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OPEN INNOVATION AS A CORPORATE STRATEGY: BALANCING INTERNAL R&D AND EXTERNAL COLLABORATION

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ABSTRACT

Innovation strategies are increasingly shaped by the need to balance internal research and development (R&D) with external collaboration. This study examines the firms structure the balance and its impact on innovation performance. Using a mixed-methods approach, quantitative data were collected from 150 innovation managers, R&D directors, and senior executives across high-innovation sectors in North America, Europe, and Asia, measuring R&D investment, collaboration frequency, and outputs such as patent filings and product launches. Qualitative insights were gathered from 15 interviews and three detailed case studies in the technology, pharmaceutical, and automotive industries. Statistical analysis showed that both internal R&D and external collaboration independently and significantly enhance innovation outcomes, with a positive interaction effect indicating synergistic benefits. Cluster analysis identified three strategic archetype such as Balanced Innovators, Internal Specialists, and External Leveragers with Balanced Innovators achieving the highest performance. Thematic analysis highlighted governance mechanisms, intellectual property management, and industry-specific adaptation as critical to success. Findings confirm that a deliberate integration of internal and external innovation, supported by effective governance, fosters absorptive capacity, mitigates risks, and yields superior results. This research provides empirical and practical guidance for firms seeking sustained competitive advantage through balanced open innovation strategies

Keywords: Open Innovation; Internal R&D; External Collaboration; Innovation Performance; Balanced Innovators

1. INTRODUCTION

Innovation has emerged as a key determinant of organizational competitiveness and economic sustainability in the long-run and the manner, in which firms are pursuing innovation has been transformed over the past few decades to a great extent. Most of the twentieth century was ruled by traditional closed innovation paradigms, where the research and development (R&D) functions were performed virtually entirely internally and focused on secrecy, dominance and proprietary gain. The accelerated pace of technological change, globalization of the market, and liberalization of knowledge have threatened this paradigm leading to the emergence of the concept of open innovation, which combines the internal and external sources of knowledge in the whole innovation process (Bigliardi et al., 2021) Open innovation postulates that useful ideas may be either internal or external to an organization, and that commercialization routes frequently necessitate cooperation between firms, institutions, and industries. Although the strategy has the advantages of reducing time-to-market, increased access to talent, and the need to share costs, the strategy also has such disadvantages as intellectual property (IP) protection, the complexity of coordination, and the difficulty of achieving strategic alignment among the partners (Gustomo et al., 2022). Among the most acute strategic dilemmas in this context is to create an optimal balance between the internal R&D capacity and outside cooperation. Excessive use of internal R&D may result in the technological isolation and slowness to respond to any market changes and excessive dependence on the external sources may cause loss of proprietary competencies and loss of long-term strategic control.

An important theme in the open innovation literature is gaining traction: internal R&D and open innovation are not mutually exclusive, but, when done well, mutually reinforcing. Internal R&D does not only generate proprietary technologies but also develops absorptive capacity, or the capability to identify, assimilate and exploit the external knowledge critical to the maximization of the value of partnerships (Flor et al., 2018). Inhouse capabilities aid in the evaluation and integration of outside feedback and such partnerships can extend the scale, velocity, and diversity of the output of innovation (Zobel & Hagedoorn, 2020). It has been noted in several industries with different patterns per industry. As an example, pharmaceutical companies tend to cooperate significantly with universities, biotech companies, and contract research institutions to distribute the burden of drug development, and the technology companies utilize open platforms and developer ecosystems to trigger the complementary innovations (Radziwon & Bogers, 2019). Conversely, other industries are more discriminating in their openness strategies, as the aerospace and automotive industries focus on preserving their process knowledge and IP and only enter specific partnerships with partners where the rewards may exceed the risks (Raffaelli et al., 2019). The governance mechanisms, which include formal contracts and IP agreements, as well as relational norms of trust are essential in reaping the value of open innovation and limiting the chances of knowledge leakage (Bican et al., 2017).

