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MASTER OF RESEARCH AND DEVELOPMENT MANAGEMENT

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**DEVELOPING A STAGE-GATE STANDARD OPERATING PROCEDURE FOR
DIGITAL R&D REQUISITION AND LIFE CYCLE MANAGEMENT IN A PHILIPPINE
MANUFACTURING FIRM**

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21 April 2026

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Acceptance Page

This Special Problem of **HEMOJIN G. CAMACHO** titled: **“DEVELOPING A STAGE-GATE STANDARD OPERATING PROCEDURE FOR DIGITAL R&D REQUISITION AND LIFE CYCLE MANAGEMENT IN A PHILIPPINE MANUFACTURING FIRM”** is hereby accepted by the Faculty of Management and Development Studies, U.P. Open University, in partial fulfillment of the requirements for the degree **Master of Research and Development Management**.

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DECLARATION

This is to certify that:

- I. The special problem comprises only my original work towards the MRDM, except were indicated in the Preface
- II. Due acknowledgment has been made in the text to all other material used
- III. The special problem is fewer than 25,000 words in length, exclusive of tables, maps, bibliographies, and appendices.

HEMOJIN G. CAMACHO

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Above all, I thank Almighty God for giving me the strength, wisdom, and grit to finish this journey. Everything I am able to do is a gift from Him.

DEDICATION

This work is dedicated to my family: my wife, Edz, and my children, Jacob, Jade, and Jia.

To my children, I hope you always cherish the joy of learning and the endless possibilities that education brings. Remember that knowledge is a God-given gift to be treasured and shared. It is a powerful tool, and with dedication and resilience, you can turn your dreams into reality.

To God be the glory.

Regards,

Jin

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List of Abbreviations

As-Is – Current state of processes

Auto-ID – Automatic Identification

COPQ – Cost of Poor Quality

CPI – Continuous Process Improvement

Dataverse – Microsoft's cloud-based storage platform

ERP – Enterprise Resource Planning

F&B – Food and Beverage

FDA – Food and Drug Administration

FGD – Focused Group Discussion

FMCG – Fast-Moving Consumer Goods

ISO – International Organization for Standardization

KPI – Key Performance Indicator

NPD – New Product Development

PLM – Product Lifecycle Management

PMBOK – Project Management Body of Knowledge

Power BI – Microsoft's Business Intelligence/Analytics tool

R&D – Research and Development

RACI – Responsible, Accountable, Consulted, and Informed (Matrix)

SOP – Standard Operating Procedure

To-Be – Future/proposed state of processes

ABSTRACT

This study addressed the operational vulnerabilities in the manual and informal New Product Development (NPD) framework at S-Line International by designing a cloud-native digital workflow architecture. A qualitative-descriptive research design, a diagnostic evaluation was conducted with core stakeholders (n=8), including the R&D Head, R&D staff, and Sales Managers. The review confirmed that reliance on shared folders, and manual spreadsheet logs caused severe data integrity risks, version control chaos, ad-hoc prioritization and sample release delays. To resolve these gaps, a Stage-Gate Standard Operating Procedure (SOP) was engineered within the Microsoft Power Platform. The solution automated intake, pre-screening, RACI-based role accountability, and cross-functional alerts for Finance and Production. The findings demonstrated that digitizing quality gates and enforcing an immutable audit trail eliminated tribal knowledge dependencies, protected technical bandwidth, and transformed the R&D function into an adaptive, data-driven innovation engine.

Keywords: Stage-Gate Model; New Product Development, Standard Operating Procedure; Digital Requisition; R&D Management; Data Governance

I. INTRODUCTION

A. RATIONALE

Research and Development (R&D) serves as the primary engine for organizational growth, providing the necessary agility for firms to sustain a competitive advantage within rapidly shifting and high-pressure markets. This function acts as a critical intermediary, meticulously translating evolving client requirements into tangible innovations, including new products, optimized systems, and specialized services. However, the successful execution of R&D is not merely a matter of scientific talent; it necessitates highly structured administrative processes designed to manage incoming requests, prioritize limited resources, and organize technical information in a rigorous, consistent manner. Without this structural backbone, the path from conceptualization to commercialization becomes fraught with inefficiency and operational friction.

For S-Line International, the R&D department is the cornerstone of its innovation strategy within the competitive food and beverage sector. Currently, the company manages New Product Development (NPD) requests through an informal system where Sales Managers submit requirements via a shared digital folder. This arrangement lacks a formal governing policy or a standard operating framework, relying instead on ad-hoc coordination. While such an informal setup may have facilitated flexibility during the company's early growth stages, the current surge in project volume and complexity has begun to expose significant operational vulnerabilities. As the organization scales, the absence of a professionalized workflow prevents the R&D team from operating at its full potential.

The most immediate and critical concern within this current setup is the preservation of data integrity. In a shared folder environment lacking strict administrative controls, files are highly susceptible to being inadvertently edited, overwritten, or even deleted without the safety net of a reliable audit trail. Because there is no systematic ledger detailing who accessed specific files or when modifications occurred, the organization lacks a "single source of truth." This weak control structure significantly elevates the risk of data loss and versioning errors. When technical records are incomplete or conflicting, R&D personnel are forced to rely on potentially outdated information, leading to the costly repetition of experiments, the waste of expensive laboratory raw materials, and debilitating project delays. Indeed, empirical research by Mithas, Ramasubbu and Sambamurthy (2011) confirms that poor data management practices are strongly correlated with increased error rates and a measurable decline in overall R&D performance.

Beyond data risks, project tracking represents a secondary but equally severe operational hurdle. The existing system lacks a centralized dashboard or any real-time monitoring mechanism to visualize the status of active requests. Consequently, managers are forced into a reactive mode, manually sifting through disparate folders to determine if a project is on schedule, stalled, or approaching a deadline. This fragmented approach severely limits executive oversight and creates a visibility vacuum. This lack of transparency also complicates the interface between the Sales and R&D departments, as communication becomes siloed and decision-making is slowed by a lack of shared context. Over the long term, this inability to track velocity and output undermines the company's capacity for strategic planning, resource forecasting, and accurate workload distribution.

Furthermore, the current structure creates a deficit in organizational accountability. Effective project management is built upon the foundation of clearly defined ownership at every milestone of the development lifecycle. At S-Line International, however, the responsibility for a specific client request often shifts informally and inconsistently between Sales personnel and R&D leads. Without a formal assignment of roles, critical tasks are more likely to be overlooked or delayed indefinitely. This ambiguity not only weakens individual and team accountability but also increases the potential for inter-departmental conflict when deliverables fail to meet expectations. Establishing clearly defined responsibilities is therefore essential to ensure that every phase of a project—from intake to final testing—is actively and competently managed.

The persistence of this informal process exposes S-Line International to a broad spectrum of organizational risks that extend far beyond internal inefficiencies. Inconsistent tracking and inadequate documentation are precursors to missed deadlines and dissatisfied clients, which ultimately translate into lost revenue and diminished market share. Moreover, product failures or quality inconsistencies stemming from inaccurate data can cause lasting damage to the company's reputation and brand equity. There is also the grave concern of regulatory and safety non-compliance; modern R&D environments demand absolute traceability and systematic control to meet stringent industry standards. Without a formal policy framework, the organization remains vulnerable to operational, legal, and financial liabilities that could have been mitigated through proper governance.

A Standard Operating Procedure (SOP) provides a structured response to these challenges (Sanchis et al., 2020). An SOP establishes clear, documented steps

for performing tasks and managing workflows. For S-Line International, a formal SOP would govern the full lifecycle of digital client requests, from submission and review to execution and closure. Standardization promotes consistency, reduces process variation, and improves cross-functional coordination (Griffin and Hauser, 1996). Through defined procedures, each request receives uniform evaluation, documentation, and monitoring

The necessity for this formalization can be further justified through the lens of public policy theory. As Villamejor-Mendoza (1998) posits, policy is best understood as a sustained course of action rather than a singular decision. Within an organization, practices—whether they are documented or merely habitual—reflect policy choices. The current lack of a structured SOP essentially constitutes a "policy of inaction" regarding process governance. This inaction yields its own set of outcomes, often manifesting as unmanaged risks and pervasive ambiguity. Furthermore, policy defines the relationships and power dynamics between different organizational actors. Since R&D must collaborate closely with Sales, Finance, and Production units, an unstructured system fails to provide the necessary bridge for coordinated decision-making. A robust SOP clarifies these communication channels and approval hierarchies, thereby strengthening institutional collaboration and ensuring that information is no longer dispersed.

