The influence of transformational and learning through R&D capabilities on the competitive advantage of firms

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Abstract

Purpose – This study provides theoretical and empirical insights into how firms can enhance their performance strategically and financially by integrating learning and transformational capabilities into research and development (R&D) activities based on the dynamic capabilities approach. To achieve this, the authors propose that transformational capabilities in R&D mediate the relationship between learning capabilities in R&D and competitive advantage.

Design/methodology/approach – Using a purposive sampling technique and standardized questionnaires, data were collected from 118 R&D and senior managers. To analyze the data, multiple regression analysis, along with SPSS PROCESS macro (Model 4), was used.

Findings – The results support the theoretical assumption that there are direct and indirect positive and significant effects between learning capabilities in R&D and competitive advantage as mediated by transformational R&D capabilities.

Originality/value – This study explores R&D from a dynamic capabilities perspective and suggests that learning capabilities should come first to enhance businesses’ competitive advantage. Furthermore, transformational R&D capabilities can explain the relationship between learning capabilities in R&D and competitive advantage. The authors recommend that researchers should investigate the contributions of R&D to promote competitive advantage.

Keywords Research and development, R&D, Dynamic capabilities, Learning capabilities, Transformational capabilities, Competitive advantage

Paper type Research paper

1. Introduction

Research and development (R&D), which is defined as an organization’s capability to engage in scientific research that participates in the development of advanced technologies (Tijssen & Winnink, 2017), plays a crucial role and is considered the main driver of product and process innovation. Therefore, it plays a significant role in helping companies attain the competitive advantage that they desperately seek. As such, a company’s R&D spending is considered to have an economic sector role, as companies convert scientific R&D into innovation that will support and sustain the economic growth in the long run (Kuhlmann, 2018). Given this context, this study theoretically and empirically explores how learning and transformational capabilities affect competitive advantage in the context of collaboration in R&D.

Collaboration in R&D with other partners and stakeholders is crucial for knowledge exchange and creation. A recent empirical study found that knowledge creation has a significant positive influence on knowledge sharing, which, in turn, affects knowledge
application (Almahamid, Al-Jayyousi, Alalawi, & AlQarny, 2021). Collaboration may occur through universities, research centers, outsourced partners and joint ventures. Collaborative efforts have increased over the last two decades due to the dynamic characteristics of the outward environment of R&D programs (Islam, Gyoshev, & Amona, 2018). Belderbos, Gilsing, Lokshin, Carree and Fernández Sastre (2018) indicated that collaboration in R&D specifies the coordination of initiatives between two independent firms that can exchange resources in many different ways.

In this study, we integrate R&D activities with learning and transformational capabilities based on the perspective of the dynamic capabilities theory, which fits the study’s aim and establishes the foundation of our conceptual framework. Dynamic capabilities theory is one of the most influential views of our time and is a popular topic of debate in the strategic management field (Di Stefano, Peteraf, & Verona, 2014; Schilke, 2014a). Dynamic capabilities are defined as companies’ capacity to coordinate, learn and transform its internal and external capabilities to respond rapidly to changes and turbulence in the environment (Teece, Pisano, & Shuen, 1997). Eisenhardt and Martin (2000) further nuanced this definition of dynamic capabilities as “the firm’s processes that use resources—specifically the processes to integrate, reconfigure, gain, and release resources—to match and even create market change” (p. 1107).

R&D capabilities within the dynamic capabilities approach could be assessed based on the launch of new products or patents in relation to spending made rather than merely considering spending or the number of new products and patents in isolation (Laaksonen & Peltoniemi, 2016). This theory allows for the analysis of how R&D will enhance the firm’s competitive advantage strategically and financially.

Learning capabilities often highlight the internal resources contributing to the change process, but they neglect external factors (Macdonald, 1995). Therefore, this study assesses how learning capabilities enable companies to transfer their information, knowledge and technology internally or externally. Learning capabilities come from recognizing opportunities in the market (e.g. marketing demands) to inform R&D activities, and they are crucial in organizational learning that enhances an organization’s knowledge assets. Learning capabilities are enhanced by collecting the right information, generating knowledge and innovating (Doloreux, Shearmur, & Rodriguez, 2015). Furthermore, they are built from routine tasks. An organizational routine is a certain way of doing something that an organization has created and learned, and in which that organization is extremely efficient and effective (Andreu & Ciborra, 1996). Thus, we consider learning capabilities to be an enabler of transformational capabilities.

Transformational change capabilities are “characterized by radical shifts in business strategy, reorganization of systems and structures and changes in the distribution of power across the whole organization” (Robinson & Griffiths, 2005, p. 205). Therefore, transformational capabilities entail integrating a firm’s entire resource base, existing and new information received from external partners and consumer knowledge obtained from various units of a company to gain new customers (Fatoki, 2021). Consequently, changes in both the external and internal environments affect the organization, giving it the impetus to re-engineer its internal and external resources through the dynamic structure to respond adequately to environmental changes. Specifically, in a turbulent environment and saturated marketplaces, quick and creative responses are important (Jurksiene & Pundziene, 2016).

