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# Innovation Capital, Process Capital and Performance of Pharmaceutical Manufacturing Firms in South-East Nigeria

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***Abstract*— This study examined the relationship between intellectual capital and the organisational performance of pharmaceutical manufacturing firms in South-East Nigeria, with particular attention to innovation capital and process capital. Two specific objectives, research questions and hypotheses guided the enquiry. A descriptive survey design was adopted, and primary data were gathered through a structured questionnaire administered to permanent employees of twenty purposively selected pharmaceutical manufacturing firms drawn from Abia, Anambra, Ebonyi, Enugu and Imo States. A sample of 100 respondents was determined and proportionally allocated across the firms, while stratified random sampling was used to select the actual respondents. The instrument was validated through content validity, and its reliability was confirmed using the test-retest method, with Cronbach's alpha coefficients ranging from 0.625 to 0.790. Data were analysed with descriptive statistics, and the hypotheses were tested using the Pearson product-moment correlation coefficient through SPSS version 23. The findings revealed a strong, positive and statistically significant relationship between innovation capital and production effectiveness ($r = 0.712$, $p < 0.05$), and between process capital and operational efficiency ($r = 0.684$, $p < 0.05$). The study concluded that intellectual capital is a decisive driver of superior performance among pharmaceutical manufacturers in the zone, and recommended sustained investment in research and development, the codification of routines and knowledge-management systems, and deliberate managerial commitment to knowledge assets.***

***Keywords*— intellectual capital, innovation capital, process capital, production effectiveness, operational efficiency, pharmaceutical manufacturing.***

## I. INTRODUCTION

Knowledge has quietly overtaken land, labour and physical machinery as the resource that separates thriving firms from struggling ones. Nowhere is this shift sharper than in pharmaceutical manufacturing, an industry that lives or dies by what its people know, how quickly it turns that knowledge into usable products, and how tightly its internal routines hold together. According to Xu and Wang (2019), intellectual capital has become the primary engine of value creation in knowledge-intensive economies, displacing tangible assets as the chief source of durable advantage. Nadeem, Gan and Nguyen (2019) support this position, arguing that firms which accumulate and deploy intangible knowledge assets consistently outperform rivals that rely mainly on physical capital. In the Nigerian context, where pharmaceutical firms operate under tight regulation, volatile input costs and intense competition from imported drugs, the ability to convert knowledge into performance is a condition of survival.

Intellectual capital is conventionally understood as the sum of the intangible knowledge resources a firm can mobilise to generate value. Nguyen and Doan (2020) describe it as the collective knowledge, skills, relationships and structural assets embedded in an organisation. Within this broad construct, scholars have isolated distinct dimensions. Human capital captures the competence and creativity of employees; relational capital reflects the value locked in external relationships; social capital concerns internal trust and cooperation; while innovation capital and process capital together form what is often labelled structural or organisational capital (Bayraktaroglu, Calisir & Baskak, 2019). This study concentrates on the two structural dimensions, innovation capital and process capital, because they most directly shape how a manufacturing firm designs, produces and delivers its output.

Innovation capital refers to a firm's renewal capacity, its stock of patents, research findings, product designs and the creative competence that fuels new offerings. Asiaei, Barani, Bontis and Arabahmadi (2020) contend that innovation capital determines whether a firm can refresh its product portfolio fast enough to remain relevant. Process capital, by contrast, resides in the documented procedures,

systems, workflows and organisational routines that allow work to be repeated reliably and efficiently. Consequently, a firm rich in process capital wastes less, deviates less and delivers more predictably. Wang, Cai and Xu (2021) observe that these two structural elements are mutually reinforcing, since fresh ideas without disciplined processes rarely reach the market, and efficient processes without innovation eventually stagnate.

The pharmaceutical sector in South-East Nigeria offers a revealing setting for examining these relationships. The zone hosts a dense cluster of manufacturers, yet many struggle with erratic power supply, dependence on imported raw materials and difficulty attracting scarce technical talent. However, a growing number of firms have responded by investing in laboratories, quality-management systems and staff development, effectively building their intellectual capital as a buffer against a hostile operating environment. Nevertheless, empirical evidence on whether these investments translate into measurable performance gains remains thin, particularly at the sub-national level, where most existing studies have concentrated on banking, telecommunications or listed firms rather than provincial manufacturers.

Organisational performance in this study is treated through two lenses that matter deeply to manufacturers: production effectiveness and operational efficiency. Production effectiveness concerns the degree to which a firm meets its output targets, quality standards and delivery commitments, whereas operational efficiency concerns the ratio of useful output to the resources consumed in producing it. According to Sardo, Serrasqueiro and Alves (2018), these two indicators jointly capture the productive health of a manufacturing enterprise. Therefore, linking innovation capital to production effectiveness and process capital to operational efficiency allows for a targeted rather than a diffuse assessment of how intellectual capital works.

Although the theoretical case for intellectual capital is well rehearsed, a persistent gap exists between the abundance of conceptual writing and the scarcity of rigorous, context-specific evidence from developing economies. Furthermore, much of the extant literature bundles all dimensions of intellectual capital together, obscuring the distinct contribution of individual components. This study responds to both concerns by isolating innovation and process capital, and by grounding the analysis in a purposively defined population of pharmaceutical manufacturers. Accordingly, the enquiry contributes fresh empirical insight to a debate that has, for too long, leaned on evidence borrowed from advanced economies and unrelated sectors.