Recent studies have added precision to the openness performance relationship as well, with some work showing that performance of openness may take an inverted-U shape: performance of innovation rises with increased openness until a point, at which coordination costs, IP risks and managerial complexity start to reduce returns (Zobel, 2013). This suggests that a well-modulated strategy is in demand, whereby companies invest enough in internal R&D to sustain their technological depth and absorbative capacity, and yet also venture through external partnerships that augment, and not replace, instead of the internal actions (Ahn et al., 2017). That is another complicating, and new level of possibilities, opened by digital technologies: the specific tools, such as platforms, data-sharing ecosystems, and advanced analytics, may lead to new forms of collaboration but also expand concerns of ownership of data, compatibility, and cybersecurity (Enkel et al., 2020). Additionally, innovation policies with a focus on sustainability are pushing companies to expand into other values than the classic value chain since they are partnering with governments, non-profits, and cross-sector networks to solve the systemic problems such as climate change and transitioning to circular economies (Franceschelli et al., 2018).

The current study aims at providing a contribution to the scientific and business knowledge in the field of the the firm may best design its portfolio of innovations. Namely, the research intends to test the correlation between internal R&D investment and external collaboration frequency in the context of determining the innovation performance, identify and define archetypes of innovation strategies based on this balance, and investigate the governance processes, industry-specific and barriers that define the successful integration of internal and external innovation. Through a mixed-methods approach involving both

quantitative and qualitative analysis in the form of case studies, the study offers empirical data and contextual information concerning the processes that lead to sustained competitive advantage by firms in the maintenance of a balanced open innovation strategy. Besides filling one of the most important gaps in the literature, this integrated view can provide managers with insight into the changing landscape of innovation within an interconnected and knowledge-intensive economy.

2. RESEARCH METHODOLOGY

2.1 Research Design

The research employed research design that combines quantitative and qualitative research to give an in-depth analysis on the organizations strike a balance between internal R&D and external alliance to be open to innovation. The quantitative part will imply gathering structured survey data to determine quantifiable correlations between innovation input and output, whereas the qualitative part will aim to immerse managerial views, organizational dynamics, and issues by means of interviews and case studies (Wibowo et al., 2024). The triangulation of results can be achieved by integrating them and making the research more valid. The research design presented in Fig.1 would involve qualitative thematic analysis and quantitative statistical analysis to solve the problem of innovation imbalance and attain the balance of strategic innovation.

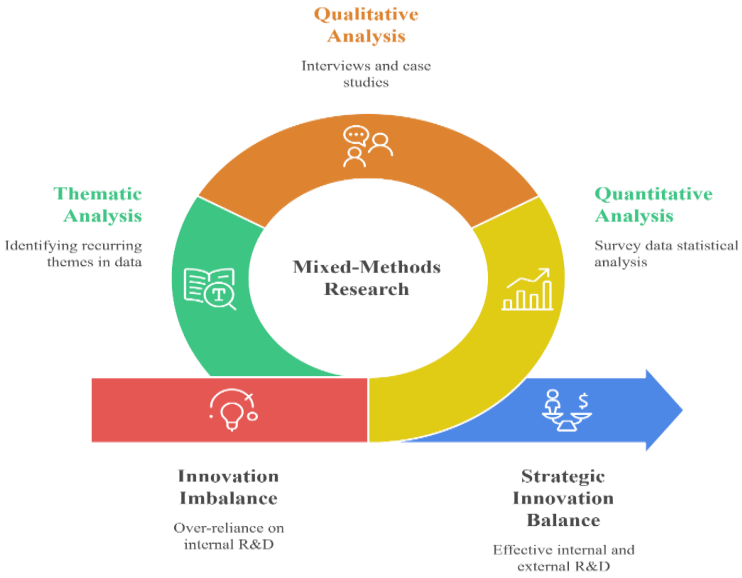

Fig. 1: Conceptual framework of mixed-methods research integrating qualitative and quantitative analyses to explore the balance between internal R&D and external collaboration for strategic innovation management.

