A CONFIGURATIONAL APPROACH TO NEW PRODUCT DEVELOPMENT PERFORMANCE: THE ROLE OF OPEN INNOVATION, DIGITAL TRANSFORMATION AND ABSORPTIVE CAPACITY

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Abstract

Globalization, digital acceleration, and market shocks have all revealed the importance of new product development in enabling companies to remain competitive. Focusing on digitally mature companies, we look into the different routes that organizations can take to accomplish this goal, involving a mix of inbound/outbound open innovation, digital transformation, and absorptive capabilities in the path towards higher levels of new product development performance. By employing structural equation modeling and fuzzy set qualitative comparative analysis, four different organizational pathways emerge. A detailed analysis of these pathways provides further insights for scholars and practitioners, enhancing our understanding of the active role of open innovation, digital transformation, and absorptive capacity in new product development performance.

Keywords: New Product Development Performance, Open Innovation, Absorptive Capacity, Digital Transformation, Fuzzy Set Qualitative Comparative Analysis.

1. **INTRODUCTION**

For companies to remain competitive, they must continuously develop new products and services (Cooper, 2019). When companies face shortages of knowledge and resources, they are open to sources of knowledge and collaboration with external partners through open innovation (OI) activities. Accordingly, OI represents: "the use of purposive inflows and outflows of knowledge to accelerate internal innovation and expand the markets for external use of innovation, respectively" (Chesbrough, 2006, p.1). The OI approach involves inbound (i.e., purposive inflows of knowledge) and outbound OI activities (i.e., outflows of knowledge) (Hung and Chou, 2013; Arias-Pérez et al., 2021), which enables new products to reach the market more quickly, be more efficient, and be less prone to risk through knowledge-intensive collaboration with external partners (Frishammar et al., 2012; Gurca et al., 2021).

The advantages of OI have been noted by researchers and practitioners (Chesbrough, 2003; Van de Vrande et al., 2009; Popa et al., 2017; Del Vecchio et al., 2018). For example, Rimac Automobili – a Croatian car manufacturer producing high-performance electric vehicles – has embraced OI by collaborating with numerous companies, universities, and research institutions to develop new technologies and improve the firm's products. The company is known for its innovative designs, and it has been successful in developing new technologies for electric vehicles, such as high-performance batteries and electric drivetrains. In 2021, Rimac joined forces with Bugatti Automobiles and formed a joint venture called Bugatti Rimac, with the goal of empowering the technology industry (Rimac, 2021). Bugatti Rimac developed an innovation hub in Berlin, where experts from all around the world could work together to design new Bugatti and Rimac hyper cars (Rimac, 2022). This approach allowed Rimac to leverage the expertise of others and accelerate innovation, while also creating new opportunities for collaboration and growth.

Scholars investigated the influence of degrees of openness on companies' success from different perspectives. For example, comprehensive studies have been carried out on customer integration into the New Product Development (NPD) process (Piller and Walcher 2006; Sandmeier et al., 2010), the integration of consumer knowledge into front-end phases of NPD (Gassmann et al., 2006; Bashir and Malik, 2021), and the influence of customer involvement on NPD performance (Morgan et al., 2018). Aliasghar et al. (2020) studied OI with regards to the breadth and depth of collaboration with stakeholders outside of the organization. Building upon a sample of companies within the automotive industry, the outcomes revealed that breadth (number of collaborations) was positively related to the innovation process, while depth was not related. Morgan et al. (2018) considered the direct impact of OI on NPD performance, as well as its indirect impact through innovativeness and absorptive capacity (AC). OI was measured through consumer participation in NPD processes, and the outcomes showed that customer participation had a positive effect on NPD performance, and that the effect was mediated by new product innovativeness and moderated by AC. Furthermore, Zhu et al. (2019) studied the effect of openness (breadth and depth) on NPD speed. Their findings revealed that NPD speed is positively affected by the breadth and depth of OI, and that the relationship between depth and NPD speed is positively strengthened by novel business models. Zhang et al. (2022) found that OI has a negative effect on innovation performance, while AC partially mediated the relationship.

Interestingly, scholars have revealed that the type of OI (breadth or depth of openness, ideation or implementation openness, commercialization, or development-centric OI) has a positive and significant impact for breadth of openness on process innovation (Aliasghar et al., 2020), customer participation on NPD performance (Morgan et al., 2018), breadth and depth of openness on NPD speed (Zhu et al., 2019), and commercialization-centric OI on innovativeness

(Rubera et al., 2016). Simultaneously, the findings revealed no significant effect of OI on company success, search depth on process innovation (Aliasghar et al., 2020), ideation and implementation openness on product innovativeness and speed (Cui et al., 2018), or development-centric OI on product portfolio innovativeness (Rubera et al., 2016). Moreover, the findings revealed there to be a negative effect of repeated partnerships on innovation performance (Zhang et al., 2022). A probable explanation for these negated findings could be traced back to the fact that the effective application of OI practices requires companies to develop the right dynamic capabilities, known as AC.

Several knowledge gaps emerged with regards to the association between OI and NPD. Although the concepts have been somewhat explored by practitioners and academics, researchers have differing views (and obtain different results) on the association direction and the strength of the relationship between OI and performance (Du et al., 2014; Moretti and Biancardi, 2020). Because the relationship between OI and firm success is only sometimes direct (Sisodiya et al., 2013), the indirect effects of different variables could help to better understand this relationship. For example, companies could develop their AC by taking full advantage of the integration of internal and external knowledge. As a dynamic capability, AC allows companies to quickly adapt to market changes and maintain a competitive advantage (Zahra and George, 2002). Besides the importance of OI and AC, digital transformation (DT) has also encouraged companies to alter their day-to-day activities and ultimately enhance NPD (Abdurrahman et al., 2022). Accordingly, advanced technologies (e.g., big data, artificial intelligence, and IoT) represent an opportunity for companies to collect and analyze data more efficiently, thereby encouraging NPD. Thus, to contribute to this inquiry, this research aims to shed light on the role of a possible mix of open innovation, absorptive capacity, and digital transformation on new product development performance.

To reveal how OI, AC, and DT can help companies to improve NPD, the article draws on a sample of digitally mature Croatian companies that participate in NPD processes. In order to present a comprehensive and in-depth interpretation of the connections between OI, AC, DT and NPD, the theoretical model is assessed by a combination of Partial Least Square Structural Equation Modelling (PLS-SEM) and Fuzzy-set Qualitative Comparative Analysis (fsQCA) (Rasoolimanesh et al., 2021). PLS-SEM was used to test the associations between endogenous and exogenous constructs, while fsQCA aided in exploring asymmetric relationships in regression-based models (Fiss, 2011).