The remainder of the paper proceeds as follows. The next subsection states the problem and sets out the objectives, questions and hypotheses that structure the enquiry. Subsequently, a review of conceptual, theoretical and empirical literature situates the study within existing scholarship. The methodology section then details the design, population, sampling and analytical procedures, after which the findings are presented, interpreted and discussed. The paper closes with the implications, conclusion and recommendations that flow from the evidence.

1.1 Statement of the Problem

Pharmaceutical manufacturers in South-East Nigeria confront a paradox. They operate in a knowledge-intensive industry where product quality, regulatory compliance and continuous improvement depend heavily on intangible assets, yet many still manage as though physical plant and raw materials were the only resources worth optimising. Consequently, output targets are missed, batches are rejected, and unit costs climb, even in firms that have quietly accumulated skilled personnel, laboratory capacity and documented procedures. This suggests that intellectual capital may be under-recognised and under-exploited precisely where it could do the most good.

The difficulty is compounded by a hostile operating environment. According to Ozkan, Cakan and Kayacan (2019), firms in developing economies frequently fail to convert their knowledge assets into performance because supporting systems and managerial attention are weak. In South-East Nigeria, unstable power, foreign-exchange pressure on imported inputs and the flight of technical talent make this conversion even harder. However, some firms in the same zone, facing identical constraints, perform markedly better than others. This variation hints that differences in innovation capital and process capital, rather than external conditions alone, may explain the performance gap.

Despite the practical importance of the issue, the empirical record is thin and fragmented. Most Nigerian studies on intellectual capital have examined banks, insurance companies or listed firms, and have tended to treat intellectual capital as a single lumped variable. As a result, the specific influence of innovation capital on production effectiveness, and of process capital on operational efficiency, within provincial pharmaceutical manufacturing, remains largely unexamined. This study addresses that gap by testing these relationships directly, thereby providing evidence that managers and policymakers can act upon.

### 1.2 Objectives of the Study

The broad objective of this study was to examine the relationship between intellectual capital and the organisational performance of pharmaceutical manufacturing firms in South-East Nigeria. Specifically, the study sought to:

i. determine how innovation capital (IC) relates to the production effectiveness of pharmaceutical manufacturing firms in South-East Nigeria; and

ii. investigate the relationship between process capital (PIC) and the operational efficiency of pharmaceutical manufacturing firms in South-East Nigeria.

### 1.3 Research Questions

In line with the objectives, the following research questions guided the enquiry:

i. What is the relationship between innovation capital (IC) and the production effectiveness of pharmaceutical manufacturing firms in South-East Nigeria?

ii. How does process capital (PIC) influence the operational efficiency of pharmaceutical manufacturing firms in South-East Nigeria?

### 1.4 Research Hypotheses

The following null hypotheses were formulated and tested at the 0.05 level of significance:

$H_{03}$: There is no significant relationship between innovation capital (IC) and the production effectiveness of pharmaceutical manufacturing firms in South-East Nigeria.

$H_{04}$: There is no significant relationship between process capital (PIC) and the operational efficiency of pharmaceutical manufacturing firms in South-East Nigeria.

## II. LITERATURE REVIEW

### 2.1 Conceptual Review

#### *2.1.1 Intellectual Capital*

Intellectual capital has attracted a variety of definitions, each emphasising a slightly different facet of the same intangible reality. According to Nguyen and Doan (2020), intellectual capital is the totality of knowledge-based resources, comprising human competence, structural systems and relational networks, that an organisation converts into value. In a similar vein, Bayraktaroglu, Calisir and Baskak (2019) define it as the collection of intangible assets and knowledge flows that generate competitive advantage but do not appear on the conventional balance sheet. Xu and Wang (2019), for their part, describe intellectual capital as the difference between a firm's market value and its book value, a gap they attribute almost entirely to knowledge assets. Taken together, these definitions converge on a single idea: value increasingly resides in what a firm knows rather than in what it owns.

Beyond definition, scholars have sought to explain how intellectual capital operates. Asiaei, Barani, Bontis and Arabahmadi (2020) argue that intellectual capital functions as a system rather than a stockpile, in which human, structural and relational elements interact to produce outcomes greater than the sum of their parts. However, Nadeem, Gan and Nguyen (2019) caution that mere possession of knowledge assets guarantees nothing; value emerges only when these assets are actively deployed, combined and renewed. Consequently, the managerial challenge lies not in accumulating intellectual capital but in orchestrating it. Vishnu and Gupta (2019) reinforce this view, noting that firms with comparable knowledge endowments often achieve very different results depending on how effectively they mobilise those endowments.

In the manufacturing context, intellectual capital assumes a particularly concrete character. According to Sardo, Serrasqueiro and Alves (2018), the knowledge embedded in production engineers, quality protocols and supplier relationships directly shapes yield, defect rates and delivery reliability. Furthermore, Wang, Cai and Xu (2021) demonstrate that manufacturers investing in structural knowledge assets, such as documented processes and innovation pipelines, achieve steadier output and lower waste

than those relying on tacit, undocumented know-how. Therefore, intellectual capital is not an abstract corporate ornament but a working input into the daily rhythm of production.