2.2 Data Collection Methods

To collect quantitative data, a survey was created online and designed with the help of thorough literature review drawing on such variables as the level of R&D investments in firms, the form and intensity of external relationships, perceived advantages and challenges of open innovation, and innovation performance indicators consisting of patent numbers and novel products launches. The survey was to be conducted among managers of innovation, R&D directors, as well as senior managers of industries that were well known to be active in innovation, namely technology, pharmaceuticals and manufacturing. To complement the same, qualitative data were gathered using semi-structured interviews with fifteen high-ranking innovation leaders in firms that have been known to embrace open innovation examples. The key strategic reasoning of achieving the balance in internal and external innovation, cooperation procedures, knowledge-sharing practices, and encountered challenges had to be revealed at these interviews (Hossain & Kauranen, 2016). Also, 3 case studies based on secondary sources of information, such as annual reports, press releases, and academic studies, were developed to give contextualised information on the strategies of open innovation that have been implemented in practice.

2.3 Sample Selection and Description

The sample was a mid-sized and large-sized firm having an active innovation program. A preference

was granted to the companies that worked in the industries with a high level of innovation intensity, including information technology, pharmaceuticals, automotive, and consumer electronics. The geographic coverage was North America, Europe, and Asia to have a wide range of innovation ecosystems. Respondents of the survey, as well as interviewees, were chosen because of their positions in the innovation strategy, R&D management, or partner development, so that the information could represent an informed opinion. The last quantitative sample was composed of 150 completed questionnaires, whereas 15 people working in 12 various firms were interviewed qualitatively. Three case studies were conducted aimed at three multinational companies that have effective internal and external innovating balancing.

2.4 Data Analysis Techniques

The quantitative data were analysed with the help of statistical programs like SPSS and R, and a description of statistics was also done to summarise the relationship between the organisations concerning the measures of the internal R&D expenditure and external collaboration behaviour of the firms. Correlation analysis was also used to study the relation between these innovation activities and performance measures, including patent filing and the launching of a new product. The multiple regression models were used to test the relative importance of the internal and external efforts towards innovations as determinants of firm innovation success. Also, cluster analysis helped to determine groups of firms that had a comparable strategy towards balancing of innovation activities. Cronbach's alpha was used to test the reliability of the survey scales and to test the construct validity; factor analysis was used.

Interviews and case studies gave qualitative data that was analyzed on a thematic basis. The transcripts were first open-coded to find important themes on strategic decision-making, types of collaboration, obstacles and strengths, and results. Axial coding was subsequently used to relate themes and come up with an explanatory framework that describes the balancing of internal innovation and external innovation by companies. The case comparisons revealed the general trends, differences by industry. The qualitative information was incorporated with the quantitative information to form a broad picture of the open innovation practices.

3. RESULTS

3.1 Quantitative Findings

The survey of 150 innovation managers, R&D directors, and top management provides a clear picture of the organization's balance between internal R&D and the outside world. Table 1, which presents the descriptive statistics, reveals that the average investment in internal R&D among the sample equals 7.8 % of revenue, with a standard deviation of 4.9 % of the revenue between 3.2 % and 15.1 %. The average number of collaborative projects in which firms engage per annum is 9.4 projects, with a minimum of only 2 projects a year and a maximum of 18 projects a year. The patent filings are on average 24.7/year, and there is an average of 11.3 new products launched in the last 3 years. The difference in these numbers indicates diverse strategic orientations that are usually influenced by industry dynamics, size of the firm, and competition. Table 1 shows the mean and standard deviation of the key variables involved in the innovation process and shows the degree of variation in the various strategies that firms used regarding investment and cooperation. Table 2 presents the correlation matrix of key innovation variables. The results show that internal R&D investment and external collaboration frequency are significantly and positively associated with patent filings and new product launches.

Table 1: Descriptive statistics of key innovation variables

Variable	Mean	SD	Min	Max
Internal R&D Investment (% of revenue)	7.8	2.6	3.2	15.1
External Collaboration Frequency (projects/year)	9.4	3.1	2	18
Annual Patent Filings	24.7	10.2	8	60

Table 2: Correlation Matrix of Key Innovation Variables

Variable	Internal R&D Investment	External Collaboration Frequency	Annual Patent Filings	New Product Launches
Internal R&D Investment	1.00	0.44**	0.61**	0.58**
Collaboration Frequency	0.44**	1.00	0.54**	0.50**
Patent Filings	0.61**	0.54**	1.00	0.67**
New Product Launches	0.58**	0.50**	0.67**	1.00

As indicated by correlation analysis, internal R&D investment and level of collaboration are positively and significantly correlated with innovation outputs, which are measured through patents and new product releases. There is a strong correlation between internal R&D investment and patent filings ($r = 0.61$, $p < 0.01$), as well as product launches ($r = 0.58$, $p < 0.01$), with the frequency of collaboration also being considerably positively correlated ($r = 0.54$ and 0.50, respectively; $p < 0.01$ in both cases). The fact that the positive correlation between R&D investment and the frequency of collaboration ($r = 0.44$, $p < 0.01$) can also indicate that the firms with strong internal capabilities are more inclined to the partnership and confirms the thought that such strategies can be either complementary or competitive.