Ultimately, all policies are judged by the outcomes they generate. While the current informal arrangement produces variability, transparency gaps, and data insecurity, a formal SOP is designed to deliver a different set of results: highly reliable records, punctual project completion, heightened accountability, and increased client confidence. By instituting clear procedures and defining specific mandates, S-Line

International can finally align its daily operational practices with its broader strategic objectives. The company already possesses a highly skilled and dedicated R&D team; what they require now is not more technical expertise, but a stronger structural foundation. Implementing a formal SOP for digital requisition and lifecycle management will secure data integrity, optimize tracking, and provide the clarity needed for the team to focus on what they do best: driving innovation in the food and beverage industry.

B. STATEMENT OF THE PROBLEM

This research endeavors to conduct a comprehensive examination of the operational imperatives within the Research and Development Department at S-Line International. The primary objective is to architect and reinforce a robust, formal Standard Operating Procedure (SOP) dedicated to the management of digital requests and their subsequent lifecycles. In the contemporary food and beverage manufacturing landscape, where digital transformation is no longer optional, the strengthening of such processes is a strategic necessity. The industry demands an uncompromising commitment to data accuracy, stringent traceability, and rapid time-to-market; therefore, a formalized framework is essential to ensure that the R&D function can pivot from reactive task-handling to proactive, high-value innovation.

The fundamental problem at the heart of this inquiry is the current policy vacuum regarding the governance of digital client requests. Presently, the R&D department operates under an informal, shared-folder paradigm that lacks standardized intake forms, clearly demarcated lifecycle stages, or formally assigned roles. This structural deficiency manifests as significant vulnerabilities in data integrity,

where information is susceptible to corruption or loss, and in project tracking, where the status of innovations remains opaque. Furthermore, the absence of defined accountability creates "ownership gaps" that hinder cross-functional synergy between R&D and other business units, ultimately slowing the pace of development.

In the absence of a formalized SOP, S-Line International faces a cascade of operational risks, including inconsistent documentation and a lack of real-time project visibility. As the volume and complexity of project demands continue to grow, this informal system increasingly limits the department's ability to scale effectively. Within a highly regulated and fiercely competitive global market, these internal weaknesses do not merely represent administrative inconveniences; they pose a direct threat to the company's innovation performance and long-term strategic growth. By failing to provide a systematic control mechanism, the organization remains exposed to inefficiencies that could result in lost revenue and diminished brand reputation.

C. OBJECTIVES OF THE STUDY

This study seeks to identify the specific process deficiencies within the current system and to propose structured solutions through the design of a formal SOP. Based on the findings, the study will recommend practical development strategies to address the identified gaps and strengthen digital process governance within the R&D function.

The study aims to analyze the existing informal digital requisition process of the R&D Department at S-Line International and to develop an enhanced and structured Standard Operating Procedure (SOP) that strengthens process control, data integrity, and project management efficiency.

Specific Objectives

The study aims to:

1. Document and analyze the current digital requisition process, including workflows, documentation practices, stakeholder perceptions, and identified pain points;
2. Formulate guiding principles for R&D requisition governance based on diagnosed deficiencies, emphasizing data integrity, traceability, accountability, transparency, and continuous improvement;
3. Develop formal policies governing the requisition lifecycle, including provisions for data ownership, access control, audit trails, data retention schedules, and regulatory compliance;
4. Design standardized procedures for the R&D request lifecycle (Intake, Review, Development, Validation, Closure), incorporating RACI-based role definitions for Sales and R&D personnel at each stage;
5. Develop a tracking and control mechanism that enables real-time monitoring of project status, timelines, and ownership, while ensuring data accuracy, security, and protection against unauthorized modification or loss; and
6. Recommend platform specifications that meet defined functional and data governance requirements, including clear evaluation criteria and justification for the selected technology stack.

Through these objectives, the study seeks to provide a systematic framework that supports operational efficiency and digital governance within the R&D function.

II. R&D MANAGEMENT FRAMING

In analyzing the informal digital requisition protocols within the R&D Department at S-Line International, this study is grounded in established R&D management theories which posit that innovation ecosystems reach peak efficacy when they are structured, transparent, and inherently accountable. Rather than diagnosing the current hurdles as isolated operational friction, this framing situates them within the broader paradigms of organizational governance, lifecycle control, and knowledge management. These theoretical underpinnings suggest that the transition toward formalization is not merely a clerical or administrative upgrade; it is a strategic repositioning designed to transform the R&D function from a reactive unit into a disciplined engine of growth.

Governance and Policy Framework

R&D management in both the public and private spheres is dictated by policy structures that serve as a "north star" for institutional behavior over time. Public administration theory defines policy as a sustained, deliberate course of action that directs organizational conduct and resource allocation (Villamejor-Mendoza, 1998). In a well-governed ecosystem, research workflows are bolstered by documented procedures, rigorous review mechanisms, and clear approval hierarchies. These structural elements serve to eliminate ambiguity and synchronize day-to-day tactical operations with high-level institutional goals.

When evaluated through this lens, the current shared-folder system at S-Line International reveals a significant governance deficit. The lack of a documented Standard Operating Procedure (SOP) means that operational expectations are

governed by assumptions rather than formal mandates. As highlighted in administrative literature, weak governance frameworks invariably lead to increased process variability and heightened operational risk (Shafritz, Hyde, & Parkes, 2017). Consequently, the research suggests that the core issue is not a lack of technical skill, but a state of structural vulnerability; formal governance is required to provide the oversight and predictability currently missing from the digital requisition process.

Lifecycle Control and Stage-Gate Management

The literature on innovation management consistently indicates that R&D rarely succeeds through unstructured or linear progression. Instead, success is often the result of lifecycle or stage-based management. A foundational concept in this area is the "Stage-Gate" model, which argues that innovation projects should be partitioned into distinct phases separated by rigorous decision checkpoints or "gates" (Cooper, 1990). Each stage necessitates specific documentation, evaluation, and formal authorization before the project is permitted to consume further resources.

Currently, the digital requisition process at S-Line International lacks these formalized checkpoints. Requests frequently advance based on informal, ad-hoc communication rather than standardized review points, which inherently limits managerial visibility and control. From a theoretical perspective, the absence of stage-based governance significantly increases the probability of project misalignment, costly rework, and timeline slippage. By applying lifecycle principles, the department can introduce measurable milestones from intake to project closure, thereby strengthening oversight without stifling the creative spirit of the R&D team.

Accountability, Role Clarity, and Project Management

Accountability is the bedrock of both R&D governance and effective public administration. Theoretical frameworks emphasize that a robust accountability system must clarify exactly who is responsible for specific deliverables at every juncture of the process (Behn, 2001). Without such a structure, organizational performance becomes impossible to assess objectively. Within S-Line International, project ownership currently shifts informally between Sales, Business Development, and R&D leads, leading to a diffusion of responsibility that increases the risk of overlooked requirements.

Project management theory advocates for the formal allocation of roles to optimize coordination and execution (Kerzner, 2017). By institutionalizing an SOP, the organization addresses these systemic ambiguities. This ensures that accountability is not viewed as a punitive measure for individual shortcomings but as a supportive framework that empowers personnel through clear expectations. Formalizing these roles through a "responsibility matrix" is a proven academic and practical method for ensuring that the development pipeline remains fluid and high functioning.

Knowledge Management and Data Governance

Innovation systems are fundamentally dependent on the quality and accessibility of information. Knowledge management theory stresses that organizational excellence is determined by how effectively an institution creates, codifies, and shares its intellectual capital (Davenport & Prusak, 1998). In a digital R&D environment, this requires strict adherence to data integrity, version control, and traceability. Standardization acts as a primary dimension of organizational structure,

facilitating the seamless transfer of knowledge and reducing the steepness of the learning curve for new or cross-functional team members (Szulanski, 1996).