In essence, this research contributes to the development of this research domain by giving equal attention to inbound and outbound OI activities. Accordingly, the results revealed that commercially orientated OI could provide additional value by strengthening DT and, through AC, could contribute to NPD performance. These results show that inter-organizational knowledge flows continuously materialize at a different pace due to technological changes and ever shorter product life cycles. The following section outlines the theoretical foundations of inbound OI, outbound OI, AC, and DT concerning NPD performance.

2. THEORETICAL FOUNDATIONS

2.1 The combination of inbound OI, absorptive capacity, and digital transformation

Inbound OI can be considered the “use of purposive inflows of knowledge” (Chesbrough, 2006, p. 1), but is also known as an “outside-in process” (Gassmann and Enkel, 2004, p. 6) or “technology exploration” (Van de Vrande et al., 2009, p. 425). Numerous authors have studied the influence of inbound OI on companies’ performance and have concluded that there are multiple benefits to implementing inbound OI practices when it comes to creating a business model and choosing a strategic direction (Sisodiya et al., 2013; Moretti and Biancardi, 2020; Hervas-Oliver et al., 2021). Companies can benefit from involving customers, suppliers, competitors, larger companies, startups, or higher education institutions in product development (Feller et al., 2009; Ardito et al., 2020; Mousavi et al., 2022). Sisodiya et al. (2013) highlighted that the link between inbound OI and firm performance is sometimes indirect. However, various factors related to the company's context (for example, relational capability or network overflow) facilitate the relationship.

For years, scientists and practitioners have studied the techniques, methods, and tools that enable successful NPD. In innovation literature, scholars have acknowledged the importance of OI activities and their contributions towards maximizing the profits from NPD. Knudsen and Mortensen (2011) analyzed the effects of openness on NPD performance, while Santoro et al. (2017) studied the ways in which external sources of knowledge affect NPD performance, along with the moderating role of research and development (R&D) concentration in the food and beverage industry. Their findings show that market-based sources (such as consumers, competitors, other companies, and suppliers) are helpful when it comes to increasing income from incremental innovation, while science-based sources (knowledge institutions or universities) contribute to income from radical innovation. They also highlighted the moderating role of R&D intensity in these relationships and concluded that AC was an important capability enabling outward inputs to be transformed into innovation. Furthermore, Thomas (2013) concluded that knowledge exchange can positively influence NPD performance, while Du et al. (2016) studied the positive link between sustainability orientation and NPD performance.

Moreover, the authors concluded that the effect on firm performance would be stronger if a company were to develop a knowledge-rich network that provides valuable resources, such as technological know-how or intellectual property. In this way, a rich network could lead to even better performance with the help of inbound OI activities. Hervas-Oliver et al. (2021) distinguished process-orientated and product-orientated innovators. They concluded that process-orientated companies acquire knowledge mainly through their suppliers. At the same time, product-orientated companies develop more internal capabilities through their R&D, acquiring knowledge from their customers. Furthermore, inbound OI also includes activities related to the purchase of intellectual property, which is recognized as efficient and inexpensive compared to in-house R&D activities (Spithoven et al., 2013, Belingheri and Leone, 2017). Hence, through inbound OI activities, firms develop strategic alliances that enable cost-sharing, more efficient production, and knowledge transfer. Overall, scholarly literature concurs that firms' willingness to open their boundaries and share knowledge through inbound OI activities can benefit them when it comes to reducing production costs, improving their time to market, increasing product and service quality, and consequently remaining competitive in the market (see the literature review of Obradović et al., 2021).

Paralleling the added value of inbound OI, the successful transformation of knowledge is regarded as a particularly important factor during times of DT. For example, Caputo et al. (2021) noted that advanced technologies and DT could help companies collect and analyze data more efficiently, thus fostering organizational performance and innovation. Bresciani et al. (2021) noted that DT and technological advancement (e.g., big data) fosters scalability, flexibility, and innovativeness. In addition, Bhatti et al.'s (2022) systematic literature review on big data and co-innovation highlights numerous barriers to OI that could be eliminated through modern digital technologies and information systems. Mubarak et al. (2019) studied how DT influences business performance in SMEs. The authors concluded that advanced technologies (e.g., IoT, big data, cyber-physical systems) and interoperability are transforming business models and helping companies to better respond to external stressors (Sultana et al., 2022). Therefore, SMEs are encouraged to implement advanced technologies to increase their productivity, reduce production costs, and add value to their products (Škare and Ribeiro-Soriano, 2021). However, because of technological complexity in DT, lack of adequate strategies, and poor digital foundations, firms should search for technological knowledge outside their company. Therefore, in pursuing survival and growth, companies often implement inbound OI for NPD to ensure market success and meet increasingly challenging market demands (Abdurrahman et al., 2022).

Scholars have concluded that a company can benefit from implementing inbound OI practices in multiple ways, but the firm's success is related to its AC. For instance, Vlačić et al. (2019) studied four dimensions of AC and their impact on companies' business performance. The authors noted the positive and significant influence of AC on firm performance and found that initiating innovation processes mediates the relationship. Moreover, the authors emphasized the importance of managerial consciousness in raising AC levels, as they represent a precondition for NPD and further increase performance. Santoro et al. (2020) studied the moderating role of AC in the relationship between formal/informal collaboration modes and innovation performance in the cultural and creative industries. The authors concluded that companies benefited more from informal modes (for example, networking, meetings, and conferences) because they facilitated faster and more flexible agreements. Therefore, it can be assumed that the success of companies depends on the types of collaboration they opt for and the industries in which they operate.

Therefore, we align with Moretti and Biancardi's (2020) call for further research on the interconnection between OI and performance, as academics still disagree on whether the relationship is positive, negative, or non-linear and propose that:

P1: Inbound Open Innovation in association with a possible mix of Absorptive Capacity and Digital Transformation influences NPD Performance.

2.2 The combination of outbound OI, digital transformation and absorptive capacity

Outbound OI can be considered the "use of purposive outflows of knowledge" (Chesbrough, 2006, p. 1), but is also known as an "inside-out process" (Gassmann and Enkel, 2004, p. 6) or "technology exploitation" (Van de Vrande et al., 2009, p. 425). Companies can benefit from implementing outbound OI activities in several ways. They can sell knowledge or technologies they no longer need or have abandoned through licensing, spin-offs, patent selling, etc. Along these lines, Kutvonen (2011) highlighted the importance of actions taken prior to technology commercialization, including contacting potential customers, negotiating, planning, controlling the entire process, and finally commercializing the technology or knowledge. Thus, similarly to inbound OI, the success of implementing outbound OI will depend on the company's strategy, business model, and organizational culture. Because commercializing knowledge or technology can harm a company's competitive position, companies should make buying or selling decisions based on their strategy. Lichtenthaler (2009) noted that outbound OI strategies positively affect company performance and are even stronger during times of high technological turbulence and in competitive conditions. Therefore, companies must enhance and adjust their day-to-day activities to successfully implement outbound OI and ensure their strategies align with their industry, competitors, and environment. This is especially important in a digital era, where digital technologies are changing how companies operate while presenting opportunities for sharing technological knowledge (Abdurrahman et al., 2022).