Regression analysis (Table 3) indicates that both internal R&D investment and the frequency of collaboration are highly predictive of the aggregated innovation performance index, which is the sum of the standardized values of patent and product launch. The slightly better effect of internal R&D investment (beta 0.42) as compared to the collaboration frequency (beta 0.37) remains important since the interaction term between the two is significant (beta 0.15, $p < 0.05$). Such a discovery brings out a synergy effect, since companies that are effective in both internal research and development and external alliances perform better than those that are good only in one of the two. The Table 3 shows both internal and external innovation activities are key factors of performance, and the positive interaction means that the two approaches complement one another.

Table 3: Multiple Regression Results: Predictors of Innovation Performance

Predictor Variable	Beta	t-value	p-value
Internal R&D Investment	0.42	4.87	<0.001
External Collaboration Frequency	0.37	4.21	<0.001
Interaction Term (R&D × Collaboration)	0.15	2.03	0.044

The sample of the study contains three different archetypes of innovation according to a cluster analysis, shown in Fig. 2. Balanced Innovators mark a 42% share of companies, and they exhibit a high internal R&D and high collaboration frequency and are ranked highest on performance consistently. Internal Specialists, the group that makes up 33% of the sample, are also very internalized on their R&D and have little in the way of cooperation. External Leveragers at 25 % rely more on partnerships, with the investment in R&D remaining low.

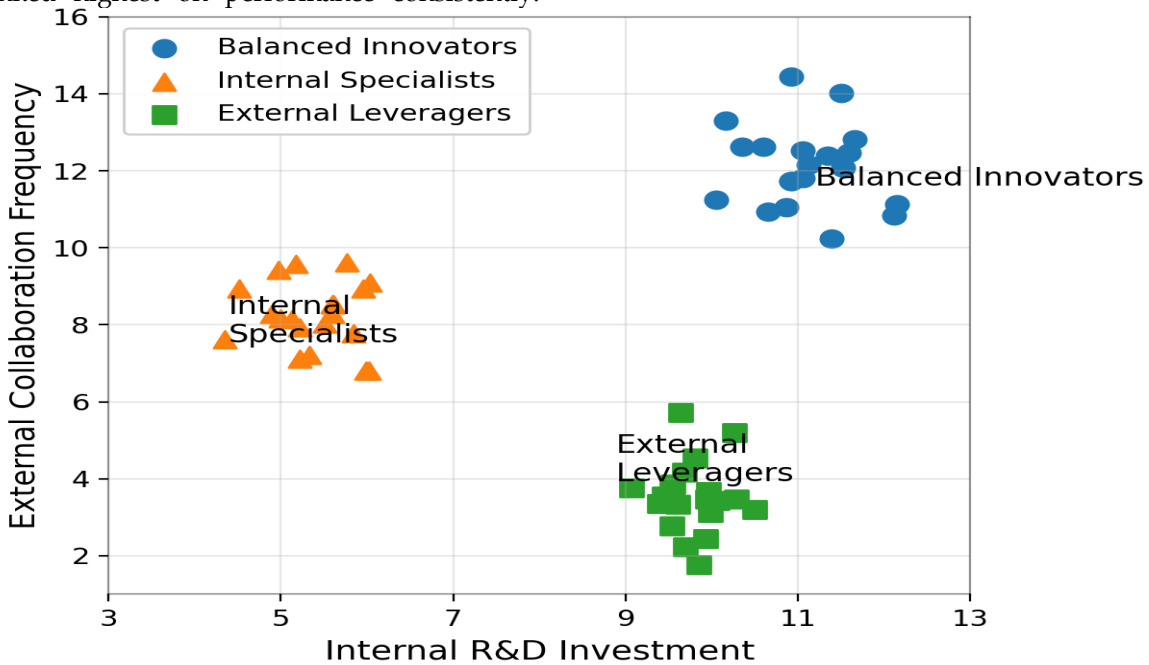

Fig. 2: Cluster Analysis of Firms by Innovation Approach

3.2 Qualitative Findings

The 15 interviews of the senior innovation leaders have extensive insights into the incentives, processes, and barriers of internal versus external innovation balancing. A reasonably balanced combination mitigates strategic risk, several respondents said,