The construct is conventionally decomposed into components. While early frameworks distinguished human, structural and relational capital, more recent scholarship has refined structural capital into innovation capital and process capital, and has treated social capital as a distinct relational sub-dimension (Bontis, 1998; Yaseen, Dajani & Hasan, 2019). This study adopts that refined taxonomy but focuses on the two structural sub-dimensions most relevant to manufacturing, namely innovation capital and process capital, while acknowledging human, relational and social capital as related dimensions that condition their effect.

The measurement of intellectual capital has itself provoked considerable debate, which further illuminates the nature of the construct. According to Bayraktaroglu et al. (2019), the value-added intellectual coefficient remains the most widely used measure, yet it captures efficiency of use rather than the underlying stock of knowledge. In contrast, Buenechea-Elberdin, Kianto and Saenz (2018) favour perceptual, survey-based measures that capture dimensions such as innovation and process capital more directly. Nevertheless, Vishnu and Gupta (2019) caution that no single measure is universally superior, and that the choice should follow the research question. Because this study is concerned with how firms perceive and deploy their knowledge assets rather than with accounting valuation, it adopts a perceptual, questionnaire-based approach, in line with the tradition established by Bontis (1998) and sustained by contemporary scholars.

A further strand of thinking stresses the dynamic character of intellectual capital. According to Wang, Cai and Xu (2021), knowledge assets depreciate if not renewed, so intellectual capital must be continuously replenished rather than merely accumulated. Moreover, Asiaei et al. (2020) argue that the components interact dynamically, such that human capital feeds innovation capital, which in turn is codified into process capital, producing a self-reinforcing cycle. Consequently, the value of intellectual capital lies as much in the flows between its components as in the components themselves. This dynamic reading justifies examining innovation and process capital not in isolation but as linked mechanisms through which knowledge is generated, codified and applied to production.

*2.1.2 Innovation Capital*

Innovation capital denotes the renewal capacity of a firm, the intangible assets that enable it to create new products, processes and solutions. According to Asiaei et al. (2020), innovation capital comprises patents, research findings, product designs, licences and the creative competence that generates them. Buenechea-Elberdin, Kianto and Saenz (2018) offer a complementary definition, describing innovation capital as the capability to generate and commercialise novel ideas that keep a firm ahead of imitation. Similarly, Xu and Liu (2020) view it as the accumulated stock of a firm's inventive output together with the organisational conditions that sustain further invention. Across these definitions runs a common thread: innovation capital is about a firm's capacity to stay ahead of obsolescence.

Explaining its significance, Buenechea-Elberdin, Kianto and Saenz (2018) argue that innovation capital is the dimension of intellectual capital most closely tied to long-term survival, because markets punish firms that fail to renew their offerings. However, Xu and Liu (2020) qualify this claim, noting that innovation capital yields returns only when a firm possesses the absorptive capacity to translate ideas into marketable products. In line with this, Kengatharan (2019) found that innovation-intensive firms outperform peers on both growth and profitability, provided their innovation efforts are aligned with market needs. Conversely, unfocused innovation can drain resources without improving performance, a caution echoed by Nadeem et al. (2019).

In pharmaceutical manufacturing, innovation capital carries obvious weight. According to Wang, Cai and Xu (2021), reformulation, improved dosage forms and process innovations directly affect a firm's ability to meet output targets and quality standards. Moreover, Sardo et al. (2018) observe that manufacturers with strong research pipelines respond faster to regulatory changes and shifting demand, which improves production effectiveness. Therefore, innovation capital is theorised in this study to relate positively to production effectiveness, since firms that renew their products and processes are better positioned to hit their production goals reliably.

Innovation capital is also closely tied to a firm's absorptive and dynamic capabilities. According to Buenechea-Elberdin et al. (2018), innovation capital is not only a stock of inventive output but also a capability to sense opportunities and reconfigure resources in response. Furthermore, Wang, Cai and Xu (2021) demonstrate that innovation capital mediates the relationship between other knowledge assets and performance, meaning that human and relational capital often influence output indirectly, through their contribution to innovation. Therefore, innovation capital occupies a pivotal position in the intellectual-capital system, serving as the channel through which latent knowledge becomes productive change. In line with this, Asiaei et al. (2020) argue that firms which institutionalise innovation, rather than treating it as sporadic, achieve more consistent performance gains.

Empirically, the innovation capital and performance link has attracted growing attention. Yaseen, Dajani and Hasan (2019) reported a significant positive relationship between innovation capital and firm performance among Jordanian pharmaceutical companies, a context closely analogous to the present one. Additionally, Xu and Liu (2020) found, in a large sample of manufacturing firms, that innovation capital was the single strongest predictor of productivity growth. Nevertheless, some scholars, such as Nimtrakoon (2015) in an earlier study, reported weaker or context-dependent effects, suggesting that the strength of the relationship varies with industry and institutional setting. This study revisits the relationship in the specific setting of South-East Nigerian pharmaceutical manufacturing.

