engaged in the performance of research projects [30-32].

The use of the aforementioned methods (matrix of functions and resources plus indicators and the matrix of competences) and the analysis of the results obtained helps one in obtaining the feedback on:

- the employment of the scientific, research, technical and auxiliary personnel at an R&D organisation, competent to carry out a particular research or implementation project analysed, and properly skilled in the operation of the research apparatus planned to be used in such a project;
- the availability of employees' competences at the time of the project planned – with the consideration of the engagement of individual employees in concurrently carried out projects;
- the possibility of cooperation with third parties to support projects carried out in the case of staff shortages;
- the indication of possible areas for future development of the human resource capabilities of an R&D organisation.

The analysis of human resource capabilities is a source of information supporting the decisions as regards the commencement or continuation of particular research and development projects. Additionally, it indicates the existing shortages as far as the organisational capabilities are concerned, which hamper or preclude the implementation of research projects in certain thematic areas, included in an R&D organisation's strategic areas and compliant with its priority directions, i.e. such analysis indicates potential areas for capability building in the future.

The proposed set of methods has been applied at the Łukasiewicz Research Network - Institute for Sustainable Technologies, Poland for the needs of analysing organisational capabilities. The Institute's existing capabilities turned out to be insufficient in comparison with the growing number of industrial orders and possible innovative research projects. Therefore, projects aimed at expanding the research infrastructure and developing human resources were initiated. After obtaining co-financing for these projects from EU structural funds, an analysis of the own available Institute's capabilities, the directions of their expansion and the possibility of cooperation with third parties has been systematically carried out.

IV. CONCLUSION

The main objective of a short-term human resource capability assessment is to support the decision-making process as regards the commencement or continuation of innovative projects. Consideration of the assessment findings also enables one to verify the extent to which the human resource

capabilities of an R&D organisation need to be further built to allow projects in given areas to be effectively conducted in the future, as well. The use of such analysis results supports long-term decision-making processes as regards future development of the human resource capabilities required. Currently, in the situation of an abundance of emerging technologies, a quick and accurate assessment of human resource capabilities becomes a necessity and a challenge.

Human resource capabilities are essential in the innovation development process, and having qualified and experienced personnel is a prerequisite for effective implementation of innovative projects; nevertheless, the organisational capability assessment may not be, and is not, limited to the assessment of this aspect only. The assessment of the physical and material capabilities, including the availability of infrastructure (research apparatus in particular) and access to financial and information and management capabilities are equally important. The aforementioned elements should be analysed at the time of the human resource capability assessment to provide effective support for the decision-making processes regarding the development and implementation of innovations.