OI activities, with the help of up-to-date technologies, represent an opportunity for firms to harmonize business models with social challenges, sustainable production, and waste reduction. Fundamentally, implementing OI activities and using digital technologies does not automatically lead to increased NPD performance. AC is therefore important when it comes to transferring information to the company. Consequently, companies experience different success rates depending on their AC when absorbing external knowledge and translating it into tangible resources (Gao et al., 2017). AC thus has an important role and, together with outbound OI and DT, tends to influence NPD performance, which leads toward proposing:

P2: Outbound Open Innovation in association with a possible mix of Digital Transformation and Absorptive Capacity influences NPD Performance.

2.3 The combination of inbound and outbound OI, absorptive capacity and digital transformation

Coupled OI is the combination of inbound and outbound OI. Mazzola et al. (2012) studied the impact of inbound, outbound, and coupled OI on innovation and financial performance and concluded that coupled OI practices had opposite effects. As a result, each of the OI activities should be studied separately, because they can affect performance in different ways.

These findings show that companies can be part of a strategic network that enables them to acquire external knowledge and bring ideas to market. However, to fully benefit from collaboration, companies should choose partners, products, and services complementary to their strategic objectives (Gassmann and Enkel, 2004). Companies collaborating through joint ventures or strategic alliances are more deeply involved in each other's R&D – as opposed to being solely concerned with buying or selling technology (Mazzola et al., 2012). Chou et al. (2016) studied the impact of coupled OI on incremental and radical innovation performance, as well as the role of AC in this relationship. Their results show that coupled OI positively affects incremental innovation and that potential AC strengthens the relationship. In contrast, scholarly literature finds no direct effect on radical innovation performance, but the interaction between coupled OI and realized AC positively influences radical innovation performance. As such, relying only on internal resources and not exchanging knowledge through OI activities could diminish the likelihood of a company's success. Companies with higher AC also manage outward knowledge more efficiently and foster innovation (Escribano et al., 2009).

Furthermore, DT provides new opportunities for OI activities. For example, greater dissemination and collaboration between partners may result in a large amount of valuable, externally sourced information which, with the help of dynamic data collection and assessment, can be transformed into valuable strategic insights. For example, artificial intelligence has presented new ways for us to analyze data and synthesize information more meaningfully. Hence, DT offers new and easier ways for firms to collaborate, while AC helps merge existing knowledge within the organization with newly acquired knowledge. Therefore, the adoption of open organizational culture and the integration of inbound and outbound OI, combined with DT and AC, can contribute to NPD performance, which leads to the following proposition:

P3: Inbound and Outbound Open Innovation in association with a possible mix of Digital Transformation and Absorptive Capacity influences NPD Performance.

The intersection of OI, DT, AC, and NPD performance is presented in the theoretical model illustrated in Figure 1.

***** Insert Figure 1 around here*****

3. **METHODOLOGY**

3.1 Data collection process

The data was collected from companies located in Croatia. This particular geographical context was selected due to Croatia's European Innovation Scoreboard ranking as an Emerging Innovator and the World Bank's recognition that Croatia should increase its companies' productivity through innovation (The World Bank, 2022a; 2022b). Thus, in light of ongoing innovation encouragements and the development of new technologies, companies located in Croatia are empowered to collaborate with external partners. Following these guidelines, and embracing a more innovative approach, Croatia has been recognized as an extremely successful player in the technological field (Stojkovski, 2022). This has recently been demonstrated by the success of two unicorns: Rimac and Infobip.

The data collection occurred between May and October 2021, resulting in 120 valid questionnaires. Although there is not an available database of companies producing new products or services, the authors compiled the contact information from the Croatian Chamber of Economy and the Financial Agency and contacted the top and middle-level managers. The data was collected from digitally mature companies.

Therefore, the valid sample comprises top and middle-level managers representing digitally mature Croatian companies that participate in NPD processes. The managers were 59% male and 41% female. The age of the managers was distributed as follows: 7.14% were aged 20-29 years; 38.39% were aged 30-39; 42.86% were aged 40-49; and 11.61% were aged 50+ years. In the sample, 37.4% of participants were classified as top managers (director, member of management board, or executive director); 50.9% were identified as middle managers (director of a sector or head of department or service); and 11.6% were recognized as "other" (product owner, project manager, or consultant). Most participants had achieved an academic level of a master's degree (81.3%), and 11.6% had achieved a doctoral degree. On average, participants had 10.6 years of experience working with the company.

In light of the study's objectives, we adopted a survey methodology and ensured that interviewees' responses were treated anonymously and confidentially. Next, a comparison of initial and late respondents did not find statistically significant differences in NPD performance. The sample characteristics are presented in Table 1.

***** Insert Table 1 around here*****

3.2 Data Sampling Criteria

This research focused on the examination of the relationship between OI and NPD performance in digitally mature companies. Managers who participated in developing new products were contacted. For the purposes of this study, we adopted the term 'new product development' (NPD) to refer to the process of bringing a new product or service to the market, renewing an existing product, or introducing a product or service into a new market (Handfield et al., 1999). As such, at the beginning of the questionnaire, the control questions were set as follows: (1) "Have you participated in the development process of new products or services in the last five years (2016, 2017, 2018, 2019, 2020)?" This control question ensured that the questionnaire was completed by the target group. The second control question ensured that companies were digitally mature. Digital maturity was measured as the adoption of digital technologies (e.g., advanced manufacturing solutions, augmented reality, IoT, big data analytics, cloud computing, cybersecurity, additive manufacturing/3D-printing, simulation, horizontal and vertical integration, and other enabling technologies) on a Likert scale from 1-7. Respondents answered the question: (2) "Please indicate the level of adoption of the following advanced technologies in your company"

(1- technology is not used, 7- technology is fully adopted). This question was adapted from the studies of Büchi et al. (2020) and Tortorella et al. (2019). The variable was considered a dummy variable, and a value of 0 was assigned to each technology if it was not used or if it was used superficially (on a Likert scale of 1-4). A value of 1 was given if the respondent used the technology intensely (on a Likert scale of 5-7). The value of all adopted technologies was then summed up. If the sum was 0 and the company had not adopted any technology, the value of 0 was attributed, and the company was removed from further analysis.