The significance of this study is that it examines how transformational change and learning can inform R&D capabilities, which have an effect on firms’ competitive advantage. Although the relationship between learning capabilities and competitive advantage has been studied, little is known about the effects of transformational capabilities on this relationship. The mechanisms used to measure how R&D expenditure affects firm performance in the long run have received little attention (Yao & Wu, 2010). Moreover, a scoping analysis of the
theoretical and empirical literature on organizational dynamic capabilities indicated flaws in the conceptualization that need to be addressed (Vargas-Hernández, 2022). Therefore, this study contributes to the literature by offering recommendations for more research into the micro foundations of dynamic capabilities (Sousa-Zomer, Neely, & Martinez, 2020). Specifically, we provide a key contribution to understanding the sources of competitive advantage (Schilke, 2014b).

Furthermore, a recent systematic literature review of 70 studies advised that research be done on how to create and use dynamic capabilities in various settings, particularly in emerging markets (Fabrizio et al., 2022). Therefore, this study used a sample from the United Arab Emirates (UAE), since the number of R&D activities in the UAE that could have a substantial impact on decision-making are limited (Hijazi, Saeed, & Alfaki, 2019). Additionally, collaboration with local partners in R&D projects in emerging countries suffers from many challenges, as these firms must convince funders that they have the capabilities and skills needed to conduct experimental projects, specifically in the science fields. For instance, in the UAE, anecdotal evidence has indicated that authors are given less credit for work associated with higher education institutions than they might have if their work were associated with institutions in Europe, North America or Australia (Ryan & Daly, 2019). Another anecdotal example has posited that academics based in the UAE may need to work harder to convince international journal editors and reviewers of the wider relevance of their work on UAE populations and topics (Ryan & Daly, 2019).

Based on this context, the study raises the following research question: Does transformational capabilities explain the relationship between learning capabilities in R&D and competitive advantage? We argue that transformational capability is a mediator that can explain the relationship between learning capabilities and competitive advantage, as transformational capabilities can also contribute to learning capabilities. To rule out reverse causality, we assessed learning capabilities from an earlier stage and their effects as precursors for transformational capabilities at a later stage. Moreover, this work considers learning capabilities to be facilitators of change and transformation in a firm’s product, service, process or structure enhancing competitive advantage.

The survey in the present study was restricted to firms operating in the UAE. R&D is a priority of the government in the UAE, since it sustains the country’s rapid growth. The UAE spent 1.3% of its GDP on R&D in 2020 and will invest 57 billion Dirham in R&D in the industrial sector by 2031 (Invest Emirates, 2022).

2. Theoretical framework and hypotheses development
This study’s theoretical framework relies on the main dimensions of dynamic capabilities theory, specifically learning capabilities, transformational capabilities and competitive advantage. Prior empirical research has found that dynamic capabilities have a significant effect on a firm’s performance and competitive advantages (Chien & Tsai, 2012; Li, Shi, & Jin, 2022; Roberts & Grover, 2012). Therefore, our theoretical model (Figure 1) critically investigates the crucial roles of learning and transformational capabilities in R&D. The main objective of dynamic capabilities is to bolster a firm’s competitive advantage. As such, the field of strategic management has undertaken extensive work to recognize, describe, forecast and quantify how organizational capabilities form a competitive advantage (Pisano, 2017).

2.1 Learning and transformational capabilities through R&D
This study considers learning capability to be an internal driver of the transformational process in R&D projects. Learning capability is defined as an organization’s ability to process knowledge. Organizations benefit from organizational learning through creating,
transferring, integrating and constantly acquiring knowledge and experience (Gomes & Wojahn, 2017). That is, organizational learning is the capacity to assimilate and transform new information. Messeni Petruzzelli and Murgia (2021) concluded that interactive learning through partnership with a university may have a greater influence on small- and medium-sized enterprises’ capacity to produce innovations with a significant technological impact.

An empirical study conducted by Belderbos, Faems, Leten and Looy (2010) on 168 R&D firms in five different sectors revealed the significance of collaborative activities in improving these companies’ technological performance. Therefore, learning and collaboration with partners enhance mutual understanding between the two parties, which may lead to innovation. Belderbos et al. (2018) further observed through a panel study in Spain collaborative R&D activities with partners who expect to work with new partners while relying on past innovation success. Consequently, organizational learning approaches can be used to describe processes with various degrees of complexity and transformational potential (Hermelingmeier & von Wirth, 2021).