The current reliance on a shared-folder approach at S-Line International lacks the audit trails and documentation protocols necessary to protect technical assets. This creates a "knowledge governance" weakness, exposing the firm to data loss and inconsistent record-keeping. A formal SOP serves as a critical documentation tool, ensuring a systematic determination of operational actions, facilitating seamless knowledge transfer and minimizing organizational risk (Szulanski, 1996). Strengthening these standards ensures that the company's best asset—its intellectual property—is managed with the same rigor as its physical inventory (Davenport & Prusak 1998).

Process Maturity and Continuous Improvement

Finally, the transition from an informal system to a formal one is best understood through Process Maturity Models. These models describe organizational growth as a progression from ad-hoc, hero-dependent practices toward defined, managed, and eventually optimized systems. Early-stage organizations typically rely on the extraordinary effort of individuals to achieve results, whereas mature organizations rely on institutionalized procedures and continuous monitoring (PMI, 2021).

The digital requisition process at S-Line International currently reflects the characteristics of an early-stage maturity model. While functional, it is overly dependent on personal initiative. To manage increasing project complexity and sustain growth, the department must advance its maturity by adopting formal SOPs,

performance monitoring tools, and feedback loops. This theoretical alignment demonstrates that structured oversight does not constrain innovation; rather, it provides the stable foundation necessary for innovation to flourish in a sustainable, scalable, and controlled manner.

III. CONTEXTUALIZATION OF THE R&D ORGANIZATION ENVIRONMENT

The contextualization of the Research and Development (R&D) ecosystem at S-Line International requires an intricate understanding of the friction between volatile external market forces and the internal administrative structures designed to harness innovation. For a prominent manufacturer in the food and beverage industry, the R&D landscape is far from a static, isolated laboratory; rather, it functions as a high-stakes intersection where scientific experimentation, stringent regulatory mandates, and aggressive market demands collide. To manage this complexity, the organization must align its internal behaviors with the external realities of a global supply chain that leaves little room for error or delay.

The Market Context: Competitive Velocity and Consumer Trends

S-Line International Inc. is positioned within the hyper-competitive Food and Beverage (F&B) sector, an arena characterized by a relentless pace of change and ephemeral consumer preferences. In this climate, R&D is not merely a support function but the primary engine for corporate survival. The organizational environment is dictated by the imperative of "Speed-to-Market," where the temporal window to capitalize on emerging trends—such as the surge in plant-based proteins or the demand for low-glycemic, "clean label" sweeteners—is remarkably narrow. This external pressure forces the R&D department to execute New Product Development (NPD) with both high precision and extreme velocity. However, in the absence of a robust digital governance framework, these external demands manifest internally as "operational friction," where the current reliance on informal shared folders creates significant bottlenecks that stall innovation.

The Internal Policy Environment: The Evolution from Organic to Formal Systems

Currently, the R&D environment at S-Line International is undergoing a profound organizational transition. Historically, the department thrived on an "organic" and informal communication model, which is often typical of agile, early-stage growth firms. While this flexibility served the company in its infancy, the sheer increase in project volume and complexity has transformed this informality into a strategic liability. From a policy perspective, S-Line International is currently navigating a "Governance Gap," wherein the lack of a formalized Standard Operating Procedure (SOP) fosters a culture of administrative ambiguity. According to public administration theory, when an entity fails to establish a documented and sustained course of action, it inadvertently adopts a "policy of inaction," effectively leaving project outcomes and quality control to chance rather than deliberate strategic design (Villamejor-Mendoza, 1998).

The Technical Environment: Ensuring Data Integrity and Traceability

In the landscape of modern food science, the R&D environment is inextricably linked to a Regulatory and Compliance Environment. Every experimental formulation, minor ingredient substitution, and longitudinal laboratory trial must be meticulously documented to ensure consumer safety, satisfy international labeling standards, and survive rigorous audits. S-Line International's current digital infrastructure, which lacks automated audit trails and robust version control, creates an unacceptable risk to Data Integrity. Contemporary R&D management necessitates a shift toward "Knowledge Governance," a paradigm where intellectual property is treated as a core asset that must be securely archived and accurately tracked throughout its entire lifecycle to

prevent the loss of institutional memory or technical errors (Davenport & Prusak, 1998).

The Collaborative Environment: Institutionalizing Cross-Functional Synergy

Finally, the R&D department does not function in a vacuum; it exists within a highly interdependent collaborative environment. The department is reliant on Sales Managers for accurate market intelligence and initial project requisitions, while subsequent stages require coordination with Finance, Research and Development and Production units. The current lack of a "Single Source of Truth" for project tracking fractures these inter-departmental relationships, leading to miscommunication and misaligned expectations. To rectify this, the environment requires the implementation of a "Stage-Gate" framework, a theoretical model that synchronizes disparate units by moving them in lockstep through defined, authorized phases of the innovation lifecycle (Cooper, 1990). By formalizing its SOPs, S-Line International aims to migrate its organizational climate away from fragmented, ad-hoc coordination toward a future of institutionalized, high-efficiency collaboration.

IV. METHODOLOGY

To achieve the study's goal of institutionalizing a formal Standard Operating Procedure (SOP) at S-Line International, the methodology is anchored in a qualitative-descriptive research design integrated with an action research framework. This dual-layered approach is specifically selected because it allows for a nuanced exploration of the variables driving current organizational behaviors while simultaneously facilitating the practical execution of a structured operational solution.

By utilizing a qualitative-descriptive lens, the researcher can document the existing informal requisition landscape, capturing the subtle complexities of human interaction and systemic failures that quantitative data alone might overlook. This descriptive depth is vital for building an empirical baseline of reality that reflects the actual challenges faced by the Research & Development (R&D) and Sales teams.

The integration of an action research framework elevates the study from a purely academic observation to a dynamic organizational intervention. Action research is inherently cyclical, involving a continuous loop of diagnosing, planning, taking action, and evaluating (Susman and Evered, 1978). This iterative process is perfectly suited for bridging the current governance gap, as it allows the researcher to work alongside internal stakeholders to pilot and refine the proposed digital protocols in real-time. This ensures that the resulting SOP is not a rigid, top-down mandate, but a functional, adaptive document that has been tested against the specific operational pressures of the food and beverage industry.

Furthermore, the methodology is organized into several strategic, sequential phases designed to move the organization toward a state of disciplined digital

governance. Each phase is mapped to a specific research objective, ensuring that every design choice—from accountability matrices to data security protocols—is backed by empirical evidence gathered from the field. By combining qualitative inquiry with the proactive nature of action research, the study provides a robust justification for formalization, demonstrating that a systematic framework is necessary to protect the integrity of the firm's innovation lifecycle and enhance its long-term competitive performance.

Data Collection

The data collection for this study relied on qualitative research tools and process diagnostics designed to capture the realities of the current workflow. Three primary methods provided a comprehensive view of daily operations:

1. Semi Structure Interviews and Focus Group Discussions (FGDs)

The primary qualitative tools consisted of face-to-face and digital interactive sessions with the department personnel. These open-ended discussions allowed staff to describe how a new product idea transitions from an initial sales lead into physical development. Participants outlined their daily routines, the software utilities they handle, and specific execution stages where tasks stall. The interviews targeted precise metrics regarding task duration, handoff points, and software constraints, helping locate critical friction points—especially during the manual transfer of files between sales personnel and technical staff.

2. Direct Process Observation

To validate the interview claims, the study tracked actual project files in real time. This involved monitoring how teams share folders, populate spreadsheet data, and log product-specific details. Observing these digital workflows revealed precisely where information gaps occur, when timelines stall, and how a lack of automated tracking compromises overall team velocity.