Beyond the direct effect, several scholars have examined the conditions under which innovation capital pays off. According to Kengatharan (2019), the returns to innovation capital depend on complementary investments in human capital, since ideas require skilled people to execute them. Moreover, Nadeem, Gan and Nguyen (2019) find that the innovation capital and performance relationship is stronger in institutional environments that protect intellectual property and reward research. Consequently, in weak-institution settings such as much of sub-Saharan Africa, the benefits of innovation capital may be constrained, though not eliminated. This qualification is pertinent to the present study, since South-East Nigerian firms operate amid infrastructural and institutional limitations that could dampen, without necessarily negating, the effect of innovation capital on production effectiveness.

*2.1.3 Process Capital*

Process capital, sometimes labelled process or procedural capital, refers to the value embedded in a firm's internal systems, routines, workflows and documented procedures. According to Bayraktaroglu et al. (2019), process capital comprises the structured knowledge codified in manuals, databases, quality systems and standard operating procedures that allow work to be repeated efficiently. Vishnu and Gupta (2019) define it as the organisational infrastructure that converts individual knowledge into collective, transferable capability. Complementing these views, Xu and Wang (2019) describe process capital as the "institutional memory" of a firm, the accumulated procedural knowledge that survives staff turnover. Common to these definitions is the notion that process capital makes performance systematic rather than personality-dependent.

On its mechanics, Vishnu and Gupta (2019) argue that process capital drives efficiency by reducing variability, eliminating rework and shortening cycle times. However, Nguyen and Doan (2020) warn that over-formalised processes can ossify into bureaucracy, stifling the very adaptability that innovation capital provides. Consequently, the value of process capital depends on striking a balance between discipline and flexibility. In line with this, Asiaei et al. (2020) contend that process capital and innovation capital must be managed jointly, since each compensates for the other's weakness.

For manufacturers, process capital is closely bound to operational efficiency. According to Sardo et al. (2018), documented procedures and quality-management systems lower defect rates and resource waste, directly improving the output-to-input ratio. Furthermore, Wang et al. (2021) demonstrate that firms with mature process capital achieve higher capacity utilisation and lower unit costs. Therefore, this study theorises that process capital relates positively to operational efficiency, since codified routines allow pharmaceutical firms to produce more output from the same or fewer resources.

The strategic value of process capital lies partly in its inimitability. According to Vishnu and Gupta (2019),

because process capital is embedded in a firm's specific history, culture and accumulated practice, competitors find it difficult to copy, which makes it a source of durable advantage under the resource-based view. Furthermore, Bayraktaroglu et al. (2019) note that process capital retains value even as individual employees leave, since it is codified in systems rather than lodged in particular heads. Therefore, process capital acts as a stabiliser, protecting performance against the disruption of staff turnover, a benefit of obvious relevance to Nigerian firms contending with the flight of skilled labour.

The empirical evidence broadly supports this expectation. Kengatharan (2019) found that structural and process capital significantly enhanced operational performance in a sample of Sri Lankan firms. Similarly, Yaseen et al. (2019) reported that process capital contributed positively to the performance of pharmaceutical firms, though its effect was smaller than that of innovation capital. Conversely, Nimtrakoon (2015) found that structural capital, of which process capital is a component, sometimes showed weak or insignificant effects, underscoring the influence of context. This study tests the relationship afresh in the South-East Nigerian setting.

A more nuanced reading recognises that process capital and operational efficiency are linked through several intermediate mechanisms. According to Wang et al. (2021), documented processes reduce information asymmetry, shorten decision cycles and enable continuous improvement, each of which lowers cost per unit of output. Moreover, Sardo, Serrasqueiro and Alves (2018) observe that firms with strong process capital are better able to sustain quality certification, which in regulated industries such as pharmaceuticals directly affects the ability to operate efficiently and avoid costly rework. Consequently, process capital contributes to operational efficiency not only directly but also by underpinning the compliance and quality systems on which regulated manufacturing depends.

*2.1.4 Organisational Performance*

Organisational performance is among the most examined yet most contested constructs in management scholarship. According to Sardo, Serrasqueiro and Alves (2018), organisational performance denotes the extent to which an organisation attains its goals, whether financial, operational or strategic. Vishnu and Gupta (2019) define it more broadly as the aggregate outcome of a firm's activities relative to its objectives and the expectations of its stakeholders. Xu and Wang (2019) narrow the concept to measurable results, such as productivity, profitability and market share. Despite differing emphases, these definitions agree that performance is fundamentally about results achieved against intended ends.

For manufacturing firms, two operational dimensions of performance are especially salient. Production effectiveness captures how well a firm meets its output, quality and delivery targets, whereas operational efficiency captures how economically it uses resources to achieve that output (Sardo et al., 2018). According to Wang et al. (2021), these two dimensions together determine the competitiveness of a manufacturer, because a firm must be both effective in doing the right things and efficient in doing them well. Therefore, this study operationalises organisational performance through these two dimensions, pairing production effectiveness with innovation capital and operational efficiency with process capital.