3.3 Measurement procedure

This study ensured the measurement validity through reliance on widely accepted scales published in flagship journals. Thus, building upon the recognized variables measurement guidelines, the constructs were characterized as reflective models and measured on a Likert scale from 1-7, where one symbolized "strongly disagree" and seven represented "strongly agree."

For example, since 2003, when Chesbrough coined the term 'open innovation', scholars and practitioners have been exploring ways of measuring inbound OI (Gassmann and Enkel, 2004; Van de Vrande et al., 2009; Hung and Chou, 2013; Moretti and Biancardi, 2020; Arias-Pérez et al., 2021; Pinarello et al., 2022). The following five practices, listed by Gassmann and Enkel (2004, p. 7), have been identified as the most accepted measures: "customer and supplier integration, listening posts at innovation clusters, applying innovation across industries, buying IP and investing in global knowledge creation." Similarly, Van de Vrande et al. (2009, p. 425) claimed that the inbound OI construct consists of five items: "customer involvement, external networking, external participation, outsourcing R&D, and inward IP licensing." For this research, the *inbound open innovation* (OII) construct consisted of five items that included activities such as acquiring external technological knowledge, seeking external ideas, acquiring IP, proactively seeking external partners as well as building strategic alliances (Hung and Chou, 2013; Arias-Pérez et al., 2021).

Outbound open innovation (OIO) activities involve bringing ideas to market, selling technological know-how, or out-licensing the company's IP (Gassmann and Enkel, 2004; Van de Vrande et al., 2009). Accordingly, outbound OI consisted of five items which included activities such as the management of external knowledge, formalization of the sale of knowledge or IP, organization of a special department for commercialization, and encouraging others to buy, but also commercial use of technological knowledge (Hung and Chou, 2013; Arias-Pérez et al., 2021).

Next, *company digitization and integration* (DT) was assessed with regards to vertical value chains, horizontal value chains, digital business models, product development and engineering, and customer access (PwC, 2016).

Absorptive capacity (AC) is a dynamic capability that enables firms to successfully combine in-house and external knowledge. AC was defined by Cohen and Levinthal (1989, p. 569) as "A firm's ability to identify, assimilate, and exploit knowledge from the environment." Since their seminal work, the concept has evolved, receiving a lot of attention among researchers (Lane et al., 2006; Ahmed et al., 2020). Zahra and George (2002, p. 185) highlighted the dynamic component of AC and defined the concept as a company's ability to "acquire, assimilate, transform, and exploit knowledge." Furthermore, they identified two dimensions of AC: potential and realized AC. Potential AC consists of knowledge acquisition and assimilation, indicating a company's ability to recognize and adopt external knowledge and understand the knowledge acquired from outside the company (Zahra and George, 2002). From the perspective of realized AC, this involves the transformation and exploitation of knowledge. It is defined as a company's ability to merge current and external knowledge and to use it for further business (Zahra and

George, 2002). Although this concept has received much attention among researchers, the authors have also looked critically at this concept and concluded that a clear distinction between potential and realized AC does not exist (Todorova and Durisin, 2007; Marabelli and Newell, 2014). Thus, the authors consider AC as one construct consisting of four dimensions, i.e., acquisition, assimilation, transformation, and exploitation. Although AC as a concept has been well studied, along with all of its dimensions, a deeper understanding of its antecedents and outcomes is emphasized to understand better the opportunities and obstacles that companies face (Jansen et al., 2005; Todorova and Durisin, 2007; Marrucci et al., 2022).

The dependent variable, *new product development performance* (NPD performance), is a construct about financial and market performance, innovativeness, and speed to market. Validated measurement scales from Ledwith and O'Dwyer (2009) and Fang (2008) were adopted. The NPD performance variable was studied from a manager's perspective. It is defined as: "the degree to which a new product achieves its objectives in terms of market share, sales growth profit, and customer benefits" (Atuahene-Gima and Ko, 2001, p. 58). It has been proven that subjective perceptions of measuring a company's success are highly correlated with objective measures (Baker and Sinkula, 2002).

Additionally, subjective measures allow comparing the impact of NPD across different industries (Vij and Bedi, 2016). The NPD performance variable consists of 19 items. An overview of these items is provided in Table 2.

Lastly, respective company-level variables were incorporated into the assessment (see Table 1): size (measured as the number of employees); number of innovations (referring to the number of innovations registered); industry (clustered broadly in manufacturing and services);

firm age (measured as the number of years since the firm was founded); and percentage of total turnover invested in R&D.

***** Insert Table 2 around here*****

3.4 Partial Least Squares Structural Equation Modeling

The PLS-SEM was used to test the relationships between endogenous and exogenous constructs. In recent years, PLS-SEM has been applied in various fields, including OI (Cui et al., 2018; Marzi et al., 2023), psychology (Kumar et al., 2021b), marketing (Silva et al., 2023), and AC (Vlačić et al., 2019). The PLS-SEM methodology is suitable for theory building and predicting key constructs, especially within models containing latent variables (Hair et al., 2017). With the assistance of PLS-SEM, the direct and indirect effects of OI, DT, and AC on NPD performance were tested. Essentially, PLS-SEM is suitable for testing theoretical models from a prediction standpoint, as the relationships between inbound and outbound OI and NPD performance, with DT and AC as mediators, have thus far not been explored in scholarly literature.

3.5 Fuzzy-set Qualitative Comparative Analysis

To provide an all-inclusive and in-depth interpretation of the associations between OI, DT, AC and NPD performance, a combination of PLS-SEM and fsQCA was used (Rasoolimanesh et al., 2021).

fsQCA represents a blend of Qualitative Comparative Analysis (QCA) and fuzzy sets and can reveal multiple paths leading to an identical outcome (Ragin, 2000). It is used to explore asymmetric relationships in regression-based models and enact a specific phenomenon in complex situations (Ragin, 2008; Fiss, 2011). Moreover, the added value of combining the two methods has been acknowledged by previous authors studying healthcare (Duarte and Pinho, 2019), IT dynamic capabilities (Mikalef and Pateli, 2017), entrepreneurship (Hernández-Perlines et al., 2021), and OI (Marzi et al., 2023).

In this research, fsQCA enabled the assessment of a combination of variables in different configurations that lead toward enhanced NPD performance. The fsQCA analysis was developed using fsQCA software version 3.0 (Ragin and Davey, 2016). The results from PLS-SEM and fsQCA are presented in the next section.