3. Operational Metrics and Document Diagnostic

To construct a comprehensive map of existing process gaps, the study gathered three main types of qualitative and operational data:

- **Process Performance Metrics:** Operational data was gathered to evaluate the speed of the current pipeline. This included tracking the standard 14-day target for creating initial product samples post-sales request, as well as total project turnaround times compared against the corporate benchmark of a six-month development window.
- **Workflow mapping data:** The study collected descriptive data to map task sequences from inception to completion. This traced a project's trajectory from the initial sales meeting, through kitchen trials, and up to larger pilot production runs. The data highlighted the technical milestones required prior to mass production, such as running 50-to-100-kilogram batches to validate product behavior.
- **System touchpoint logs:** This data focused on the transmission of technical records through the organization. It tracked how files such as test reports, base formulas, and pricing structures are managed, demonstrating how these details

move across manual spreadsheets and shared folders before entry into the central system.

A total of eight (n=8) key stakeholders from the R&D and Sales departments participated in the data collection process, representing the core team responsible for transforming client concepts into finished goods.

- One (1) Research and Development Head - provided critical insight regarding resource management, project approvals, and top-level management alignment. These responses linked directly to findings on total project turnaround times and scheduling goals.
- Three (3) Research and Development staff - provided detailed feedback on benchwork, kitchen trials, pilot scaling, and technical documentation creation. Their inputs linked directly to logs on technical records handling and pilot trial capacities.
- Four (4) Sales Managers - explained client needs, market benchmarks, and difficulties of gathering full product profiles at the start of the project lifecycle. Their feedback linked to metrics tracking the 14-day sample window and initial workflow mapping data.

Data analysis

Using the collected data and the R&D management frame as previously discussed, the study proceeded with the following analytical phases.

Phase I: Diagnostic Assessment and Workflow Mapping

To satisfy the primary research objective of meticulously documenting and evaluating the existing digital requisition ecosystem, the methodology conducted a comprehensive process audit and stakeholder inquiry. This phase is designed to conduct a granular "As-Is" mapping of the shared-folder environment, which serves as a diagnostic "X-ray" of the current operational state. By tracing the journey of a request from its inception to its storage, the researcher can pinpoint latent bottlenecks, unnecessary redundancies, and critical procedural gaps that impede productivity. This technical audit is not merely an inventory of files but a structural analysis of how information flows—or fails to flow—within the current unregulated digital architecture.

To complement the technical audit, the study gathered rich qualitative data through semi-structured interviews and focused group discussions (FGD) involving key Sales Managers and R&D leads. This approach captures the unique perceptions, frustrations, and "lived experiences" of the personnel who navigate the system daily. By listening to these primary stakeholders, the researcher can identify the "hidden" cultural and behavioral factors—such as informal workarounds or a lack of perceived urgency regarding version control—that contribute significantly to data mismanagement. Understanding these nuances is essential; technical failures are often symptoms of deeper organizational habits that an SOP must address to be effective.

Ultimately, this diagnostic phase establishes a rigorous empirical baseline that serves as the evidentiary foundation for the entire study. It transforms anecdotal complaints into documented data, providing the necessary justification for an institutional shift toward formalization. By grounding the research in this baseline, the study ensures that the proposed Standard Operating Procedure (SOP) is not a generic

template, but a bespoke solution engineered specifically to resolve the documented inefficiencies and "pain points" unique to S-Line International (Sanchis et al., 2020). This phase bridges the gap between identifying a problem and designing a targeted, strategic intervention.

Phase II: Structural Design of the Standardized SOP

The second phase of the methodology shifts from diagnostic analysis to the proactive engineering of a formalized governing framework. This stage is dedicated to fulfilling the core objective of developing a standardized, step-by-step Standard Operating Procedure (SOP) that serves as the "To-Be" workflow for the department. To ensure this design is rooted in industry-leading innovation practices, the study utilizes the Stage-Gate Model (Cooper, 1990) as its primary theoretical blueprint. By adopting this model, the methodology transitions the R&D process from a continuous, unregulated stream into a disciplined series of manageable segments, each designed to maximize quality control and resource efficiency.

The design process Operating Procedures meticulously categorizes the lifecycle of a digital requisition into five distinct and sequential phases: Intake, Technical Review, Development, Validation, and Closure. Unlike the current informal system, where the progression of a project is often ambiguous, this new architecture defines each stage with rigorous entry and exit criteria. These gates act as critical quality checkpoints, ensuring that a project cannot proceed to the next level of resource investment until it has satisfied specific documentation and approval requirements. This systematic partitioning of the workflow justifies the institutional shift toward a structured roadmap, providing the R&D team with a clear, predictable path from the inception of an idea to the delivery of a finished product.

By detailing these granular steps, the methodology provides a robust defense against the inefficiencies of the previous "ad-hoc" arrangement. The implementation of a standardized procedure is specifically designed to mitigate process variability, which is a frequent precursor to inconsistent product quality and wasted materials. Furthermore, by formalizing the hand-offs between stages, this phase aims to eliminate the "hidden delays" currently embedded in the informal shared-folder system—delays often caused by missing information or pending unauthorized reviews. Ultimately, this structural design phase ensures that every digital request at S-Line International undergoes a uniform, high-standard evaluation process, thereby protecting the integrity of the innovation pipeline.

Phase III: Institutionalizing Accountability through Role Formalization

The third phase of the methodology is dedicated to resolving the critical issue of organizational ambiguity by formalizing the human infrastructure of the R&D process. To fulfill the objective of defining precise roles and responsibilities, the research incorporates a RACI (Responsible, Accountable, Consulted, and Informed) Matrix analysis. This analytical tool serves as a high-resolution lens used to dissect the complex interactions between Sales, R&D staff, the R&D Head, Finance and Production personnel at every microscopic stage of the digital request lifecycle. By moving beyond generic job descriptions, the RACI framework assigns specific duties to every task, ensuring that there is never a doubt as to who "owns" a deliverable or who must be provided with critical updates before a project can advance.

The primary strategic goal of mapping these roles is to eliminate the detrimental "ownership gaps" that currently plague the department. In the existing informal system, projects often languish in a structural blind spot where both Sales and R&D assume

the other is taking the lead, resulting in avoidable stagnation and missed client deadlines. This phase of the methodology justifies the necessity of clear role definitions as a fundamental prerequisite for successful institutional collaboration. By codifying these expectations within the SOP, the research creates a transparent environment where performance can be objectively measured and where cross-functional friction is minimized through predefined communication protocols.

Furthermore, this institutionalization of accountability is rooted in the theoretical understanding that a high-functioning organization is more than just a group of skilled individuals; it is a system of coordinated actions. As Villamejor-Mendoza (1998) posits, such formalization is transformative, evolving a disparate collection of individual actions into a sustained and predictable course of organizational policy. By embedding the RACI matrix into the digital workflow, S-Line International replaces the unpredictability of personal initiative with the reliability of a governed system. This ensures that the R&D lifecycle is not dependent on the memory or availability of a few key individuals, but is instead supported by a resilient structure of documented accountability.

Phase IV: Engineering the Tracking and Monitoring Framework

The fourth phase of the methodology addresses the vital need for organizational transparency by developing a robust, structured tracking mechanism. To satisfy the objective of creating a reliable oversight system, the study utilizes advanced process instrumentation and visualization techniques. The core of this phase involves the conceptual design and implementation of a centralized digital log or management dashboard, intended to serve as the organization's "single source of truth." By consolidating all project data into a unified interface, the methodology

effectively replaces the current fragmented system—where information is buried across disconnected digital folders—with a streamlined portal that offers a real-time, high-definition view of the entire innovation pipeline.

A critical component of this engineering phase is the rigorous definition of Key Performance Indicators (KPIs) tailored specifically to the R&D lifecycle. The study identifies and integrates metrics such as request lead times, phase-to-phase transition speeds, and milestone completion rates. These data points allow for the continuous monitoring of project health, enabling the department to move beyond anecdotal progress reports and toward data-driven performance assessments. By moving away from time-consuming and error-prone manual folder searches, this mechanism provides the high-level visibility required for strategic workload forecasting. This ensures that the R&D department can manage fluctuating project volumes with agility, allocating resources where they are most needed based on empirical evidence rather than intuition.

