GEOMECHANICS AND GEOENERGY JOURNAL
(GGJ)

Extended Abstract

Presenting a model for improving the technological capability of geomechanics in the upstream oil and gas industry

Maryam Behifar[1]; Mohammad Reza Razavi[2*]; Parivash Jafari[3]

1- PhD Student in Technology Management, Department of Technology Management, Science and Research Branch, Islamic Azad University, Tehran, Iran.

2- Assistant Professor, Department of Technology Management, Science and Research Branch, Islamic Azad University, Tehran, Iran.

3- Professor, Department of Educational Management, Science and Research Branch, Islamic Azad University, Tehran, Iran.

Received: 30 August 2025; Accepted: 22 November 2025

DOI: 10.22107/ggj.2025.544070.1257

Keywords

Geoenergy, petroleum geomechanics, learning, capability, resource-based View

Abstract

Geomechanics plays a significant role in the development and sustainability of energy resources. Petroleum geomechanical testing, modeling, and analysis of fluid/rock interactions form an integral part of a comprehensive approach to reservoir characterization and development. The lack of proper geomechanical studies has been one of the main reasons for the failure of many drillings and reservoir development operations in the oil and gas industry. The technological capabilities of companies providing services to oil and gas exploration and production can prevent such problems to occur. Therefore, this study analyzes the technological capabilities of geomechanics in the upstream oil and gas industry. The sample studied to determine the causal relationships between the dimensions of geomechanics technological capability consisted of 45 geoenergy and geomechanics experts who were selected through purposive sampling. The results of the Gray DEMATEL method and the causal relationships between dimensions showed that the dimension of management and strategic capability has the highest impact and the lowest effectiveness among other dimensions of technological capability in geomechanics and is a purely impactful dimension. The ability to connect and network is ranked second in terms of impact and given that the impact of this dimension is greater than its impactability, it is considered a pure impactor. Investment capability is the third dimension in terms of impact and affects the other dimensions of capability more than it is affected by them. Human resource capability has the least impact on the other dimensions and is a pure influencer. Learning ability has the highest interaction among other ability dimensions, meaning it has the highest importance.

1. Introduction (Times New Roman 12 pt font-Bold)

In the oil and gas industry, the need to create value, increase production, and discover new opportunities for unconventional reservoir production has created many challenges for upstream managers to survive and thrive in this changing business environment, which requires a new and more effective approach to developing and deploying strong technological capabilities [1]. Instead of taking advantage of available external innovations in the same way, firms each follow their own path based on their own unique characteristics. Developing countries follow an evolutionary path based on their initial situation, but over time, they deviate from this path due to factors such as firm growth, policy changes, market development, and external factors [2]. Therefore, in this study, citing Behifar, Razavi, and Jafari (1402) [34], the capability of geomechanical technology in the oil and gas industry was identified and categorized into 7 dimensions and 34 components. The dimensions of geomechanical technology capability in the oil

* **Corresponding Author:** maryambehifar@gmail.com

and gas industry include investment capability with 4 components, linkage/networking capability with 5 components, learning capability with 6 components, human resources capability with 4 components, management and strategic capability with 7 components, technical and executive capability with 4 components, and complementary capability with 4 components.

2. Methodology

The research community was composed of geoenergy experts and specialists (with relevant education and at least 10 years of experience), from whom 45 people, as a sample, purposefully completed 8 paired comparison matrix questionnaires to determine the effectiveness and efficiency of the dimensions and components of technological capability of upstream geomechanics in the oil and gas industry (matrix (7*7) for main dimensions, matrix (4*4) for human resource capability components, matrix (5*5) for linkage/networking capability components, matrix (4*4) for investment capability components, matrix (4*4) for technical and executive capability components, matrix (7*7) for management and strategic capability components, and matrix (6*6) for learning capability components).

3. Results and Conclusions

The dimension of management and strategic capability has a high net interaction and impact and is considered the most effective dimension of technological capability in oil and gas geomechanics and affects the dimensions of learning, human resources, complementarity, investment, linkage/networking and technical, executive and is only directly affected by the dimensions of learning and linking/networking and it is considered a core dimension or intertwined contributors/legislators and is considered one of the most important dimensions of the technological capability of oil and gas geomechanics. Therefore, by improving the management and strategic capability dimension, the main problem of improving the technological capability of oil and gas geomechanics can be solved, and it should be given top priority in planning. The linkage/networking capability dimension has high interaction and impact, and it affects other dimensions more than it is affected by other dimensions. It is considered a core dimension or interwoven contributors, and is considered one of the most important dimensions of technological capability in oil and gas geomechanics. In other words, it affects the dimensions of learning, human resources, complementary, technical and executive, investment, management, and strategic, and is only directly affected by the dimensions of management, strategy, and investment. Therefore, improving the linkage/networking dimension can solve the main problem of enhancing the technological capability of oil and gas geomechanics, and it should be given top priority in planning. The investment capability dimension has a relatively high interaction and, although it is a net influencer, it has a relatively small impact. Therefore, it is known as a driving dimension or independent driver. In other words, the investment dimension influences the dimensions of learning, linkage/networking, human resources, technical, and executive, and is directly affected by the linkage/networking, management, and strategic dimensions. Therefore, improving the investment dimension can be solved by improving the technological capability of oil and gas geomechanics, and in planning it should be the second priority after the linkage/networking and management and strategic dimensions. The complementary capability dimension has relatively little interaction and impact. It affects the technical and executive dimensions and is directly affected by the management, strategic, and networking dimensions. Therefore, it is an independent influential dimension that affects a small number of dimensions.

4. Acknowledgment

The authors hereby express their gratitude to the Petroleum Geomechanics Society and the Petroleum Geomechanics Engineering Department of Khajeh Nasir Toosi University of Technology (Dr. Hassan Ghasemzadeh and Dr. Hormoz Ghalavand) who sincerely assisted us in conducting this research.

5. References

[1] Shuen, A., Feiler, P. F., & Teece, D. J. (2014). Dynamic capabilities in the upstream oil and gas sector: Managing next generation competition. Energy Strategy Reviews, 3, 5-13.

[2] Lall, S. (1992). Technological capabilities and industrialization. World development, 20(2), 165-186.

[34] Behifar, Maryam, Razavi, Mohammad Reza and Jafari, Pariyosh. (2013). Identifying the technological capabilities of geomechanics in the oil and gas industry. Journal of Petroleum Geomechanics, 6(2), 48-63. Doi:

10.22107/jpg.2023.407649.1201.