The measurement of organisational performance has itself evolved. According to Nguyen and Doan (2020), reliance on purely financial indicators such as profit and market value understates the contribution of intangible drivers, because financial results lag operational realities. As a result, scholars increasingly favour operational and multidimensional measures. In line with this, Sardo et al. (2018) advocate combining financial and non-financial indicators to capture the full effect of intellectual capital. This study follows that reasoning by adopting operational measures, production effectiveness and operational efficiency, which respond more immediately to changes in knowledge assets than financial ratios do.

Scholars increasingly link performance to intangible drivers. According to Nadeem, Gan and Nguyen (2019), intellectual capital explains a substantial and growing share of performance variance across industries. Moreover, Ozkan, Cakan and Kayacan (2019) found, in a study of Turkish firms, that intellectual capital components significantly predicted both efficiency and effectiveness measures. Nevertheless, the strength of the link varies with industry, firm size and institutional context, which

justifies context-specific enquiry such as the present one.

There remains, however, a lively debate over the direction of causation. According to Xu and Liu (2020), the relationship between intellectual capital and performance may be reciprocal, since profitable firms can afford to invest more in knowledge assets, which in turn raise performance. Conversely, Vishnu and Gupta (2019) maintain that the dominant direction runs from intellectual capital to performance, at least in the short to medium term. Although this study does not test causation directly, its correlational design is well suited to establishing the existence and strength of the association, which is a necessary precondition for any causal claim. Therefore, the analysis that follows addresses the more fundamental question of whether, and how strongly, innovation and process capital are related to the two performance dimensions.

2.2 Theoretical Framework

*2.2.1 Resource-Based View*

The resource-based view, developed by Barney (1991) and refined by subsequent scholars, provides the principal theoretical anchor for this study. The theory holds that a firm's sustained competitive advantage flows from resources that are valuable, rare, inimitable and non-substitutable. According to Nadeem, Gan and Nguyen (2019), intellectual capital fits this profile almost perfectly, since knowledge assets are difficult to imitate, socially complex and deeply embedded in a firm's history. Consequently, innovation capital and process capital, as intangible, firm-specific resources, are precisely the kind of assets the resource-based view predicts will drive superior performance. Applying the theory, Vishnu and Gupta (2019) argue that intellectual capital confers advantage because rivals cannot easily buy or copy a firm's accumulated know-how and routines. However, the theory has been criticised for underplaying the role of managerial action in converting resources into results. In line with this critique, Asiaei et al. (2020) extend the resource-based view with a knowledge-management lens, arguing that resources create value only when actively orchestrated. This study adopts that extended reading, treating innovation and process capital as valuable resources whose effect depends on deliberate deployment.

*2.2.2 Knowledge-Based View*

The knowledge-based view, an outgrowth of the resource-based view, treats knowledge as the pre-eminent strategic resource. According to Grant (1996), as elaborated by Nguyen and Doan (2020), a firm exists chiefly to integrate the specialised knowledge of its members into productive activity. Therefore, innovation capital and process capital can be read as two mechanisms of knowledge integration: innovation capital generates new knowledge, while process capital codifies and diffuses it. Furthermore, Buenechea-Elberdin et al. (2018) argue that the knowledge-based view explains why some firms out-innovate and out-execute rivals with similar tangible resources. This study draws on the theory to justify examining innovation and process capital as distinct but complementary knowledge processes.

2.3 Empirical Review

Yaseen, Dajani and Hasan (2019) investigated the impact of intellectual capital on the performance of Jordanian pharmaceutical companies. Using regression analysis on survey data, they found that innovation capital and process capital both significantly enhanced firm performance, with innovation capital exerting the stronger effect. Their setting closely mirrors the present study, lending direct relevance to their findings. In a related enquiry, Kengatharan (2019) examined the effect of intellectual capital on organisational performance among Sri Lankan firms. The study reported that structural capital, which encompasses process capital, and human capital jointly predicted operational performance, though the author noted that the effect of structural capital depended on the presence of supportive management systems. Furthermore, Xu and Liu (2020) analysed a large sample of Chinese manufacturing firms and found that innovation capital was the strongest single predictor of productivity growth, outperforming both physical and human capital. Their finding reinforces the theorised link between innovation capital and production effectiveness. However, they cautioned that the effect weakened in firms lacking absorptive capacity, echoing the conditional pattern reported elsewhere.

Ozkan, Cakan and Kayacan (2019) studied Turkish banking firms and reported that intellectual capital components significantly influenced both efficiency and profitability. Although their sector differs from manufacturing, their evidence adds to the weight of

findings connecting structural knowledge assets to efficiency, which is central to the present study's second hypothesis. Similarly, Nadeem, Gan and Nguyen (2019), in a cross-country study, found robust positive associations between intellectual capital and firm performance, though the magnitude varied with institutional development. According to Bayraktaroglu, Calisir and Baskak (2019), such aggregation risks masking important component-level effects. Consequently, a clear gap exists for studies that disaggregate intellectual capital and test its components within provincial manufacturing. This study addresses that gap directly. Hence, the pharmaceutical sector deserves particular mention, since it is among the most knowledge-intensive of all manufacturing industries. According to Vishnu and Gupta (2019), whose study of Indian pharmaceutical firms is directly comparable to the present one, both innovation and process capital significantly influenced firm performance, with knowledge assets accounting for a large share of the value created. Similarly, Yaseen et al. (2019) found that intellectual capital conferred competitive advantage on Jordanian pharmaceutical companies. These sector-specific findings strengthen the expectation that intellectual capital matters greatly for pharmaceutical manufacturers, yet they also highlight the absence of comparable Nigerian evidence, which this study supplies.