4. RESULTS

4.1 Results of PLS-SEM

To ensure the reliability and validity of the constructs before proceeding to the path analysis, we first assessed the measurement model (see Table 2). Following Hair et al.'s (2013) recommendations on how outer loadings can be considered reliable, the authors adopted the threshold of 0.7. In this study, most factor loadings were higher than the threshold. However, upon careful consideration and following the assessment of the factor loadings' effects on the overall model, those that did not meet the criteria were excluded. Four items (OII2, NPD1, NPD5, NPD6) were retained as they did not affect the construct reliability and validity (Kumar et al., 2021b). The values of Cronbach's alpha and composite reliability were between 0.7 and 0.95, thus indicating high levels of internal reliability for all constructs. Next, the average variance extracted was tested. With values over 0.5, the convergent validity was supported (Straub et al., 2004). The discriminant validity was evaluated using the Heterotrait-Monotrait ratio of correlations (HTMT). The results shown in Table 3 reveal that all of the values were below 0.85, meaning that discriminant validity had been established between the latent variables (Henseler et al., 2014). The constructs are distinct and do not correlate with the model's other constructs.

***** Insert Table 2 around here*****

***** Insert Table 3 around here*****

The results of the PLS-SEM analysis shows that the model has moderate levels of explanatory power with $R^2 \approx 50\ \%$ (Hair et al., 2019). Next, the model's overall quality revealed minimum collinearity, as all the variance inflation factors (VIF) were below the value of 5 (Hair et al., 2011). The computed RMS theta value was 0.091, significantly below the threshold of 0.12, and can be considered a good fit (Hu and Bentler, 1999; Henseler et al., 2014). Lastly, all Q^2 values for endogenous variables were higher than zero (DT= 0.133; AC= 0.173; NPD = 0.107), indicating adequate predictive relevance for the outcome variable. To ensure the robustness of the results, we performed an analysis of unobserved heterogeneity, employing the FIMIX-PLS procedure, which demonstrated that unobserved heterogeneity does not critically affect the assessment of the model (Sarstedt et al., 2017, Marzi et al., 2023).

***** Insert Figure 2 around here*****

The effects of direct and indirect paths are represented in Figure 2 and Table 4, and mediated paths are shown in Table 5. The control variables' size, firm age, number of innovations, industry, and percentage of total turnover invested in R&D did not show statistically significant effects.

***** Insert Table 4 around here*****

In essence, the result of direct effects highlighted the added value of decoupling OI into inbound and outbound, as both variables have direct positive effects with different statistical significance. Accordingly, while both OII ($\beta = 0.238$; $p = 0.000$) and OIO ($\beta = 0.369$; $p = 0.000$) are associated with AC, the PLS-SEM analysis reveals that only outbound OI significantly affects DT ($\beta = 0.464$; $p = 0.000$). The outcome variable was directly and positively associated with DT and AC. At the same time, there was no evidence of direct effects from OI.

Respectively, a synthesis of the mediation analysis (see Table 5) reinforced the relevance of differentiating between outbound and inbound OI. Namely, two specific paths leading from outbound OI to NPD yielded a statistically significant positive effect: OIO → AC → NPD (β = 0.116; p = 0.000) and OIO → DT → NPD (β = 0.162; p = 0.000). Moreover, the specific indirect effect of inbound OI resulted in a borderline significant relationship in association with AC which, taking into consideration the fact that all of the assessments were performed using bootstrap analysis with 5000 sub-samples (Carrión et al., 2016), increased interest in further investigation. We performed the fsQCA analysis to support the findings, which provided further insights. The results are presented in the following sub-section.

***** Insert Table 5 around here*****

4.2 Results of fsQCA

In order to conduct fsQCA analysis, all variables needed to be calibrated to the fuzzy set scales. Thus, the first step involved calibrating the data from a 7-point Likert scale into a set of values from 0 to 1 (see Table 6). The values of 0.05, 0.50, and 0.95 were chosen as breakpoints for transforming the data into log-odds metrics, with all values being in the interval 0-1 (Duarte and Pinho, 2019; Pappas and Woodside, 2021; Rasoolimanesh et al., 2021). These values follow widely accepted fsQCA practices and signify that non-membership was established for a fuzzy score of 0.05, the crossover point was at 0.50, and the threshold for full membership equals 0.95 and above.

***** Insert Table 6 around here*****

Next, we performed a necessary condition analysis which revealed that no stand-alone condition was necessary for achieving high levels of NPD performance. Thus, given that no single condition explained the NPD performance, we adopted the guidelines set by Schneider and Wagemann (2010) and Xie and Wang (2020) and progressed with the analysis by combining causal conditions, with frequency thresholds set to 2 and the consistency threshold above 0.80 (see Table 7).

***** Insert Table 7 around here*****

The fsQCA results indicate that several configurations lead to high levels of NPD performance. Firstly, the existence of several causal paths indicates the presence of equifinality (Fiss, 2011; Duarte and Pinho, 2019). Next, the overall solution coverage explains 80% (standard threshold of 45%) of cases with a consistency of 0.835 (standard threshold of 0.80). Finally, the four configurations also indicate acceptable coverage and consistency (Ragin, 2008). Importantly, while the raw coverage (i.e., the share of the outcome explained by a specific solution) is highest in Solution 1, it represents the best solution. Nevertheless, given the minor differentiation in raw coverage, unique coverage, and consistency, Solutions 1 and 4 require specific attention, as shown in the next section.

5. DISCUSSION AND IMPLICATIONS

5.1 Discussion of results

The results of PLS-SEM and fsQCA signal that three independent variables (i.e., OI, AC, DT) positively affect, in combination, new product development performance. Considering the findings obtained by PLS-SEM, an active role of OI, AC and DT enhances NPD performance. In essence, the direct effect of DT and AC seems more relevant in combination with OI, thus overcoming barriers from close R&D activities. However, although the direct effects of OI (inbound and outbound) on NPD performance are not statistically significant, the indirect effects, especially those of outbound OI, show significant mediation effects through DT and AC. In a nutshell, this suggests that DT and AC are necessary conditions, at the firm level, for OI to impact NPD. Without DT and/or AC, OI does not have a statistically significant effect on NPD. This finding suggests that commercially orientated OI (e.g., licensing out and managing outward knowledge) can provide added value by enhancing DT and, via absorptive capabilities, can benefit NPD performance. In addition to the financial benefits powered by commercially orientated activities, companies improve NPD performance by developing AC to internalize customer knowledge and reach the markets faster, exploring new networks and market opportunities.

In addition, fsQCA indicated a myriad of organizational configurations (i.e., paths) leading toward higher levels of NPD performance, thus extending and complementing PLS-SEM analysis (Marzi et al., 2023; Saura et al., 2023). Indeed, results suggest that no variable appears to, on its own, influence NPD performance, but a combination of variables does, and their mixture leads to higher NPD performance.