with internal R&D providing proprietary knowledge and long-term development of technical capability, and outsourcing providing access to complementary technology at a speed previously unattainable and time-to-market. The scale and complexity of modern science requires collaborative approaches, since no single organization can manage the entire innovation process alone. (Paul et al., 2010).

It turned out that an important success factor in collaboration was good governance. To overcome the expectations and to safeguard any proprietary knowledge, the high achievers establish common steering committees, financing based on milestones, and clear-cut intellectual property agreements. The involvement of innovation intermediaries was also used in some companies- e.g., industry consortia, technology transfer offices- to facilitate screening and partner selection and reduce search costs and decrease interaction time.

The qualitative data also display the existence of barriers. The most commonly mentioned barrier was that of intellectual property issues, which in many cases restricted the openness of knowledge exchange. Differences in cultures between the organizations involved in the partnership, especially between the large corporations and less established and more nimble startups, contributed to delays in achieving integration and other misunderstandings. In other situations, an issue of resource allocation emerged whereby internal groups were hesitant to transfer human or financial resources to projects that are externally managed.

The business environment also had its influence on these trends. The open innovation was more likely to be used by technology companies since it is an area of rapid technological change and adaptation. Drug companies had depended on alliances with academic institutions and biotech companies to distribute the high cost of drug development and risk. Conversely, automobile companies focused on in-house R&D, and this showed the premium that was put on guarding the secret process of manufacturing and ensuring a high level of control.

3.3 Case Study Comparisons

The three case studies, including TechCorp (technology), PharmaGlobal (pharmaceuticals), and AutoMotiveX (automotive), bring out the industry context's effect on innovation strategy. As shown in Fig. 3, these firms are compared based on their R&D levels of investments, their rates of collaboration, and the number of patents that they produce. The Balanced Innovator is embodied by TechCorp, and this organization has a great interest in R&D and alliances. PharmaGlobal does a moderate R&D investment but also has a high level of collaboration, which represents the reliance of the industry on those external pipelines. AutoMotiveX makes the greatest investment in R&D and has few partnerships, preferring to keep exclusivity in their production techniques.

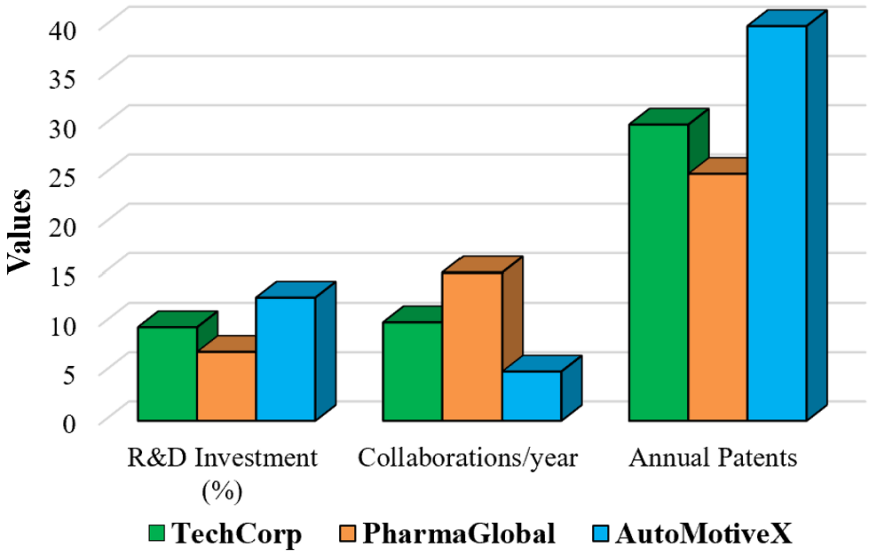

Fig. 3: Comparative Innovation Profiles of Case Study Firms

The advantage of the Balanced Innovator model can be noticed by considering the quantitative findings along with the qualitative ones. These are their average impersonation scores of innovation performance depicted in Figure 3. Balanced Innovators are the highest (about 85), and then Internal Specialists (about 70) and External Leveragers (about 65). Such a performance gap highlights the advantage of investing in both internal and external partnerships in R&D, at the same time.