## III. RESEARCH METHODOLOGY

### 3.1 Research Design

This study adopted the descriptive survey research design. The design was considered appropriate because it enables a researcher to gather data from a representative sample and to describe relationships among variables as they exist, without manipulation. Furthermore, the design facilitated the testing of hypotheses concerning the relationships between innovation capital and production effectiveness, and between process capital and operational efficiency.

### 3.2 Sources of Data

Data for the study were drawn from both primary and secondary sources. Primary data were first-hand information collected directly from the field through a structured questionnaire administered to employees of the selected firms. The questionnaire was organised into two sections: Section A elicited demographic information, while Section B contained items relating to the study variables, measured on a five-point Likert scale. Secondary data were obtained from journals, periodicals, textbooks and reputable internet sources, and were used to build the conceptual, theoretical and empirical foundations of the study.

### 3.3 Population of the Study

The population comprised the permanent employees of pharmaceutical manufacturing firms operating in the South-East geo-political zone of Nigeria. The choice of pharmaceutical manufacturers was informed by the need to ensure homogeneity of products, production processes and regulatory environment, thereby strengthening the validity and reliability of the findings. Although about 250 registered pharmaceutical manufacturing firms operate in the zone, twenty firms were purposively selected, four from each of the five states, namely Abia, Anambra, Ebonyi, Enugu and Imo States. The population therefore consisted of all permanent employees, both senior and junior, of the twenty selected firms.

### 3.4 Sample Size Determination

Given the modest and clearly bounded population of accessible respondents across the twenty firms, and in the interest of depth and response quality, the study worked with a sample of one hundred (100) respondents. This size was considered adequate for the correlational analysis employed and consistent with the practical constraints of field access in the zone. The sample was distributed across the twenty firms using proportional allocation, so that each firm was represented in proportion to its staff strength.

### 3.5 Sampling Procedure

A stratified random sampling technique was employed. Employees were first stratified according to their position in the organisational hierarchy, namely top, middle and lower-level management. Within each stratum, respondents were then selected randomly, ensuring that every unit had an equal chance of inclusion. This procedure guaranteed that both senior and junior staff were represented, and reduced the risk of selection bias.

### 3.6 Validity and Reliability of the Instrument

The validity of the instrument was established through content validity. The draft questionnaire was submitted to experts in management, who examined the items for relevance and clarity. In the light of their observations, the structure and wording of the

instrument were refined to reduce inconsistency, verbosity and ambiguity. Reliability was determined through the test-retest method, using a pilot study in which forty copies of the questionnaire were administered to forty randomly selected respondents across the zone. The resulting Cronbach's alpha coefficients were: human capital 0.750; relational capital 0.625; innovation capital 0.790; process capital 0.706; social capital 0.725; and organisational performance 0.754. Since all coefficients exceeded the 0.5 threshold recommended by Cooper and Schindler (2022), the instrument was adjudged reliable.

3.7 Method of Data Analysis

Demographic data and responses to the questionnaire items were summarised using frequencies, percentages and tables. The hypotheses were tested using the Pearson product-moment correlation coefficient, which measures the strength and direction of the relationship between two variables. All analyses were conducted with the Statistical Package for the Social Sciences (SPSS) version 23. The null hypotheses were rejected where the probability value was less than 0.05.

## IV. DATA ANALYSIS AND FINDINGS

4.1 Questionnaire Distribution and Response Rate

Of the one hundred copies of the questionnaire distributed to respondents across the twenty selected firms, ninety-two were completed correctly and returned, representing a response rate of 92 per cent. This high rate was considered adequate for meaningful analysis. Table 1 summarises the distribution and return of the instrument.

Table 1: Questionnaire Distribution and Response Rate

| Response Category | Frequency | Percentage (%) |
|---|---|---|
| Returned and usable | 92 | 92.0 |
| Not returned / unusable | 8 | 8.0 |
| Total | 100 | 100.0 |

*Source: Field Survey (2026).*

4.2 Demographic Characteristics of Respondents

Table 2 presents the demographic profile of the ninety-two respondents. The distribution shows a reasonable spread across gender, management level and working experience, which strengthens confidence that the responses reflect a cross-section of the workforce rather than a narrow segment.

Table 2: Demographic Profile of Respondents

| Variable | Category | Frequency | Percentage (%) |
|---|---|---|---|
| Gender | Male | 54 | 58.7 |
| | Female | 38 | 41.3 |
| Management level | Top | 14 | 15.2 |
| | Middle | 31 | 33.7 |
| | Lower | 47 | 51.1 |
| Experience | Below 5 years | 22 | 23.9 |
| | 5–10 years | 41 | 44.6 |
| | Above 10 years | 29 | 31.5 |

*Source: Field Survey (2026).*

As shown in Table 2, male respondents (58.7%) slightly outnumbered female respondents (41.3%). The majority of respondents occupied lower-level (51.1%) and middle-level (33.7%) positions, which is consistent with the pyramidal structure of manufacturing firms. Moreover, most respondents (76.1%) had at least five years of working experience, suggesting that the responses were informed by adequate familiarity with the firms' operations.