Ultimately, the development of this monitoring framework is justified by the fundamental management principle that transparency is the primary driver of efficiency in complex, high-stakes R&D environments. When workflows are visible and measurable, the "information silos" that typically hinder large-scale manufacturing projects are dismantled. This phase empowers leadership at S-Line International to shift from a reactive management style—where issues are addressed only after they cause delays—to a proactive intervention model. With real-time data at their fingertips, managers can identify emerging bottlenecks, re-balance personnel assignments, and adjust timelines before operational friction impacts the bottom line, thereby ensuring a fluid and reliable path from product conception to commercialization.

To transition this monitoring framework from a conceptual baseline into a live, engineered system, this phase establishes a structured evaluation matrix to guide the final software selection. Drawing from frameworks in technology acquisition and enterprise architecture lifecycle management (Sanchis et al., 2020; Davenport and Prusak, 1998), the study evaluates available digital options against four critical corporate dimensions:

1. **Functional Alignment:** Evaluated as the core software architectural capacity to enforce mandatory upstream Stage-Gate criteria, secure technical parameters, and codify precise accountability workflows natively within the operational layout (Cooper, 2021).
2. **Implementation Speed and Agility:** Defined as the total operational velocity required to map local physical processes—specifically the transition of manual intake assets like *S-Line International Form 26-001*—into live, functional digital workflows without extensive development timelines.
3. **Data Security and Audit Integrity:** Assessed as the structural presence of immutable, system-generated tracking logs, role-based access control (RBAC), and rigorous version locking to safeguard proprietary technical intellectual property, benchmarked against international electronic record standards (U.S. FDA, 2018; 21 CFR Part 11).
4. **Total Cost of Ownership (TCO):** Analyzed as the cumulative financial impact across the software lifecycle, encompassing upfront infrastructure acquisition, recurring licensing models, and the specialized engineering labor hours required for long-term maintenance.

Phase V: Establishing Data Governance and Security Protocols

The final phase of the methodology is dedicated to the critical preservation of organizational intelligence through the establishment of rigorous data control and protection measures. To fulfill the objective of ensuring information reliability, the research conducts a risk-based security analysis of the entire digital information lifecycle. This analytical process maps the flow of sensitive data from the initial entry of a client requisition to the final archival of a product formula, identifying specific "vulnerability nodes" where data integrity is currently threatened. By pinpointing exactly where the shared-folder system is susceptible to unauthorized editing, accidental deletions, or the confusion of multiple un-versioned drafts, the study can engineer precise, mitigating controls that are seamlessly embedded into the fabric of the new Standard Operating Procedure (SOP).

To address these identified risks, the methodology designs a multi-layered security protocol that replaces the current "open-access" culture with a disciplined knowledge governance framework. These protocols include the implementation of restricted access permissions, ensuring that only authorized personnel can modify technical specifications, and the adoption of standardized file-naming conventions to eliminate the ambiguity of file versions. Most importantly, the study establishes mandatory audit trails, creating a chronological and immutable record of every change made to a project file. This ensures that the R&D department can operate with "information trust," knowing that the data used for laboratory trials and production scaling is both accurate and current.

The justification for this phase is rooted in the strategic necessity of protecting the company's competitive edge. In the food and beverage industry, proprietary formulations and technical processes represent the most valuable assets a firm

possesses. As Davenport and Prusak (1998) argue, effective organizational performance is inextricably linked to how a firm codifies and secures its knowledge assets. By prioritizing these security protocols, the research ensures that S-Line International's technical intellectual property is not merely "stored" but is actively protected as a core strategic asset. This rigorous approach to data governance not only prevents costly operational errors but also ensures the organization remains resilient and compliant within an increasingly stringent regulatory and digital landscape.

V. RESULTS AND DISCUSSIONS

A. DIAGNOSTICS AND DIGITAL R&D REQUISITION PROCEDURES DESIGN

1. Diagnostic Analysis

S-Line International faces serious operational risk in its New Product Development (NPD) process. The company manages this high-stakes work informally, relying on scattered, static shared folders instead of automated workflows. Without a connected system, cross-functional departments cannot collaborate reliably. This lack of architectural structure creates operational errors that frequently degrade the agility of food and beverage firms (Cooper, 2021).

To diagnose these structural roots, the study mapped the "As-Is" operations and interviewed the R&D Head, R&D staff, and Sales Managers. The empirical findings reveal acute vulnerabilities across communication protocols, data management systems, and daily tracking mechanisms.

a. Structural Deficiencies and the Governance Gap

The organization's foundational operational problem is the total absence of a formalized Standard Operating Procedure (SOP) built on a Stage-Gate methodology. High-performing research and development teams treat product development as a strict, phased strategy, setting rigid criteria for when a project can transition from one stage of resource investment to the next (Cooper, 2021). While the company maintains a legacy, paper-based SOP framework, it lacks the automation necessary to integrate cross-departmental operations.

i. The "Tribal Knowledge" Trap and Siloed Communication

This lack of procedural control creates an acute vulnerability because the organization relies on individual memory instead of structural records. Crucial technical parameters, raw material specifications, and core processing skills stay trapped within the minds of a few veteran employees. If these key workers leave the organization, the systemic knowledge of how to manufacture specific formulations disappears. Consequently, the firm wastes months re-engineering solutions it had already successfully discovered in the past (Nonaka and Takeuchi, 1995).

Process mapping revealed a major breakdown in early teamwork between Sales Managers and Product Developers. Under the current setup, after a Sales Manager fills out a physical product request form, they must use unofficial, ad-hoc communication channels to prompt action from the technical team. As mentioned by a participant in the study:

“There is an urgent need to integrate forms and streamline communication between the Sales Manager and Product Developer from the very start. Right now, sharing product briefs, client deals, and feedback happens by hand. This manual work creates gaps, making it hard to turn customer needs into lab tasks.” (Interview, Key Informant A - R&D Head)

ii. Absence of Quality Gates & Unidentified Stakeholders Outputs

Without formal checkpoints, the company cannot systematically evaluate whether an incoming project is technically viable or financially sound. In a structured Stage-Gate system, a project must prove it is cost-effective, complies with regulatory frameworks, and meets clear market demands before advancing into laboratory

development (Cooper, 2021). Without these explicit validation rules, unviable concepts remain active.

Interview data with the R&D Head and R&D staff confirmed this vulnerability: the team frequently initiates kitchen and bench trials without prior raw material costing or regulatory screening. R&D personnel noted that they regularly spend days formulating concepts that are later abandoned during pilot scaling because the target ingredient costs exceed the client's budget, or because the formulation violates regional food safety regulations.

These failing projects actively waste R&D instrumentation, capital, and labor hours that should be allocated to high-potential innovations instead. Furthermore, feedback from the four Sales Managers highlighted a deep structural disconnect at the front end of the pipeline: because there is no standardized "gate" forcing the collection of a complete product profile at inception, sales personnel often submit vague requests based on brief client conversations.

Consequently, the current setup fails to define expected technical outcomes, regulatory boundaries, or clear staff ownership from the initial digital request to final sign-off. This lack of upstream discipline forces R&D to work with incomplete assumptions, driving the operational inefficiencies observed in the shared-folder environment.

b. The R&D "Black Box": Shared Folder and Manual System Dependency

The company's R&D team stores its development files in static shared folders. This system acts as a passive storage space rather than an active workflow tracking

engine. Other departments cannot see into this operational "black box", causing factory execution errors and wasting specialized labor hours.

i. Version Control and Code Chaos

Typically, Sales Managers upload product details into a shared folder, which R&D staff then open to reference benchmarks, packaging details, and formulas. This legacy storage architecture makes it difficult to manage critical product codes, raw material tracking numbers, and recipes. In the consumer goods industry, working out of un-versioned spreadsheets within a shared drive halts procurement planning and causes massive batch failures during factory production (Benbasat et al., 1987). This is evident in the accounts of the following participants:

“We rely heavily on shared folders to reference benchmarks, packaging details, and formulas during development. However, managing these files manually via Excel leaves us vulnerable. A fully digital solution is highly preferred over manual Excel tracking to streamline data input, eliminate errors, and lock in approved data.” (Interview, Key Informant B - Sales Manager)