For example, Configuration 1 highlights organizations' reluctance towards OI. This configuration, aligned with the PLS-SEM analysis of direct effects, focuses on the pivotal role of DT and AC as drivers of higher levels of NPD performance. This configuration is aligned with research streams focused on the connection between DT and NPD (Schweitzer et al., 2019; Barrane et al., 2021), AC and NPD (Stock et al., 2001; Morgan et al., 2018), or the role of AC as a mediator in the relationship between digital capacity and firm performance (Liu et al., 2013; Kastelli et al., 2022). On the other hand, the results from fsQCA facilitate a deeper understanding of the specific combination of DT and AC, leading to higher NPD performance.

When combined, DT and AC can create a powerful innovation ecosystem that enables firms to develop innovative, high-quality, customer-centric products faster and at a lower cost. This is because DT can facilitate the acquisition and sharing of external knowledge (Bhatti et al., 2022), while AC enables firms to effectively assimilate and apply that knowledge to their innovation processes. Therefore, investing in these capabilities can be a strategic decision for firms looking to enhance their innovation capabilities and gain a competitive advantage in the market.

The presence of DT suggests that the organization has embraced technological innovation, which can aid collaboration with external partners (e.g., suppliers, customers, and research organizations) to develop new products. At the same time, the presence of AC in a company suggests that it has the ability to effectively collaborate with these partners and leverage their knowledge and expertise in NPD. Overall, this configuration suggests that a focus on internal innovation capabilities (through DT and AC) can be a successful approach facilitating the achievement of high levels of NPD performance, even if the organization is not engaging in OI with external partners. In the absence of OI, organizations may not be collaborating with external partners to acquire new knowledge and resources. However, by leveraging their internal resources and capabilities, organizations can still drive innovation and achieve higher levels of NPD performance. Furthermore, the presence of AC suggests that the organization is able to learn from its environment and apply that knowledge to NPD (Cohen and Levinthal, 1990). This means that the organization can effectively assimilate and apply external knowledge when it is available, but it can also rely on its internal knowledge and resources to drive innovation.

This configurational path portrays management’s decisive role in potentially avoiding structural changes coming from OI (Saura et al., 2023) and depicts the profile of companies focusing on technological AC, as well as openness toward DT, as a way of achieving higher levels of NPD performance (Coronado-Medina et al., 2020; Kastelli et al., 2022, Scuotto et al., 2022). Furthermore, it indicates that companies with strong AC have a clear digital strategy, significant leadership support for digital initiatives, and a digital infrastructure that is well-planned and well-executed – ultimately leading to higher levels of NPD performance.

Configuration 2 depicts an organizational profile focused on commercially orientated OIs, revealing the relevance of sharing and selling internally developed knowledge (Marzi et al., 2023). In this configuration, the digital configuration was absent but not negated, highlighting the importance of networks and stressing the link between AC and innovation (Scuotto et al., 2022).

A somewhat similar path – but with a focus on inbound OI – can be seen in Configuration 3. This path towards higher levels of NPD performance signals the organizational relevance of arranging AC to implement external knowledge (Spithover et al., 2010). Companies capable of overcoming internal constraints by proactively contacting organizations to acquire technological knowledge benefit through a mixture of OI inbound activities and AC (Xia and Roper, 2016; Russo-Spena and Di Paola, 2019).

Somewhat differing from the first path, Configuration 4 shows the profile of a company embracing OI while being sensible with regards to DT. Thus, this path shows how combining technology and OI processes enriches NPD performance (Mention and Asikainen, 2012). This path is aligned with an extensive literature review by Bigliardi et al. (2020), where outbound OI positively affects firm performance in the long run. Through outbound OI activities, the company improves the quality of its technology, which increases the external company's dependence and further strengthens the positive impact of outbound OI on performance. Nwankpa and Roumani (2016) concluded that DT mediates the relationship between IT-related capabilities and companies' performance. The authors stressed that companies need to implement advanced technologies (big data, mobile platforms, etc.) to improve performance. Moreover, they should invest in IT infrastructure and build their capabilities to perform better and outperform their competitors. Moreover, seeking external knowledge and collaborating with external partners can help companies reduce costs and increase innovativeness. Overall, fostering the development of digital technologies with a focus on OI can have a significant influence on the progress of the business, the economy, and society (Bogers et al., 2018).

Surprisingly this is the only path that indicates the absence of AC, but not the negation of it. As such, it brings to light the fact that inter-organizational knowledge flows only sometimes materialize due to technological changes and diminishing product lifecycles. As both AC and OI revolve around external sourcing and dynamic capabilities, firms must continuously develop skills to cope with and benefit from external sources of knowledge and technology. In the absence of AC, organizations may not have a strong internal capability to assimilate and apply external knowledge to their innovation processes. However, by engaging in OI, organizations can still benefit from external knowledge and resources to develop new products. The absence of AC may also suggest that the organization is not as effective at assimilating and applying external knowledge. However, by engaging in OI, organizations can still benefit from the knowledge and expertise of external partners who may be more effective at assimilating and applying that knowledge. Thus, this profile depicts a somewhat complementary link between OI and AC (Vanhaverbeke et al., 2008; Lewandowska, 2015).

5.2 Theoretical implications

From a theoretical standpoint, although the concept of OI has gained attention among researchers and practitioners, outbound OI has been studied less intensively than inbound OI (Lichtenthaler, 2009; West and Bogers, 2014). Thus, this paper fills the gap by differentiating between inbound and outbound OI. Our approach complements Dabić et al.’s (2019) notion that companies should combine external knowledge with their existing knowledge management practices by introducing the relevance of DT and several configurations towards enhanced NPD performance.

Successful product development stems from meeting customer needs and producing products that give a firm a competitive advantage. Companies must be able to adapt to rapid market changes and benefit from advanced technologies. The resource-based view emphasizes that valuable capabilities could contribute to a sustainable competitive advantage, but it is the dynamic capability view that explains the company's use of resources in dynamic circumstances. Thus, this research contributes to the development of the dynamic capability view by highlighting the mediating effect of AC (which is characterized as a dynamic capability) in the relationship between OI and NPD performance.

A combination of symmetric and asymmetric approaches contributed to shedding further light on these intriguing intersections. The PLS-SEM methodology determined the direct and indirect effects of the independent variables on the dependent variables. Whilst the fsQCA determined the necessary combinations of independent variables affecting NPD, expanding our understanding of the results obtained using PLS-SEM. This approach facilitated a deeper understanding of the role played by independent variables, such as inbound and outbound OI, on the dependent variable (i.e., NPD performance) through intermediary variables (DT and AC).