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4.3 Descriptive Analysis of Study Variables

Table 3 reports the mean responses and standard deviations for the four study variables, measured on a five-point Likert scale where a mean of 3.0 was taken as the criterion for acceptance. The results indicate that respondents generally agreed with the statements describing the presence and effect of innovation and process capital in their firms.

Table 3: Descriptive Statistics of Study Variables

| Variable | N | Mean | Std. Dev. | Remark |
|---|---|---|---|---|
| Innovation Capital (IC) | 92 | 3.94 | 0.71 | Accepted |
| Production Effectiveness | 92 | 3.88 | 0.74 | Accepted |
| Process Capital (PIC) | 92 | 3.79 | 0.69 | Accepted |
| Operational Efficiency | 92 | 3.72 | 0.77 | Accepted |

*Source: Field Survey (2026); SPSS Output (Version 23).*

Table 3 shows that all four variables recorded mean scores above the 3.0 criterion, ranging from 3.72 to 3.94. The relatively low standard deviations indicate a fair degree of consensus among respondents. Innovation capital recorded the highest mean (3.94), suggesting that respondents regarded their firms' renewal and research activities as reasonably strong, while operational efficiency recorded the lowest (3.72), hinting at room for improvement in resource utilisation.

4.4 Test of Hypotheses

The two null hypotheses were tested using the Pearson product-moment correlation coefficient at the 0.05 level of significance. A correlation is deemed statistically significant, and the null hypothesis rejected, where the probability value is less than 0.05.

*4.4.1 Test of Hypothesis One ($H_o1$)*

$H_{03}$ stated that there is no significant relationship between innovation capital and production effectiveness of pharmaceutical manufacturing firms in South-East Nigeria. Table 4 presents the correlation result.

Table 4: Correlation between Innovation Capital and Production Effectiveness

| Variables | Innovation Capital | Production Effectiveness |
|---|---|---|
| Innovation Capital (Pearson r) | 1 | 0.712** |
| Sig. (2-tailed) | | 0.000 |
| Production Effectiveness (Pearson r) | 0.712** | 1 |
| N | 92 | 92 |

*Source: SPSS Output, Version 23 (2026). **Correlation is significant at the 0.01 level (2-tailed).*

The result in Table 4 reveals a strong, positive correlation between innovation capital and production effectiveness ($r = 0.712$, $p = 0.000 < 0.05$). Since the probability value is less than 0.05, the null hypothesis is rejected. Therefore, there is a significant positive relationship between innovation capital and the production effectiveness of pharmaceutical manufacturing firms in South-East Nigeria. This implies that as firms strengthen their innovation capital, their production effectiveness rises correspondingly.

*4.4.2 Test of Hypothesis Two ($H_o2$)*

$H_{04}$ stated that there is no significant relationship between process capital and operational efficiency of pharmaceutical manufacturing firms in South-East Nigeria. Table 5 presents the correlation result.

Table 5: Correlation between Process Capital and Operational Efficiency

| Variables | Process Capital | Operational Efficiency |
|---|---|---|
| Process Capital (Pearson r) | 1 | 0.684** |
| Sig. (2-tailed) | | 0.000 |

| Variables | Process Capital | Operational Efficiency |
|---|---|---|
| Operational Efficiency (Pearson r) | 0.684** | 1 |
| N | 92 | 92 |

*Source: SPSS Output, Version 23 (2026). **Correlation is significant at the 0.01 level (2-tailed).*

Table 5 shows a strong, positive correlation between process capital and operational efficiency ($r = 0.684$, $p = 0.000 < 0.05$). Given that the probability value is below 0.05, the null hypothesis is rejected. Consequently, there is a significant positive relationship between process capital and the operational efficiency of pharmaceutical manufacturing firms in South-East Nigeria. This suggests that firms with better-documented and better-managed processes achieve higher operational efficiency.

4.5 Conceptual Framework of the Study

Figure 1 depicts the conceptual framework that guided the study, showing the hypothesised relationships between the two dimensions of intellectual capital and the corresponding measures of organisational performance.