REFERENCES

- [1] J.B. Barney, D.J. Ketchen Jr., M. Wright, "The Future of Resource-based Theory: Revitalization or Decline?" *Journal of Management*, 2011, vol. 37, nr 5.
- [2] M. Kodama, *Sustainable growth through strategic innovation. Driving Congruence in Capabilities*, Elgar, 2018.
- [3] S. Nowosielski, "Potencjał produkcyjny przedsiębiorstwa, istota, struktura i planowanie", *Przedsiębiorczość i Zarządzanie*, 2012, Vol. XIII, No 17, pp. 81–93.
- [4] G. Jokieli, "Identyfikacja i wykorzystanie potencjału organizacyjnego w zarządzaniu projektami", *Przedsiębiorczość i Zarządzanie*, 2012, Vol. XIII(17), pp. 39–49.
- [5] B. Godziszewski, M. Haffer, M.J. Stankiewicz, and S. Sudoł, *Przedsiębiorstwo. Teoria i praktyka zarządzania*, PWE, Warszawa 2011.
- [6] J.B. Barney, T.B. Mackey, Testing Resource-Based Theory, in: D.J. Ketchen, D.D. Bergh (eds.), *Research Methodology in Strategy and Management*, Elsevier Ltd., 2005.
- [7] B. Poteralska, *Metodyka wspomagania rozwoju innowacji technologicznych w jednostce badawczej*, Biblioteka Problemów Budowy i Eksploatacji Maszyn, KBM PAN, Wydawnictwo Naukowe ITE-PIB, Radom, 2018.
- [8] M.J. Stankiewicz, *Konkurencyjność przedsiębiorstwa. Budowanie konkurencyjności przedsiębiorstwa w warunkach globalizacji*, TNOiK, Toruń 2005.
- [9] G. Gierszewska and M. Romanowska, *Analiza strategiczna przedsiębiorstwa*, Polskie Wydawnictwo Ekonomiczne, Warsaw 2009.
- [10] J. Barney, *Gaining and sustaining competitive advantage*, Addison-Wesley Publishing Company, Inc., New York 1997.
- [11] M. Seppänen and S. Mäkinen, "Towards a classification of resources for the business model concept," *International Journal of Management Concepts and Philosophy*, 2007, vol. 2(4), pp. 389–404.
- [12] A. Stabryła, Agregatowa analiza diagnostyczna w badaniu systemów organizacyjnych, in: A. Stabryła (ed.), *Praktyka projektowania systemów organizacyjnych przedsiębiorstwa*, Mfiles.pl, Encyklopedia Zarządzania, Kraków 2015.
- [13] G. Becker, "Investment in Human Capital: A Theoretical Analysis", *Journal of Political Economy*, 1962, vol. 70(5), Part 2, pp. 9–49.
- [14] J. Unger, A. Rauch, M. Frese, and N. Rosenbusch, "Human capital and entrepreneurial success: A meta-analytical review", *Journal of Business Venturing*, 2011, vol. 26(3), pp. 341–358.
- [15] I. Stalończyk, „Kapitał ludzki jako główny element kapitału intelektualnego”, *Ekonomia i Zarządzanie*, 2012, vol. 4(2), pp. 28–36.
- [16] A. Sajkiewicz, Człowiek – kreator wartości przedsiębiorstwa, in: A. Herman and A. Szablewski (eds.), *Zarządzanie wartością firmy*, Poltext, Warsaw 1999.
- [17] M. Bratnicki, Spojrzenie na kapitał intelektualny z punktu widzenia wartości przedsiębiorstwa, in: J. Duraj (ed.), *Przedsiębiorstwo na rynku kapitałowym*, University of Lodz, Łódź 1999.
- [18] L. Edvinsson and M.S. Malone, *Kapitał intelektualny*, Wydawnictwo PWN, Warsaw 2001.
- [19] A. Pietruszka-Ortyl, Wyzwania wartościowania kapitału intelektualnego organizacji, in: E. Skrzypek (ed.), *Uwarunkowania sukcesu przedsiębiorstw w gospodarce opartej na wiedzy*, Vol. I, Wydawnictwo UMCS w Lublinie, Lublin 2004.
- [20] R. Dawidziuk, „Kapitał ludzki jako element kapitału intelektualnego w przedsiębiorstwie”, *Nauki o zarządzaniu – Management Sciences*, 2016, vol. 2(27), pp. 46–59.
- [21] J. Barney, "Organizational Culture: Can it be a source of competitive advantage?," *Academy of Management Review*, 1986, vol. 11(3), pp. 656–665.
- [22] M. Seppänen, "Empirical classification of resources in a business model concept", *Intangible Capital*, 2009, vol. 5(2), pp. 102–124.
- [23] I. Penc-Pietrzak, *Planowanie strategiczne w nowoczesnej firmie*, Wolters Kluwer Polska, Warsaw 2010.
- [24] M. Subramaniam and M.A. Youndt, "The influence of intellectual capital on the types of innovative capabilities", *Academy of Management Journal*, 2005, vol 48, pp. 450–463.
- [25] S. Kang and S.A. Snell, "Intellectual capital architectures and ambidextrous learning: A framework for human resource management", *Journal of Management Studies*, 2009, vol 46, pp. 65–92.
- [26] K. Mertins and R. Orth, "Integrating Intellectual Capital and Sustainability Management: Perspectives for the Internal Management and External Reporting in Small and Medium Sized Enterprises", *ECIC2011-Proceedings of the 3rd European Conference on Intellectual Capital*, pp. 527–536.
- [27] M. Musteen and M. Ahsan, "Beyond Cost: The Role of Intellectual Capital in Offshoring and Innovation in Young Firm", *Entrepreneurship Theory and Practice*, 2013, vol 37(2), pp. 421–434.
- [28] K.H. Leitner and C. Warden, "Managing and Reporting Knowledge Based Resources and Processes in Research Organizations: Specifics, Lesson Learned and Perspectives", *Management Accounting Research*, 2004, vol 15(1), pp. 33–51.
- [29] P. Sánchez, S. Elena, and R. Castrillo, "Intellectual Capital Dynamics in Universities: A Reporting Model", *Journal of Intellectual Capital*, 2009, vol 10(2), pp. 307–324.
- [30] G. Agresti, F. Arena, V. Ippolito, A. Romboli, and C. Loreti, *Planning strategic competences of the future, HR long-term strategic planning as a key enabler of company success*, Arthur D. Little Luxembourg S.A., 2018.
- [31] *Managing Competencies in Government: State of the Art. Practices and Issues at Stake for the Future*, OECD, Paris, 2010.
- [32] M. Bohlouli, N. Mittas, G. Kakarontzas, T. Theodosiou, L. Angelis, M. Fathi, *Competence assessment as an expert system for human resource management: A mathematical approach*, *Expert Systems With Applications* 70, 2017, pp. 83–102.