The participation of a university in an R&D partnership may be advantageous in the exploitation of foreign expertise, especially if the university is characterized by a high degree of specialization (Messeni Petruzzelli & Murgia, 2020). However, in a globalized environment, it is unclear how organizations can effectively alter themselves and what leaders can do to successfully achieve significant change (Boonstra, 2021). Furthermore, it is important to enhance a firm’s potential for learning and improvement, which may assist in transforming the business’s operational capabilities in marketing, R&D and operational management (Liang, Xiu, Fang, & Wu, 2020). Thus, collaboration with a new partner locally or internationally will provide the firm with up-to-date knowledge, enhancing its capacity for learning and providing it with the opportunity to transform and apply its R&D output by creating new products, services and processes.

Internal or external R&D learning from collaborations creates opportunities for technological advancement. Since, learning capabilities advance continued learning and adaptation to changing environments (Blaigue, Ismail, & Aldabbas, 2022). New technological knowledge emerges through the accumulation of information and knowledge owned by many parties (Messeni Petruzzelli, Albino, & Carbonara, 2007). Thus, we formulated the following hypothesis:

**H1.** Learning capabilities relate positively to transformational capabilities in R&D.
2.2 Transformational capabilities in R&D and competitive advantage

Transformational R&D capabilities by technological innovations can give firms a competitive advantage. Therefore, this study considers transformational R&D capabilities to be a change enabler. Transformational capabilities can boost the diversification of products and services, leading to a greater number of different firm products and services. This, in turn, leads to a competitive advantage because in the transformational process, the firm exploits data for risk assessment and predictive prevention (Stoeckli, Dremel, & Uebernickel, 2018).

An essential component of a firm’s transformational capabilities is their ability to adapt (Liang et al., 2020). Organizations differ because they use diverse mechanisms to accomplish their goals. Thus, collaboration in R&D could persuade individuals and organizations to change the way they operate if they find a new technique to attain a competitive advantage sooner. The reallocation and reconfiguration of resources should occur not only between resources but also in firm thinking and the way a firm operates and innovates.

Process-driven transformational capabilities in R&D can be internal or external (e.g. collaboration). To generate new processes that are more effective and efficient and to support the expansion of present competitive advantages, transformative capabilities in R&D are necessary (Adams & Lamont, 2003). Therefore, transformational R&D capabilities provide opportunities for collaborators to discuss their concerns and obstacles, which encourage creative thinking that leads to enhanced organizational performance and competitive advantages.

Thus, diverse collaboration in R&D (e.g. university and industry) is likely to facilitate the achievement of both exploitation and explorative objectives, boosting the value of mutual innovations (Messeni Petruzzelli & Rotolo, 2015). Additionally, enhanced transformational capabilities allow firms to go beyond basic research and publications; firms can be empowered to come up with new products, services or processes, and the outcome of R&D may motivate collaborators to establish new firms by utilizing the technology. Thus, R&D involves the seizing of technological opportunities, the development of new products, and the generation of a competitive advantage (Chen, 2018). Given this information, we formulated the following hypothesis:

\[ H2. \] Transformational capabilities in R&D relate positively to competitive advantage.

2.3 Learning capabilities in R&D and competitive advantage

Internal and external learning are both crucial for organizations. Internal learning comes from a company’s training of its employees, whereas external learning comes from interactions with partners, customers, and suppliers (Fatoki, 2021). Combining external complementary knowledge with internal knowledge is crucial in the development of new knowledge and, thus, innovation (Messeni Petruzzelli & Rotolo, 2015). Additionally, enhanced transformational capabilities allow firms to go beyond basic research and publications; firms can be empowered to come up with new products, services or processes, and the outcome of R&D may motivate collaborators to establish new firms by utilizing the technology. Thus, R&D involves the seizing of technological opportunities, the development of new products, and the generation of a competitive advantage (Chen, 2018). Given this information, we formulated the following hypothesis:

\[ H2. \] Transformational capabilities in R&D relate positively to competitive advantage.

Firms can enhance their learning processes from successes and failures in R&D projects. Khanna, Guler and Nerkar (2016) empirically analyzed 97 pharmaceutical companies and showed that the importance, number and timing of minor failures were connected with a decline in R&D patents and a rise in R&D citations to patents; thus, early drawbacks provide better learning opportunities, which can mitigate failures in later stages. A similar study of
successes and failures in R&D projects conducted by Magazzini, Pammolli and Riccaboni (2012) showed that citations for failed projects occurred more often than patents lacking preclinical information. Thus, each R&D initiative should be evaluated based on its phases to highlight any challenges or obstacles before such gaps increase and become difficult to deal with.