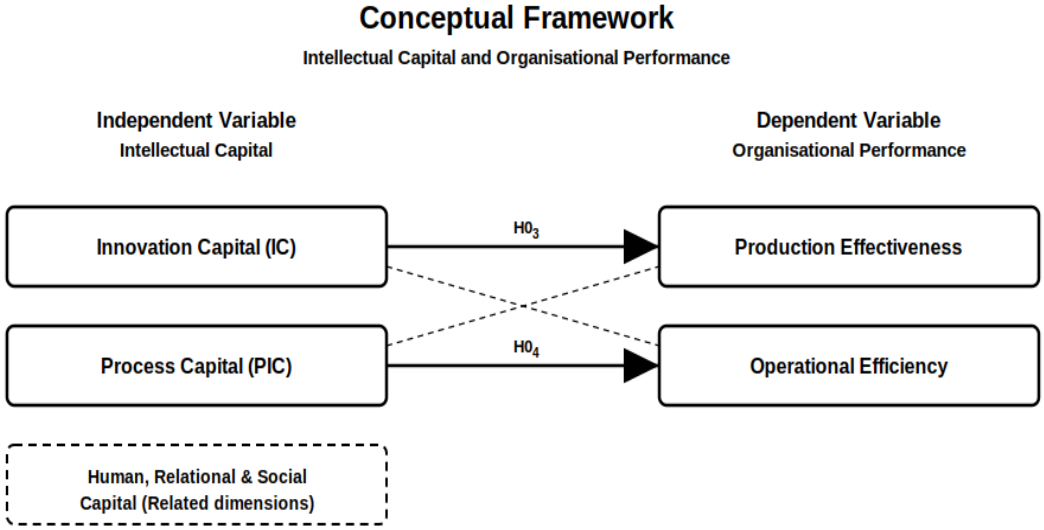


Figure 1: Conceptual Framework of Intellectual Capital and Organisational Performance

*Source: Researcher's Conceptualisation (2026), adapted from Bontis (1998) and Edvinsson and Malone (1997).*

4.6 Discussion of Findings

The first finding established a strong, positive and significant relationship between innovation capital and production effectiveness ($r = 0.712$, $p < 0.05$). This result aligns with Yaseen, Dajani and Hasan (2019), who reported that innovation capital significantly enhanced the performance of Jordanian pharmaceutical firms. It also corroborates Xu and Liu (2020), who found innovation capital to be the strongest predictor of productivity among manufacturing firms. Therefore, the evidence supports the theoretical expectation, grounded in the resource-based and knowledge-based views, that a firm's renewal capacity translates into a greater ability to meet its output and quality targets. In practical terms, pharmaceutical firms that invest in research, reformulation and product improvement are better equipped to produce effectively.

The second finding revealed a strong, positive and significant relationship between process capital and operational efficiency ($r = 0.684$, $p < 0.05$). This is consistent with Kengatharan (2019), who found that structural and process capital enhanced operational performance, and with Wang, Cai and Xu (2021), who linked mature process capital to higher capacity utilisation and lower unit costs. Consequently, the finding confirms that codified routines, quality systems and documented procedures allow firms to convert inputs into outputs more economically. Nevertheless, the slightly lower coefficient, compared with innovation capital, echoes Yaseen et al. (2019), who observed that process capital tends to exert a smaller effect than innovation capital.

Read together, the two findings reinforce the central argument that intellectual capital, and specifically its structural sub-dimensions, materially shapes manufacturing performance. Moreover, the results challenge the still-common managerial assumption that performance depends mainly on physical assets. Instead, they lend weight to the position of Nadeem, Gan and Nguyen (2019) that intangible knowledge assets explain a growing share of performance variance. Accordingly, the evidence from South-East Nigerian pharmaceutical manufacturing extends the intellectual capital literature into a sub-national manufacturing context that has been largely overlooked.

## V. IMPLICATIONS, CONCLUSION AND RECOMMENDATIONS

### 5.1 Implications of the Study

The findings carry clear implications for theory, practice and policy. Theoretically, the study reinforces the resource-based and knowledge-based views by demonstrating that innovation and process capital, treated as distinct resources, each contribute significantly to performance. This supports the case for disaggregating intellectual capital rather than treating it as a single lumped variable. For practice, the results signal to managers of pharmaceutical firms that investment in research capacity and in the codification of routines is not discretionary overhead but a direct lever on output and efficiency. For policy, the evidence suggests that industry bodies and regulators can strengthen the sector by encouraging knowledge-management standards and by supporting research and development in provincial manufacturing.

### 5.2 Conclusion

This study examined the relationship between intellectual capital and the organisational performance of pharmaceutical manufacturing firms in South-East Nigeria, focusing on innovation capital and process capital. The evidence established that innovation capital relates strongly and positively to production effectiveness, and that process capital relates strongly and positively to operational efficiency. It follows that intellectual capital is a decisive determinant of performance in the sector, and that firms which cultivate their structural knowledge assets are better placed to meet output targets and to use resources economically. The study therefore concludes that intellectual capital, far from being an abstract corporate ideal, is a practical driver of manufacturing performance in the zone.

### 5.3 Recommendations

In line with the findings, the study recommends the following:

i. Pharmaceutical manufacturing firms in South-East Nigeria should sustain and increase investment in innovation capital through research and development, product reformulation and continuous process improvement, since these directly enhance production effectiveness.

ii. Firms should strengthen their process capital by documenting standard operating procedures, adopting robust quality-management systems and institutionalising knowledge-management practices, thereby improving operational efficiency.

iii. Management should treat intellectual capital as a strategic asset, allocating budget and attention to its development, and should train staff to codify and share tacit knowledge before it is lost to turnover.

iv. Industry regulators and associations should promote sector-wide knowledge-management standards and support research initiatives that build the innovation and process capacity of provincial manufacturers.

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