“We once mixed a pilot batch using an outdated spreadsheet from the shared drive because three different versions were named ‘Final’. It cost us two days of production time and discarded raw materials.” (Interview, Key Informant C - R&D staff)

ii. Administrative Tracking Burden

Empirical management data shows that R&D staff working within unorganized digital spaces lose up to 20% of their operational velocity simply searching for the

correct document iterations (Davenport and Prusak, 1998). Under the current system, tracking progress forces staff to type operational updates by hand into a centralized Excel log. They must manually change text labels from "Received" to "Pending Head Evaluation" and then to "COMPLETED." This administrative workload keeps technical staff away from product testing, forcing them to manage spreadsheets instead of executing bench chemistry.

c. Operational and Strategic Fallout

The absence of a centralized digital requisition platform at S-Line International has cascading effects across multiple departments. Without a standardized New Product Development (NPD) lifecycle management tool, both strategic planning and daily operations suffer from systemic inefficiencies. These structural gaps compromise the organization's ability to efficiently allocate resources and seamlessly transition projects from the laboratory to the production floor.

i. "Squeaky Wheel" Prioritization vs. Resource Classification

The company assigns tools and staff based on urgent pressure rather than structured data or a clear commercial strategy (Cooper, 2021). Internal workflows rely on unwritten, informal rules where R&D casually labels requests as either a "Minor Tweak" for small adjustments or a "New Innovation" for starting from scratch. However, the shared-folder system cannot track total capacity or quantify how much work the team can handle at any given time.

Interview feedback from the four Sales Managers and three R&D staff confirmed that this lack of systemic visibility creates a "squeaky wheel" dynamic. R&D staff noted that they are frequently pulled away from active benchwork because a

salesperson follows up aggressively on a recent request. Because the pipeline lacks an automated queue or formal prioritization matrix, urgent, last-minute sales requests constantly push aside valuable, long-term development ideas, leaving R&D in a reactive loop.

ii. Cross-Functional Notification Bottlenecks

Under the current manual setup, once the R&D Head marks a project as "COMPLETED" on their local tracking sheet, they must remember to manually notify the separate Finance (Costing) and Production departments to initiate commercial costings and factory viability checks.

Institutional data and process observations revealed that this total reliance on human memory creates critical operational blind spots. Because notifications depend entirely on ad-hoc emails or chat messages, handoffs frequently fall through the cracks. The R&D Head noted that completed formulations sometimes sit in shared folders for days before the Costing team is notified. This communication breakdown directly stalls production costing, delays formal sample testing, and severely compromises the company's ability to issue timely quotes to competitive client accounts.

iii. Timeline Slippage and Scale-up Constraint

The R&D team operates within compressed operational targets to develop prototypes and execute factory scale-up trials, rapidly transitioning from small kitchen batches to larger 50-to-100-kilogram pilot lots. Still, the reliance on disconnected files makes it nearly impossible to accurately track cumulative project lifecycles.

Operational data gathered from pipeline logs highlights a severe baseline gap: the company frequently misses its standard 14-day target for initial product samples, while total project turnaround times routinely exceed the six-month development window. Research indicates that a six-month delay in launching a new product can cut its lifetime profits significantly (Cooper and Edgett, 2008). To mitigate these costly timeline slippages and eliminate technical bottlenecks during the critical 50-to-100kg scaling phase, the company must migrate its manual rules into a connected digital requisition architecture.

d. Integrative analysis

To bridge the gap between identifying operational symptoms and engineering a localized structural intervention, this section provides an integrated synthesis of the process mapping and diagnostic findings discussed above. The empirical evidence gathered from the eight core stakeholders reveals that the operational bottlenecks at S-Line International are not isolated software glitches, but systemic vulnerabilities stemming from an unregulated digital architecture. By analyzing the "As-Is" workflow alongside qualitative narratives, the study identifies a compounding loop of inefficiency where structural gaps directly fuel behavioral workarounds.

The relationship between these diagnostic discoveries, impacted organizational roles, and the required digital system correctives is summarized in table 5.1.

Table 5.1

Matrix of Process Diagnostic Digital Interventions

Workflow Domain	Diagnostic Findings and Empirical Evidence	Impacted Stakeholders	Proposed Digital Mitigation
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Project Inception and Gating	Absence of upfront checkpoints; vague sales briefs submitted without raw material costing or regulatory screening; formulations fail late during pilot scaling.	Sales Managers (n=4) R&D Staff (n=3)	Gate 1 Standardization: Mandatory digital intake fields requiring baseline commercial and regulatory parameters before queue visibility.
Resource Allocation	"Squeaky Wheel" prioritization; unclassified capacity tracking allows aggressive follow-ups to constantly derail long-term innovations.	R&D Staff (n=3) R&D Head (n=1)	Capacity & Queue Automation: Centralized platform dashboard tracking active workloads, replacing manual tracking with an automated prioritization matrix.
Cross-Functional Handoffs	"COMPLETED" status updates rely on human memory and ad-hoc chat notifications; formulations stall in shared folders before Finance/Production are alerted.	R&D Head (n=1) Finance & Production	Automated Workflow Routing: System-driven triggers that instantly dispatch formulation data to costing and plant teams upon status modification.
Lifecycle Execution	Timeline slippage across the 14-day sample window and 6-month launch target; untracked project velocities during 50–100kg pilot runs.)	Entire Core Team (n=8)	End-to-End Milestone Tracking: Live digital tracking logging development speeds against corporate benchmarks to eliminate operational drag.

This structural breakdown highlights that technical failures—such as version control chaos or missing the 14-day sample window—are direct symptoms of a deeper "governance gap." The current dependency on passive shared folders forces a highly

qualified technical and commercial team to burn up to 20% of their operational velocity on manual administrative tracking.

Furthermore, the friction observed between the Sales and R&D departments is a logical consequence of this structural layout: Sales managers operate without an objective quality intake gate, while R&D personnel lack an automated shield to protect their bench capacity. As a result, proprietary organizational knowledge remains dangerously siloed within the minds of individual veterans, exposing the firm to severe "tribal knowledge" vulnerabilities if key personnel depart.

Ultimately, this diagnostic baseline transforms localized, anecdotal complaints into documented process gaps. It establishes the empirical foundation required to transition S-Line International from a state of reactive manual habit into a structured framework of disciplined digital governance. By consolidating these findings, the study establishes the explicit operational requirements needed to develop the formalized, "To-Be" workflow detailed in the succeeding design subsections.

2. Structural Design of the Standardized SOP

a. Guiding Principles

To move S-Line International from its manual state to a disciplined innovation hub, the system design is structurally anchored in Cooper's (1990) Stage-Gate Model. This framework shifts product development from an unregulated stream of files into a series of distinct stages punctuated by rigorous quality check gates. By digitizing these boundaries, the system replaces informal habits with automated process discipline.

1. *Enforced Quality Gates* - the new tool must automatically verifies all technical checkpoints in the SOP before a request can move forward, This includes checking of restricted materials and matching.
2. *One Central Source of Truth* - the software must pack all project files, supplier briefs, active recipes, and file histories into a single space. This change makes manual spreadsheet tracking obsolete.
3. *Connected Teams* - it needs to instantly share data and route tasks between Sales, R&D Finance, and Production the moment the team hits a goal or clears a gate.
4. *Data Integrity and Accountability* - to eliminate ambiguity and structural friction, the system must show clear details on project ownership, target timelines, and staff duties at every single step of the requisition lifecycle (Villamejor-Mendoza, 1998). Every active request is hard-coded to a specific owner based on a predefined role-responsibility framework, preventing tasks from languishing in cross-departmental blind spots. Furthermore, target timelines are locked into the system configuration, allowing for automated escalation alerts when milestones are threatened and ensuring that personal accountability is maintained from initial data entry through laboratory development and final operational sign-off.

b. Formal Policies

These new rules establish strict management practices across the company. They control data rights, regulatory boundaries, and operational work steps regardless of the technical infrastructure used.

Digital Intake Mandate - the organization shall only recognize, evaluate, or process a product request if it is initiated inside the official application portal. The request must include complete, verified client criteria and fit into a clear development category (e.g., Minor Tweak or New Innovation).