Therefore, an organization can not only learn and increase its knowledge assets based on the information collected to obtain benefits from successful R&D projects, but also identify possible failures and drawbacks if they develop a post-review process. One way for a company to gain a competitive edge is to learn faster than its competitors (Fatoki, 2021). Consequently, successful learning capabilities allow organizations to match their products and services to customers’ preferences and increase competitive advantage. Based on this information, we formulated the following hypothesis.

H3. Learning capabilities in R&D relate positively to competitive advantage.

2.4 Mediating effect of transformational capabilities on R&D

This section explores the mediating effect of transformational capabilities on the relationship between learning through R&D capabilities and firms’ competitive advantage. A firm’s ability to adapt and transform is critical to organizational success (Ashurst & Hodges, 2010). Therefore, firms are finding it increasingly important to develop their employees’ skills, capabilities and knowledge to respond to changes in the business environment as a condition for long-term competitiveness (Almahamid, Awwad, & McAdams, 2010).

R&D contributes to a firm’s building and acquiring of knowledge, which will lead to understanding how capabilities derived from technology are related to R&D and operational activities (Helfat, 1997). Helfat’s (1997) study on the US oil industry revealed how an increase in oil prices would encourage a firm to develop and transform its R&D capabilities toward alternative natural resources (e.g. coal). For example, the 2022 energy crises have motivated different governments to start investing intensively in R&D and change their policies to promote alternative energy options (e.g. renewable energy). The European Union phased out coal-fired power plants in three European countries. Five states in the United States updated their energy renew policies. China implemented a new policy for renewable energy. Korea has increased the amount of renewable energy generated from electricity by over 20% and nuclear power by over 30% by 2030 (Weforum.org). Moreover, the UAE announced a new policy target to reach net zero emissions by 2050 (Weforum.org).

When an organization chooses the proper change projects, approaches them effectively, successfully delivers them, and then sustains and exploits the outcomes, it will certainly result in successful transformational capacities (Ashurst & Hodges, 2010). For instance, collaboration in R&D (e.g. university–industry) can encourage the exchange of knowledge, create a climate of innovation and enhance organizational strategic outcomes (Aldabbas, Pinnington, & Lahrech, 2020).

Altogether, transformational capabilities in R&D lead to competitive advantage based on learning accumulation from R&D projects. The dynamic capabilities theory argues that companies must combine and redeploy knowledge resources to create a competitive advantage. Therefore, we expect that transformational capability plays a mediating role in the relationship between learning capabilities in R&D and competitive advantage. These arguments have been supported by the dynamic capabilities approach, which allows a company to combine and redeploy knowledge resources, resulting in improved performance (Chien & Tsai, 2012). Even long-term transformational change is perpetually dynamic rather than static (Williams, Dickman, & Smurthwaite, 2021). Thus, we expect that transformational capability plays a mediating role in the relationship between learning capabilities in R&D and competitive advantage:
H4. Transformational capabilities in R&D mediate the relationship between learning capabilities in R&D and competitive advantage.

3. Methods
This empirical study on survey circulated through a web link. The data were collected in the first two months of 2019. For the hypothesis tests, the study used PROCESS macro, more specifically Hayes (2018) Model 4, which relies on ordinary least square (OLS) regression and is considered one of the most commonly used techniques (Hayes & Cai, 2007). Following Certo, Busenbark, Woo and Semadeni (2016), we used different estimators (e.g. OLS) to test the research, since sample-induced endogeneity may not produce bias. Moreover, in many social sciences, using the PROCESS macro to conduct mediation is the norm (Sarstedt, Hair, Nitzl, Ringle, & Howard, 2020).

3.1 Sampling and data collection
A purposive sampling method was used, since the study specifically targets R&D employees. This sampling method was selected to ensure that respondents understood the survey questions (Rossiter, 2010). Purposive sampling has been used to investigate the effects of transformational leadership on R&D culture in Malaysian universities (Asmawi, Zakaria, & Chin Wei, 2013) and R&D intensity on a firm’s performance (Dewiruna, Subroto, & Subekti, 2020). A recent study used purposive sampling to examine the effects of corporate governance on R&D (Septiandendi & Ramadhan, 2021).

The survey was circulated via the first author’s LinkedIn network and was strictly restricted to respondents who worked in R&D or were members of top management. These categories of employees were assumed to be aware of the R&D activities in their organizations. The survey was for 203 employees. General information, such as industry type, designations and firm age was included in the survey.

The descriptive results were as follows: The majority of respondents were from the sectors of general services (n = 57.48%), information technology (n = 38.32%) and manufacturing (n = 23.20%). The majority of respondents were top management (n = 63.53%), project managers (n = 30.25%) and R&D managers (n = 23.21%). Firms were divided into groups based on years of existence, specifically 10 years and below (n = 9.8%), 10–29 years (n = 30.25%), 30–49 years (n = 67.57%) and 50 years or more (n = 12.10%).