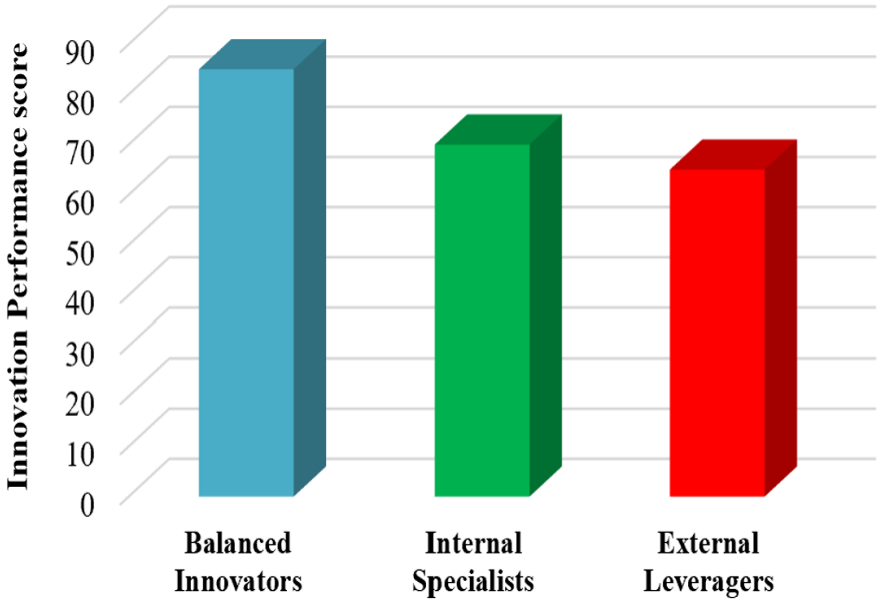

Fig. 4: Innovation Performance by Strategy Archetype

The findings indicate that internal as well as external innovation activities are contributors to innovation success on their own, and that the two, coupled together (with the facilitation of effective governance and appropriate adaptation to the industry concerned), bring about the best results. Balanced Innovators, although sharing the same issues of IP protection, cultural alignment, and resource allocation, prove that such obstacles can be overcome with structured management and a clear strategic intent.

4. DISCUSSIONS

The research concludes that internal R&D investment and external collaboration positively and significantly contribute to innovativeness, yet the two are particularly strong when combined. Our positive interaction indicates that the best characteristics of the firms in both domains, those called Balanced Innovators, perform better than those that lean heavily on one or the other. This is consistent with new results that the absorptive capacity developed because of internal R&D makes firms more proficient at identifying, learning, and leveraging external knowledge and enhances the advantages of an open innovation (Zou et al., 2018). Meanwhile, the inverted-U reasoning of openness about the potential harm of overdependence on outside resources reminds of the necessity to attain the equilibrium, with some research indicating that the performance improvements level off after optimal amounts of openness are benefited (Lu & Chesbrough, 2022).Our qualitative results explain why these trends have been quantitative. It was pointed out by interviewees that internal R&D fosters long-term expertise, whereas external cooperation brings in speed, complementary skill sets and new horizon. Solid governance arrangements; including, joint steering committees, milestone funding and customized IP contracts, proved to be important facilitators in enabling firms to achieve value through cooperation without diminishing in-house capacity. These results are reflected in the literature that has been promoting alignment of IP protection approaches with modes of openness among firms (Grimaldi et al., 2021). Besides, our statistics show: pharmaceutical companies are widely involved in outside collaborations, technology companies combine the two approaches, and automobile companies focus on inside R&D. These differences in sectors have been echoed with other sectors as the more agile sectors are more open whereas those stuck in manufacturing-based control are more cautious.The companies ought to invest in in house R&D not just to achieve break innovation, but also to increase the ability of companies to assimilate and exploit outside ideas. Managers ought to design their portfolio of innovation deliberately to incorporate both inbound and outbound channels and add structure to selective collaboration to complement their internal effort. The major protagonist is governance: incorporating open modalities (e.g. APIs, licensing, alliances) with the defensibility of IP strategy, firms can reap the benefit of the external reach that they can attain, without losing access to vital knowledge. The matching of mechanisms, such