Automated Constraint Clearance Policy - the system must automatically block or flag any incoming requisition that specifies restricted raw materials or manufacturing processes that exceed plant capability. This operational gate prevents non-viable concepts from advancing into development.

Data Ownership and Access Control Policy - personnel can only edit data fields within their designated operational phase. Sales holds exclusive write permissions during the request initiation phase. R&D maintains final editing rights during the pre-screening, feasibility, and pilot-scaling phases. Finance and Production are granted read access to technical files with write permissions restricted to their specific costing and facility note areas.

Triggered Notification and Zero-Lag Policy - staff will no longer send updates by hand. The moment R&D updates a project state to "COMPLETED" within the database, the engine must instantly route the verified formulation data to Finance and Production for concurrent cost and manufacturing reviews.

Immutable Revision and Audit Trail Policy - once an active recipe or product brief is saved to the central repository, any subsequent technical adjustments, material substitutions, or profile shifts must generate an immutable, system-authored log. This record will permanently capture the User ID, exact timestamp, and delta changes.

c. Standardized Procedures (RACI)

The operational matrix in Table 5.2 puts these formal policies into action, transitioning the manual workflow into an automated, role-governed process.

Table 5.2

NPD Requisition Workflow RACI Matrix

Phase / Milestone	Sales Manager	R&D Staff	R&D Head	Finance	Production	Executive Management
1.Request Initiation & Form Submission	A	I	I	I	I	I
2.Pre-Screening & Technical Audit	I	R	A	I	I	I
3.Feasibility & Authorization Review	C	R	A	I	I	I
4.Costing& Production Notification	I	I	R	A	A	I
5.Pilot Run Scaling	I	R	C	I	A	I
6. Final Executive Sign-off	I	I	C	I	I	A

R = Responsible | **A** = Accountable (Ultimate Approver) | **C** = Consulted | **I** = Informed

d. Tracking and Control Mechanism

The tracking framework replaces manual spreadsheet logs with a system-driven data control structure:

i. System-Driven State Transitions

Tracking status labels like "Received," "Pending Head Evaluation," and "COMPLETED" update automatically based on form validation and digital signatures. This programmatic adjustment removes manual data entry errors.

ii. Cross-Departmental SLA Monitoring

Built-in timers track the operational velocity of cross-departmental handoffs. The moment the R&D Head approves a feasibility review, the engine dispatches automated Service Level Agreement (SLA) alerts to Finance and Production to measure response times against corporate benchmarks.

iii. Security Control & Tamper-Proofing

Every modification to a product brief, raw material matrix, or recipe log generates a permanent historical record. This tracking asset saves the unique User ID, the exact modifications, and the calendar timestamp to safeguard intellectual property.

e. Platform Specifications and Technology Justification

Now that the diagnostic needs, guiding principles, formal policies, and tracking rules are set, this section reviews and explains the final software choice to run the new digital setup.

i. Evaluation Criteria for Platform Selection

To identify the optimal solution that minimizes financial exposure while enforcing strict structural rules, the study evaluated three distinct technology paths: **Custom Code Development**, **External Proprietary Product Lifecycle Management (PLM) Software**, and **Low-Code Application Ecosystems**.

These platforms were analyzed using the four core corporate dimensions established in the methodology framework, drawn from technology lifecycle literature (Davenport and Prusak, 1998):

1. **Functional Alignment:** This dimension evaluates the software's native ability to enforce Stage-Gate quality checks, automate back-end routing, and lock in staff responsibilities directly out of the box (Cooper, 2021). Custom coding offers unlimited layout flexibility but requires constructing every validation rule from scratch. Proprietary PLM software provides highly specialized, ready-made food and beverage architectures but introduces rigid structures that struggle to adapt to S-Line's localized cross-departmental operations. Conversely, Low-Code Application Ecosystems strike a precise balance, offering customizable, ready-made components that seamlessly embed the required RACI accountability matrix rules directly into the workflow.
2. **Implementation Speed and Agility:** This metric measures the operational time and configuration agility needed to transform physical, manual assets—

specifically *S-Line International Form 26-001* and its associated handoff procedures—into live, active digital operations. Custom programming routes demand extensive code writing, debugging, and lengthy development cycles, heavily delaying deployment. Proprietary PLMs shorten this deployment path but often require costly external consultants to configure local variables. Low-Code environments excel in this area by using visual, drag-and-drop design canvases that allow the rapid digitization of Form 26-001 and its logic gates within weeks. .

3. **Data Security and Audit Integrity:** This criterion examines the system's native architectural power to maintain unchangeable, system-generated tracking logs, robust security roles, and strict access controls to protect proprietary formulations, drawing from global electronic system compliance standards (U.S. FDA, 2018; 21 CFR Part 11). While custom code can be engineered to be highly secure, it remains vulnerable to human error during manual security patching. Proprietary PLM systems provide enterprise-grade, ironclad data encryption and version control, though at a significant premium. Low-Code ecosystems offer built-in, governance-approved security layers, delivering automatic version history tracking and immutable audit trails across shared tenant environments without complex infrastructure management.
4. **Total Cost of Ownership (TCO):** This structural dimension assesses total capital expenditure, including immediate infrastructure acquisition, recurring software licensing fees, and specialized engineering labor. Custom code carries an unpredictable, high TCO due to its total reliance on expensive software developers for every routine workflow adjustment. External Proprietary PLM options present a prohibitive cost profile, driven by aggressive

per-user licensing fees and steep integration outlays that often strain mid-market corporate budgets. Low-Code Application Ecosystems offer a highly optimized TCO by leveraging pre-existing enterprise cloud subscriptions and utilizing visual development tools that allow internal systems officers to handle long-term maintenance.

ii. Evaluation ratings

To select the optimal technology infrastructure, the options were scored across the four core dimensions. Maximum ratings were awarded to platforms demonstrating close functional alignment, rapid deployment velocities, robust data governance, and minimized license overhead. All three options satisfied the mandatory safety baselines.

Critical analytical weight was applied to implementation speed and lifecycle cost. Options 1 and 2 were rejected due to extended development schedules and prohibitive capital requirements. Option 3 emerged as the optimal choice by leveraging the organization's existing enterprise cloud subscription architecture, significantly reducing upfront development costs and deployment timelines.

Table 5.3*Technology Stack Justification Matrix*

Selection Criteria	Option 1 : Custom Code Development (e.g., .NET/SQL)	Option 2: Proprietary PLM Software (Food Specific)	Option 3: Code Cloud Ecosystem(Micros oft Power Platform)
Functional Alignment	High (Built to Order)	Medium (Hard to change to fit S- Line International)	High (Matches S- Line International stage and forms easily)
Implementation Speed	Low (Takes months to build and test)	Medium (Requires long vendor setups)	High (Built quickly using visual builders)
Security & Audit Integrity	High (Requires manual security coding)	High (Built-in enterprise compliance)	High (Uses existing company logins and logs edit)
Total Cost	Low (High developer costs)	Low (Expensive license fees)	High (Uses licenses the company already owns)
Decision Result	Rejected (Too costly and slow)	Rejected (Too rigid and pricy)	Selected (Best choice for security, speed and cost)

Based on the evaluation matrix, a low-code, cloud native application framework is specified to execute S-Line International's design without expensive infrastructure overhead.

iii. Automated Requisition System Architecture

The framework outlines the digital routing and approval stages for new product development requests. By transitioning from a manual intake method to a structured

digital architecture using the Microsoft Power Platform, the R&D department minimizes administrative bottlenecks and enforces strict data governance. For the R&D organization, this digital pipeline ensures that every incoming brief is automatically pre-screened for restricted materials and dynamically routed to the appropriate stakeholders without manual intervention. Ultimately, this system protects R&D bandwidth, ensures all required project parameters are complete before benchwork begins, and creates a seamless, cross-functional data handoff upon completion.