We used G*Power (3.1.9.4) (Faul, Erdfelder, Buchner, & Lang, 2009) to assess sample size adequacy in our dataset, compute the results by selecting multiple regression analysis at a significance level of 0.05 with an effect size of 0.10 and power at 90%. The results showed that 108 total respondents were required for our model to provide rigorous results. However, only 118 respondents completed the survey with a response rate of 58%.

3.2 Measurements
Thirteen items were adopted from Schilke (2014a), our major measures are provided in Appendix. The survey used in the study was made up of three constructs to capture information about: learning capabilities in R&D, transformational capabilities in R&D and competitive advantage. We used a seven-point Likert scale (1 = strongly disagree to 7 = strongly agree).

Learning capabilities in R&D—the independent variables in our study contained four items. An example of a question used to assess this construct is as follows: “We have the capability to learn from our R&D alliance partners” (Cronbach’s α = 0.894). The Guttman split-half coefficient was 0.883 (alpha part 1 = 0.850, alpha part 2 = 0.794). The split-half coefficient was one of the steps used to validate a measure (Churchill, 1979).
Transformational capabilities in R&D—our mediator variable contained three items. A sample item is as follows: “Flexibility, in response to a request for change, is characteristic of our R&D alliance management process” (Cronbach’s $\alpha = 0.862$). The Guttman split-half coefficient was 0.713 (alpha part 1 = 0.866, alpha part 2 = 0.999).

Competitive advantage—we operationalized competitive advantage as one construct. The original scale contains two dimensions: strategic performance and financial performance (Schilke, 2014a). However, six items were designed in our study to measure the firm’s competitive advantage as one construct. An example question was as follows: “We have gained strategic advantages over our competitors” (Cronbach’s $\alpha = 0.897$). The Guttman split-half coefficient was 0.811 (alpha part 1 = 0.852, alpha part 2 = 0.875).

To further ensure scale validity and sampling adequacy, we performed the Kaiser–Meyer–Olkin (KMO) test. The results yielded a value of 0.838, which is greater than 0.70, indicating that the sample is acceptable because the result is close to 1. Following that, we used Bartlett’s test of sphericity, the results of which were significant ($p < 0.001$). Additionally, the items in our survey were easily comprehended by the respondents (Rossiter, 2002). Pre-testing or pilot testing was not performed to ensure the validity of our survey, since pre-tests are required when the scale includes items measuring a new concept (Rossiter, 2002).

4. Results
4.1 Descriptive statistics
The mean, standard deviation (SD), correlations, skewness and kurtosis are shown in Table 1. The resulting value of the normality test (skewness and kurtosis) did not exceed ±2, suggesting that all variables were within the normality range. Our analysis showed the strongest association between learning and transformation through R&D capabilities ($r = 0.598$, $p < 0.01$) followed by learning capabilities in R&D and competitive advantage (0.524, $p < 0.01$) (Table 1). In our latent exogenous constructs test, we applied a variance inflation factor (VIF) to eliminate the probability of multicollinearity. VIFs were found to be below the 4.0 cut-off value.

<table>
<thead>
<tr>
<th></th>
<th>Learning capabilities in R&amp;D</th>
<th>Transformational capabilities in R&amp;D</th>
<th>Competitive advantage</th>
<th>Industry</th>
<th>Position</th>
<th>Firm age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning capabilities in R&amp;D</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transformational capabilities in R&amp;D</td>
<td>0.598**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Competitive advantage</td>
<td>0.524**</td>
<td>0.451**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industry</td>
<td>-0.013</td>
<td>-0.071</td>
<td>-0.044</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Position</td>
<td>-0.081</td>
<td>-0.053</td>
<td>-0.140</td>
<td>0.286**</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Firm Age</td>
<td>0.045</td>
<td>-0.040</td>
<td>0.035</td>
<td>-0.006</td>
<td>0.031</td>
<td>1</td>
</tr>
<tr>
<td>Mean</td>
<td>5.112</td>
<td>4.845</td>
<td>4.956</td>
<td>2.161</td>
<td>2.322</td>
<td>2.703</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>1.355</td>
<td>1.416</td>
<td>1.327</td>
<td>0.886</td>
<td>0.805</td>
<td>0.766</td>
</tr>
<tr>
<td>Skewness</td>
<td>-1.216</td>
<td>-0.861</td>
<td>-0.933</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>0.860</td>
<td>0.549</td>
<td>0.527</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 1. Descriptive statistics
Note(s): Sample = 118, ** Correlation is significant at the 0.01 level
4.2 Common method bias (CMB)
To obtain reliable results, a CMB analysis was carried out (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). The first factor accounted for 29.736% of variation, which is below the 50% cutoff, according to Harman’s single-factor test. We used this test to extract the total variance using an unrotated factor technique. Our survey had only 13 items, making it concise. This helped prevent the issue of respondents feeling bored (Lindell & Whitney, 2001). The targeting of professional employees was another element in the survey’s design that met Rindfleisch et al.’s (2008) criteria for cross-sectional data. All these steps ensured that our sample was free of CMB.