In addition, the examined nexus among constructs revealed the configurations and the extent to which the assimilation of external knowledge and different capabilities affected the output variable. This is the first study to uncover the possible mix of relationships between OI, DT, and AC leading to higher levels of NPD performance.

5.3 Managerial implications

Rapid market changes, natural disasters, war, and pandemics have resulted in raw material price increases, delivery delays, resource scarcity, and supply chain disruptions (Xu et al., 2020; Kähkönen et al., 2021; Kumar et al., 2021a), and managers should be interested in the alignment of OI, AC, DT, and NPD. Essentially, knowledge, capabilities, and resources are not limited by a company's boundaries, allowing managers to collaborate with external partners. AC represents a company’s dynamic capability. This is a key factor in management studies. Allowing managers to acquire, assimilate, transform, and exploit knowledge to produce new products and services, all while tapping into beneficial DT, may lead to higher levels of NPD. In addition, managers can use the presented configurations as stepwise processes, dedicating initial attention to developing AC and, later, embracing the benefits of openness. Alternatively, they could recognize the complementarity of OI and AC from the beginning. Although inbound and outbound OI work differently, both accelerate NPD performance, allowing companies to adapt in turbulent environments by acquiring and assimilating external knowledge, creating a competitive advantage for a company, which is then reflected through AC (Zahra and George, 2002).

6 CONCLUSION

While former studies have contributed to our understanding of the connection between partner collaborations and companies' performance, the general understanding of OI, DT, and AC's role in NPD performance still needs further attention. Our results suggest somewhat complementary dimensions between OI and AC, highlighting four configurations leading to higher levels of NPD performance. Moreover, this study brings to light the importance of the European Innovation Scoreboard. Despite the fact that it is among the countries with the lowest GDP per capita when compared to the EU average, Croatia is recognized as an Emerging Innovator. The country's leap in innovation performance in 2021 was noted, and further progress is expected in the future. Countries characterized as Emerging Innovators should be further studied. The success of digitally mature companies encourages new employment, new investments for startups and micro firms, and further digitalization and education in the field of IT. It also affects other industries, such as manufacturing or finance and insurance.

As with most studies, this research does have limitations. Although we incorporated numerous tests to ensure the validity of the response, the survey approach is subject to self-reporting bias. Thus, in the future, countries becoming strong innovators should comprehensively collect information about innovative ventures and enable cross-section and cross-border studies. Moreover, we recognize that single-country studies are subject to limitations. We therefore followed up on the portrayed configurations. Future studies could further investigate their relevance across different geographical contexts.

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Figure 1 – Theoretical Model