as innovation intermediaries, living labs, and platforms mediated by policymakers and industry bodies, should also be encouraged as the mechanisms facilitate specific cooperation and minimize the potential of leakage (Lee & Trimi, 2018; Ogink et al., 2023). Openness strategies (open interfaces, cores, or layers) are necessary, particularly in the industries where the process of digital transformation or the proliferation of platforms is taking place.

These are limited to the extent that they can be generalized by the limitations of the study. Our sample was skewed in favour of medium to large sized companies in high- innovation industries and may under-represent small start-ups, or in the public sector. The use of self-reported information can add bias or reduce causality, even in the case of triangulating the data with interviews and case examples. The counts of patents and releases of new products, traditional measures of output, which may fail to reflect more holistic results such as innovation of the business models or contribution to an ecosystem (Schuhmacher et al., 2022). Moreover, the research did not look into the digital platform strategies or the sustainability effects directly, even though the modern research results indicate that it is gaining more and more significance in determining the open innovation dynamics (Gawer, 2022).

When comparing our findings to the literature, there is still a growing consensus: the internally and externally balanced innovation perform better (Brunswicker & Chesbrough, 2018; Santoro et al., 2019). This sector-specific differentiation replicates previous research that pharmaceutical industries make intensive use of academia and biotech partners, whereas automotive companies are discriminating in terms of opening around suppliers and platforms. IP governance and control remain to be one of the most significant issues in the conduct of open innovation. The addition is that the empirical connection between internal-external complementarity and actual performance outcomes and provide an illustration of governance mediates this association-often more abstract characterizations of openness-performance relationships in past reviews.

The study strengthens one piece of practical advice: internal R&D investment should be seen as the basis of innovation resilience and absorptive capacity and then overlay the degrees of carefully controlled openness to your industry situation and risk acceptance. Neither one-sided specialists nor the other, Balanced Innovators are the best organizations to achieve the goal of turning collaboration breadth into competitive advantage. Studies may be expanded to a broader set of firm sizes and industries, more elaborated measures (e.g. the digital ecosystem value), and research concerning openness in platform settings and platform-based sustainability transitions

5. CONCLUSIONS

The given research highlights that the most successful innovation techniques are those that strategically integrate a strong in-house R&D with partnerships that are well-coordinated. The quantitative and qualitative evidence provided illustrates that only firms adopting the Balanced Innovator model does better as compared to those that over-use a single source of innovation. Internal R&D forms the basis of establishing proprietary knowledge and absorptive capacity which would help organizations in identifying, assimilating and exploiting ideas of outside partners more effectively. When managed with proper intellectual property rights, well-defined project management and limited engagement with partners, external partnerships can offer complementary resources, help speed up the pace of product development, and expand access to emerging technologies. These two approaches complemented each other and this was reflected in improved patent outcomes, higher levels of new products and improved overall innovation outcomes.

Industry-specific trends also indicate that openness practices have to be sector-specific. Faster-changing areas of activity, like technology and pharmaceuticals are at an advantage in terms of having a broader collaboration network, whereas capital-intensive and process-specific industries (as the automotive industry manufacturing, for instance) have a greater tendency of maintaining more control over its innovative processes. In any case, structured openness where robust internal capabilities are in place reduces the typical impediments that can occur which includes risks of intellectual property, cultural mismatch and resource conflicts.

To sum up, it should be noted that companies, that want to maintain a lead in innovation, should not consider the investment in their own R&D and external relations as competing but complementary. This strategic balancing will enable firms not only to realize better innovation but also to be resistant to market and technological change. Future studies like this should be expanded into other fields and include more innovation performance measures, as well as investigate the effects of digital platform ecosystems and sustainability driven innovation.

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