4.3 Confirmatory factor analysis
As shown in Table 2, the goodness-of-fit for all survey items was acceptable. Moreover, the hypothesized model showed a better goodness-of-fit compared to the two-factor and one-factor models. This indicates that our hypothesized model had goodness-of-fit and \( \chi^2 \) (49) = 96.964 and \( p \) value is < 0.001.

4.4 Convergent and discriminant validity
The average variance extracted was as follows: learning capability in R&D = 0.631, transformational capabilities in R&D = 0.675 and competitive advantage = 0.595; all results were above the threshold of 0.50. The composite reliability (CR) was as follows: learning capability in R&D = 0.872, transformational capabilities in R&D = 0.861 and competitive advantage = 0.913. All results were above the 0.70 threshold. Discriminant validity for learning capability in R&D, transformational capabilities in R&D and competitive advantage were 0.794, 0.822 and 0.771, respectively. All results of discriminant validity were higher than any correlation between the other study variables (Table 1).

4.5 Hypotheses test
Model 4 of the PROCESS macro (Hayes, 2018) was used. Hypothesis 1 investigated the relationship between learning capabilities and transformational capabilities in R&D \( (B = 0.598, t\text{-value} = 8.037, p < 0.001) \). Hypothesis 2 investigated the relationship between transformational capabilities in R&D and competitive advantage \( (B = 0.215, t\text{-value} = 2.215, p < 0.050) \). Hypothesis 3 investigated the relationship between learning capabilities in R&D and competitive advantage \( (B = 0.395, t\text{-value} = 4.074, p < 0.001) \). We found that transformational capabilities in R&D mediate the association between learning capabilities in R&D and competitive advantage \( (B = 0.129, \text{standard error} = 0.065, p < 0.05) \), since zero did not fall in the range of 0.011–0.267 \( (p \) was positive and significant at 5\%) (see Table 3).

<table>
<thead>
<tr>
<th>Model</th>
<th>( \chi^2 )</th>
<th>df</th>
<th>CFI</th>
<th>TLI</th>
<th>RMSEA</th>
<th>SRMR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three-factor (hypothesized)</td>
<td>96.964</td>
<td>49</td>
<td>0.954</td>
<td>0.926</td>
<td>0.091</td>
<td>0.050</td>
</tr>
<tr>
<td>Two-factor (merged LC and TC)</td>
<td>208.232</td>
<td>55</td>
<td>0.852</td>
<td>0.790</td>
<td>0.154</td>
<td>0.073</td>
</tr>
<tr>
<td>One-factor (merged LC, TC and CA)</td>
<td>470.159</td>
<td>65</td>
<td>0.609</td>
<td>0.531</td>
<td>0.230</td>
<td>0.120</td>
</tr>
</tbody>
</table>

Note(s): LC = learning capabilities in R&D, TC = transformational capabilities in R&D, CA = competitive advantage, CFI = comparative fit Index, TLI = Tucker–Lewis index, RMSEA = root mean square error of approximation, SRMR = standardized root mean square, df = degrees of freedom

Table 2. Confirmatory factor analysis
<table>
<thead>
<tr>
<th></th>
<th>Coeff</th>
<th>Std. Err</th>
<th>t</th>
<th>p</th>
<th>LLCI</th>
<th>ULCI</th>
<th>Coeff</th>
<th>Std. Err</th>
<th>t</th>
<th>p</th>
<th>LLCI</th>
<th>ULCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.000</td>
<td>0.074</td>
<td>0.000</td>
<td>1.000</td>
<td>-0.147</td>
<td>0.147</td>
<td>0.000</td>
<td>0.077</td>
<td>0.000</td>
<td>1.000</td>
<td>-0.153</td>
<td>0.153</td>
</tr>
<tr>
<td>Learning capabilities in R&amp;D</td>
<td>0.598</td>
<td>0.074</td>
<td>8.037</td>
<td>0.000</td>
<td>0.451</td>
<td>0.745</td>
<td>0.395</td>
<td>0.097</td>
<td>4.074</td>
<td>0.000</td>
<td>0.203</td>
<td>0.588</td>
</tr>
<tr>
<td>Transformational capabilities in R&amp;D</td>
<td>–</td>
<td>–</td>
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<td>–</td>
<td>–</td>
<td>0.215</td>
<td>0.097</td>
<td>2.215</td>
<td>0.029</td>
<td>0.023</td>
<td>0.407</td>
</tr>
</tbody>
</table>

\[ R^2 = 0.358 \]
\[ \text{F (1,116) = 64.600 < 0.001} \]

\[ R^2 = 0.304 \]
\[ \text{F (2,115) = 25.145 < 0.001} \]

**Note(s):** Sample = 118, LLCI: Lower-level confidence interval, ULCI: Upper-level confidence interval
5. Discussion and empirical implications
This study investigated the effects of R&D-related transformational and learning capabilities on firms’ competitive advantage.