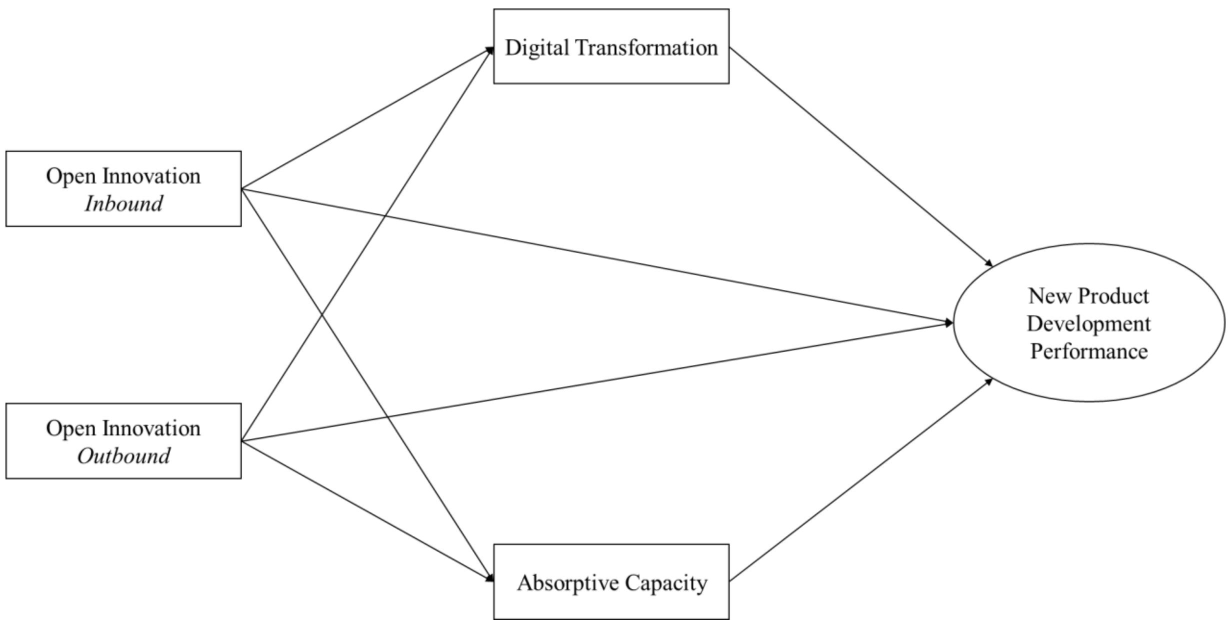

Figure 2 – PLS Results

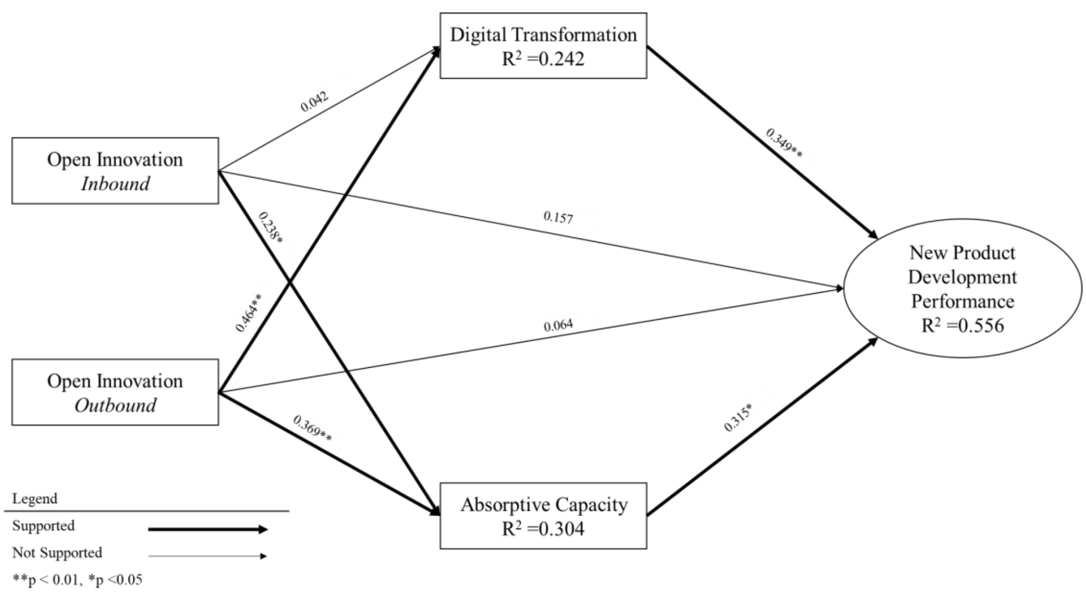

Table 1: Sample characteristics

Sample characteristics – Company level					
Size (employee number)			*Firm age*		
1 - 9	13	10.8 %	Mean		39.4
10 - 49	16	13.3 %	St. Deviation		37.7
50 - 249	27	22.5 %	Min		1
250 - 499	10	8.3 %	Max		150
more than 500	54	45.0 %			
Number of Innovations			*Industry*		
0	3	2.5 %	Manufacturing	62	51.7 %
1-3	43	35.8 %	Service	58	48.3 %
4-10	42	35.0 %			
More than 10	32	26.7 %			
Research & Development expenditure (% of total turnover)					
0%	6	5.0 %			
1 - 3%	43	35.8 %			
4 - 5%	18	15.0 %			
6 - 10%	22	18.3 %			
11 - 20%	11	9.2 %			
21 - 30%	11	9.2 %			
more than 31%	9	7.5 %			
Total	**120**				

Table 2 – Items and Loadings

Constructs and Items		**Loadings**	**Mean (SD)**	**CA**	**CR**	**AVE**
Open Innovation Inbound						
OII2	We often seek external ideas to enable value creation.	0.677	4.44 (1.18)	0.8	0.825	0.624
OII3	We have a monitoring system to search for and acquire external technology and intellectual property	0.788				
OII4	We proactively contact external organizations to acquire technological knowledge and improve its products.	0.869				
OII5	We tend to build a greater number of alliances with external actors and to trust their innovations.	0.813				
Open Innovation Outbound						
OIO1	We are proactive in managing outward knowledge flow	0.727	3.83 (1.57)	0.804	0.813	0.629
OIO2	We make it a formal practice to sell technological knowledge and intellectual property in the market	0.81				
OIO3	We have a dedicated unit to commercialize knowledge assets	0.75				
OIO4	We welcome others to purchase and use our technological knowledge or intellectual property	0.877				
Digital Transformation						
DT1	Vertical value-chain integration	0.863	4.69 (1.08)	0.864	0.867	0.65
DT2	Horizontal value-chain integration	0.834				
DT3	Digital business models, product and service portfolio	0.831				
DT4	Product development and engineering	0.733				
DT5	Customer access, sales channels and marketing	0.762				
Absorptive Capacity						
AC1	Our management supports the development of prototypes.	0.721	5.43 (1.04)	0.907	0.914	0.644
AC2	Our company regularly considers technologies and adapts them accordant to new knowledge.	0.851				

Constructs and Items		Loadings	Mean (SD)	CA	CR	AVE
AC3	Our company has the ability to work more effectively by adopting new technologies.	0.775				
AC4	Our employees have the ability to structure and use collected knowledge.	0.737				
AC5	Our employees are used to absorbing new knowledge as well as to prepare it for further purposes and to make it available.	0.848				
AC6	Our employees successfully link existing knowledge with new insights.	0.849				
AC7	Our employees are able to apply new knowledge in their practical work.	0.827				
New Product Development Performance						
NPD1	Our new products or services are very successful in terms of development costs	0.669	4.83 (1.03)	0.898	0.901	0.523
NPD2	Our new product or service is creative	0.742				
NPD3	Our new product or service is interesting	0.784				
NPD4	New product or service is capable of generating ideas for other products	0.72				
NPD5	Our new products or services are very successful in terms of sales	0.65				
NPD6	Our new products or services are very successful in terms of market share	0.681				
NPD7	The development speed of the new product or service is far ahead our time goals	0.738				
NPD8	The development speed of our new product or service is faster than industry norm	0.786				
NPD9	The development speed of our new product or service is much faster than we expected	0.747				
NPD10	The development speed of our new product or service is faster than our typical product development time.	0.702				

Table 3 – Discriminant Validity

	OII	OIO	DT	AC	NPD
Fornell-Larcker Criterion					
OII	0.79				
OIO	0.637	0.793			
DT	0.337	0.493	0.806		
AC	0.473	0.52	0.599	0.803	
NPD	0.463	0.498	0.635	0.643	0.723
HTMT					
OII	-				
OIO	0.748				
DT	0.391	0.575			
AC	0.543	0.582	0.675		
NPD	0.534	0.533	0.712	0.699	-

Table 4 – Direct Effects

Relationship	**Std Beta**	**t-value**	**p-value**
OIO → NPD	0.064	0.674	0.500
OIO → DT	0.464**	5.881	0.000
OIO → AC	0.369**	3.723	0.000
OII → NPD	*0.157*	*1.701*	*0.089*
OII → DT	0.042	0.434	0.664
OII → AC	0.238*	2.224	0.026
DT → NPD	0.349**	3.837	0.000
AC → NPDT	0.315*	3.031	0.002

**p < 0.01, *p <0.05

Table 5 – Path Analysis (mediation analysis)

Path	**Std Beta**	**t-value**	**p-value**
OII → AC → NPD	*0.075*	*1.673*	*0.094*
OII → DT → NPD	0.015	0.417	0.677
OIO → AC → NPD	0.116*	2.489	0.013
OIO → DT → NPD	0.162**	3.32	0.001

**p < 0.01, *p <0.05

Table 6 – fsQCA Calibration

	Min	**Max**	**Fuzzy Scores**		
			0.05	**0.50**	**0.95**
OII	1.25	7.00	2.01	4.63	6.24
OIO	1.00	7.00	1.26	3.75	6.25
DT	2.40	7.00	2.81	4.6	6.98
AC	2.43	7.00	3.43	5.57	7.00
NPD	2.00	7.00	3.20	4.90	6.50

Table 7 – Configurations leading to high levels of NPD performance.

	Solutions			
Configuration	1	2	3	4
OII			●	●
OIO		●		●
DT	●			●
AC	●	●	●	
Consistency	0.880	0.889	0.889	0.918
Unique coverage	0.040	0.027	0.007	0.038
Raw coverage	0.685	0.668	0.632	0.570
Overall solution consistency	*0.835*			
Overall solution coverage	*0.802*			

Note: black circles (●) indicate presence; blank spaces denote absence.