Our first hypothesis indicated that learning capabilities in R&D relate positively to transformational capabilities in R&D. Empirical studies support our argument that learning capabilities enhance transformational capabilities through R&D alliances (Belderbos et al., 2010, 2018). Prior literature has indicated a positive relationship between organizational learning and transformative change (Mohamed & Otman, 2021). Howard, Steensma, Lyles and Dhanaraj (2016) empirically found that great social interaction and more opportunities for learning between the firm and other experts in the field led to increased collaboration and enhanced firm performance.

Our second hypothesis regarding the association between transformational capabilities in R&D and competitive advantage was also supported. Firms should respond quickly to external changes in the environment. When employees in high-tech industries, for instance, are empowered to make creative and swift responses to real-time changes, they gain opportunities to change and adapt (Liang et al., 2020). Moreover, the transformation process leads to a competitive edge, as this process takes into consideration corporate resources and the external environment. For instance, a company that improves its digital transformational capabilities will decrease costs and enhance its corporate competitiveness (Zhai, Yang, & Chan, 2022). Thus, to improve strategic and financial performance, an organization has to transform organizational requirements into customer satisfaction and competitive advantage (Ulrich & Lake, 1991).

Our third hypothesis, which links learning capabilities with firm competitive advantage, was also supported. Hájek and Stejskal (2018) found that companies’ cooperation with universities and other companies encourages different types of knowledge spillover and results in diverse approaches to sustainable initiatives and innovation, thus bolstering competitive advantage. Additionally, Bolívar-Ramos (2017) conducted an empirical study on 3,101 companies in Spain and revealed that R&D spending and joint regional or national collaboration yielded a greater number of strong patents. Similarly, an empirical study of manufacturing sector companies listed on the Indonesia Stock Exchange between 2013 and 2017 showed that increased R&D spending significantly improved a firm’s success and competitive advantage (Dewiruna et al., 2020). Furthermore, knowledge creation and sharing allow and facilitate the exchange of explicit and implicit knowledge, boost know-how and contribute as key factors in innovation and performance (Aldabbas, Pinnington, & Lahrech, 2021; Jurksiene & Pundziene, 2016).

Lastly, Hypothesis 4 on the mediating effect of transformational capabilities on the relationship between learning through R&D capabilities and the competitive advantage of firms was also supported. Firms’ performance and competitive advantage are achieved through a “guideline for the direction of the learning and change process” (Siebenhüner & Arnold, 2007, pp. 341–342). Therefore, by integrating and coordinating the required resources, including the human capital needed to deal with a new partner and putting in place a plan to do the experimental work, which is the output of R&D, new knowledge will be acquired. This will enhance a firm’s learning capabilities and provide it with the opportunity to transform and deploy its R&D outputs via new products, processes and services, thereby enhancing the organization’s performance financially and strategically (e.g. competitive advantage).

Based on the previous discussion, we found theoretical and empirical support for our four hypotheses in a recent systematic literature review of 70 studies, which found that dynamic capabilities directly and indirectly impact competitive advantage (Fabrizio et al., 2022). Our study sheds light on the importance of transformational and learning capabilities as antecedents of firm performance and competitive advantage, considering that studies on the impact of different constructs on R&D-performance linkages are quite scarce (Boiko, 2022). Therefore, the degree to which firms possess the transformational and learning capabilities required to implement significant changes impacts their competitive advantage.
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This study contributes theoretically to dynamic capabilities theory by highlighting the flexibility in firms’ capabilities, which are conducive to high performance if these capabilities are appropriately employed, along with the fostering of a culture of collaboration in R&D. This will make the firm resilient to external environmental changes and responsive to such changes internally to preserve its long-term competitiveness. Such resource reconfiguration will lead the firm to a better position in line with the collaborative approach. Capaldo and Messeni Petruzzelli (2014) stated that knowledge diversity and integration are two significant enablers of knowledge-creating partnerships’ innovative performance.

5.1 Implications for practitioners
This study’s findings have significant implications for organizational managers in the dominion of R&D. We advise that senior management adopt specific recommendations to enhance organizational performance and competitive advantages.

1. Top management should allocate the needed resources and funds to support training and learning activities and encourage training beneficiaries to apply their newly acquired skills and knowledge (Anlesiny, 2018; Pinnington, Aldabbas, Mirshahi, & Pirie, 2022).

2. R&D managers may organize networking events to allow employees to gather and learn from each other’s experiences, since it has already been proven that networking will enhance employee performance (Nasaj, 2021), which will increase employee learning and contribute to organizational competitiveness.

3. The commercialization of R&D initiatives through university–industry associative partnerships or joint ventures will enhance organizational technological advancement, learning and ultimately performance (Aldabbas et al., 2020; Islam et al., 2018; Pun & Ghamat, 2016).

4. Organizations should advance their learning capabilities and alliance collaborations to efficiently manage diverse information flows (Garcia Martinez, Zouaghi, & Sanchez Garcia, 2019). Collaboration on R&D projects with companies that use related technologies may limit the prospects for knowledge exchange (Ardito, Messeni Petruzzelli, Pascucci, & Peruffo, 2019).

5. To equip employees with R&D skills and transformative capabilities, firms need to utilize a knowledge management system to configure and reconfigure their operations and processes to respond to risks and turn them into opportunities (Almahamid, 2018).

6. Organization managers should plan for post-review processes to learn from successes and failures in R&D projects to be recorded and documented for future R&D initiatives. For example, Huawei’s entrepreneurial culture emphasizes failure as a source of learning (Liang et al., 2020).

7. To transform businesses, organizational managers should coordinate, communicate and control the R&D process. Furthermore, they should determine how to maximize the benefits of collaboration by integrating learning and transformation capabilities and R&D activities.

8. Organizational managers should encourage knowledge sharing, which may result in new ideas, and eventually, productivity benefits for the firm (Messeni Petruzzelli, 2011).

9. Finally, it is difficult to determine the exact level of funding for research because of the federal structure of the different emirates that make up the UAE, although it is generally believed to be less than 1% of the GDP. Therefore, investment in scientific
research-intensive universities is mandatory (Ryan & Daly, 2019). Policymakers in the UAE can benefit from this study by creating a research culture, attracting quality researchers and investing intensively in research to enhance the UAE’s R&D capabilities.

6. Conclusion
This study explored the influence of the integration of the dynamic capabilities approach into integration R&D to understand its effect on firms’ competitive advantage. Specifically, it examined the mediating role of transformational capabilities in the relationship between learning capabilities in R&D and competitive advantage. The research examined four hypotheses using multiple regression. The model found relatively strong empirical support for the factors and relationships affecting competitive advantage in UAE firms.

Firms may encourage R&D collaborators if effective business transformation methods enabled by learning capabilities are applied. If this method of enhancing learning capabilities were to be adopted and implemented in practice, it would encourage firms to interact actively and positively in the long term as part of a transformational process. To sum up, we concluded that collaboration in R&D will give the firm more rewards, such as enhancing its learning capabilities, transformational capabilities, strategic performance, financial performance and competitive advantage overall.

6.1 Limitations and agenda for future research directions
The limitation of this study lies in the sampling issue. We used a purposive sampling method and a small sample size of 118 respondents. Future research could include longitudinal studies or time lags to understand how much time it takes for the transformational process in R&D to be translated into improvements in organizational performance. This study investigated R&D from a collaboration perspective. Future studies could examine the same framework for noncollaboration in R&D when an organization executes R&D projects alone without any partnerships with a third party. Future research may explore different types of collaborations, such as university–industry collaboration, public–private collaboration, outsourcing, joint ventures and alliance.

Moreover, to understand the factors motivating decision-makers, qualitative studies may raise the question of why firms select specific types of collaborative partnerships (e.g. public–private or university–industry). Additionally, one of this study’s limitations is that only learning capabilities were assessed as one of the internal drivers of the transformational process in R&D projects. Other factors (e.g. organizational culture) have an effect on transformational capabilities. Lastly, future studies should consider the same framework based on sustainable development because the question of how dynamic capabilities can be sustained in firms remains unaddressed (Liang et al., 2020).

References


Further reading

Appendix
Items for primary measures

Learning capabilities in R&D
(1) We have the capability to learn from our R&D alliance partners.
(2) We have the managerial competence to absorb new knowledge from our R&D alliance partners.
(3) We have adequate routines to analyze the information obtained from our R&D alliance partners.
(4) We can successfully integrate our existing knowledge with new information acquired from our R&D alliance partners.

Transformation capabilities in R&D
(1) We are willing to put aside contractual terms to improve the outcome of our R&D alliances.
(2) When an unexpected situation arises, we would rather modify an R&D alliance agreement than insist on the original terms.
(3) Flexibility, in response to a request for change, is the characteristic of our R&D alliance management process.

Competitive advantage
(1) We have gained strategic advantages over our competitors.
(2) We have a large market share.
(3) Overall, we are more successful than our major competitors.
(4) Our EBIT (earnings before interest and taxes) is continuously above industry average.
(5) Our ROI (return on investment) is continuously above industry average.
(6) Our ROS (return on sales) is continuously above industry average.

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