Table 5.4

Process Flow & Stage Breakdown

Process Stage	Application / Platform	Automated Actions & Outputs
1.Request Intake	Sales: Power Apps Portal	Captures the request via the standardized S-Line Form 26-001 Intake .
2. Engine Processing	Power Automate Engine	<p>Programmatic Pre-Screening: Automatically conducts a restricted material audit on the requested formulation.</p> <p>Dynamic Routing: Escalates and routes the digital brief from R&D Personnel up to the R&D Head.</p>
3.Data Finalization	SharePoint Online DB	Automated Status Lock: Secures the final record and flags it as "COMPLETED."

Front-End Interface (Power Apps) - this layer translates the complete operational parameters of *S-Line International Form 26-001* into a responsive digital application canvas. It replaces the legacy paper and spreadsheet inputs with a unified web interface featuring conditional drop-down menus for project classifications, mandatory file attachments for client briefs, and single sign-on (SSO) authentication using active corporate credentials.

Workflow Orchestration Engine (Power Automate) - this component drives the back-end processing logic established in the standardized SOP rules. Upon user submission, the engine executes the pre-screening logic, prompts the technical team via integrated workspace alerts, and manages the escalation paths if a brief is systematically flagged as incomplete or returned to Sales for clarification.

Data Architecture and Storage (SharePoint Online / Dataverse) - this layer replaces the un-governed shared folder structure with a secure database schema. It houses all active formulation values, tracks document versions natively, and serves as the locked data repository before final manufacturing codes are transitioned into the enterprise master SAP system for mass production scale-up.

Change Management Strategy

To successfully transition S-Line International from an unregulated, shared-folder environment to a structured digital requisition system, a robust change management framework is required. Projects are explicitly designed to drive organizational change, moving an entity from its current state to a desired future state to create value.

Implementing an SOP or new software is rarely a purely technical challenge; it is a cultural shift. The following change management strategy uses the ADKAR (Awareness, Desire, Knowledge, Ability, Reinforcement) model, John Kotter's structural change principles, and modern project management principles—such as adopting a holistic view and focusing on value—to align your operational fixes with modern R&D management practices.

Source of Potential Resistance

Shifting from an informal system to a structured digital architecture introduces friction. According to Dent and Goldberg (1999), resistance is rarely a refusal to change itself, but rather a psychological defense against the perceived negative consequences of that change, such as a loss of status, comfort, or autonomy. Engaging stakeholders continuously throughout the project life cycle integrates diverse perspectives and raises the probability that desired outcomes are achieved. Understanding why your core stakeholders might resist allows you to proactively address their concerns.

Table 5.5

Sources of Potential Resistance by Stakeholder Group

Stakeholder Group	Source of Resistance	Underlying Fear / Motivation (Dent & Goldberg, 1999)
Sales Managers	Perception of administrative burden and "bureaucracy."	Fear: Standardized digital briefs and required fields at project inception will slow down their response times to clients or make them look inflexible to accounts.

R&D Staff	Loss operational autonomy and increased surveillance.	Fear: Strict system logging and automated timeline tracking (e.g., the 14-day sample window) will feel like "micromanagement" or an unfair audit of their benchwork speed.
R&D Head	Inter-departmental friction and resource allocation blame.	Fear: Enforcing strict data governance might alienate the Sales team, leading to a drop in total project submissions or political pushback within executive leadership.

Structured Communication Plan

To mitigate this resistance, communication must move away from top-down mandates and focus on the WIIFM ("What's In It For Me?") principle for each group, a foundational element in building organizational "Awareness" and "Desire" (Hiatt, 2006).

Phase 1 (Month 1): Creating Urgency and Vision (Awareness)

Following Kotter's (2012) framework for leading structural change, the R&D Head and executive sponsors must host a joint Sales-R&D town hall. The message must establish a clear sense of urgency regarding operational drag without assigning blame (e.g. *"We lose weeks of development time waiting on file transfers..."*). This aligns with the project initiation phase, where involving sponsors and stakeholders creates a shared understanding of success criteria and aligns the project's purpose with expectations.

Phase 2 (Month 2): Targeted Alignments (Understanding)

Conduct separate, department-specific briefings. or Sales, demonstrate how a complete digital brief prevents R&D from asking repetitive follow-up questions. For R&D, emphasize that the system acts as a protective shield against incomplete, un-costed sales requests. A value-focused approach helps ensure that the project delivers value from the specific perspective of these differing stakeholder groups.

Phase 3 (Month 3): The Pulse Check (Feedback Loops)

Establish weekly 15-minute "friction logs" during the first month of rollout where users can voice user interface (UI) or workflow bugs without penalty. Effective feedback mechanisms allow decision-makers to assess the success of their decisions, learn from the data, and improve long-term operational effectiveness.

Training Requirement and Tailored Program

Generic software training fails because it teaches features rather than specific procedural workflows. Training should be split into role-specific, bite-sized modules rather than an exhaustive multi-hour marathon. This reflects the principle of tailoring, which is the deliberate adaptation of processes to make them more suitable for a given environment and fit for the purpose of the work at hand.

The Sales Track: "The Quality Gate"

Focus: Complete data entry, mandatory regulatory and commercial fields, and understanding Gate 1 criteria.

Format: A 45-minute interactive workshop. Sales managers will practice inputting a mock client request live, learning how the system automatically flags missing information before it ever reaches the R&D queue.

The R&D Track: “Ecosystem Management”

Focus: Receiving tasks, attaching test reports, documenting pilot trial logs, and executing digital hand-offs.

Format: Hands-on sandbox sessions. Staff will practice moving a project through system milestones, emphasizing how updating a central sheet replaces the old habit of manually emailing tracking documents.

Hypercare and Support Systems During Transition

The period immediately following launch is the most volatile. If a user encounters a system bug and has no immediate support, they will quickly revert to their old desktop sheets and personal folders.

- **Establish "Super-Users":** Appoint one Sales Manager and one R&D staff member as system champions, creating a localized guiding coalition. Cultivating a team environment that honors diversity and seeks to harness it constructively fosters an atmosphere where conflicts can be managed efficiently. When a peer gets stuck, a helpful colleague is much more approachable than filing a formal IT ticket.
- **The 2-Week Hypercare Window:** Dedicate a direct line of contact for technical assistance during the first 14 days post-launch. Guarantee a 1-hour resolution time for system lockouts or workflow stalls to prevent operational frustration.
- **The Legacy Freeze:** To enforce the change, establish a hard "read-only" date for old shared folders. After Week 4, the old folders are locked to new inputs. This

acts as a structured governance mechanism that guides project management decisions and activities to optimize value delivery.

The Role of Leadership

The R&D Head cannot simply delegate this implementation; they must actively champion it to anchor it into the company culture.

- **Accountable Leadership:** The R&D Head must take ownership of the target business objectives and guide the team with integrity while fostering a culture of trust. Effective leaders influence, inspire, and motivate others by leading by example.
- **Shoring Up Peer Alignment:** The R&D Head must work directly with the Sales Director to establish mutual accountability. If a sales request bypasses the digital system, leadership must agree that R&D is officially authorized to pause work on that project until the system compliance loop is closed.

Incentives Adoption

The "Clean Data" Recognition

Implement a monthly, lightweight incentive for the team or individual with the highest rate of first-time-right submissions or fastest digital handoff execution.

KPI Integration

Tie system adoption metrics directly to performance appraisals. For Sales, track the percentage of briefs submitted with complete parameters. For R&D, track adherence to digital milestone documentation within 24 hours of trial completion.

Assessing Success

Assessing project success requires evaluating both the success of project outcomes and the efficiency of project management processes. Framing the system as a benchmark for professional excellence turns an operational chore into a career asset, directly aligning individual performance with target metrics that demonstrate meaningful impact to the organization's strategic goals.

VI. CONCLUSION AND RECOMMENDATIONS

This study has addressed the operational gaps in the manual, informal New Product Development (NPD) framework at S-Line International by designing and developing a cloud-native digital workflow architecture. The diagnostic review, built on process-mapping and targeted stakeholder interviews, confirmed that relying on scattered shared folders, manual Excel logs, and loose communication protocols exposed the company to severe operational risks. These issues showed up as a heavy reliance on tribal knowledge, version control chaos, ad-hoc project prioritization, and an information vacuum that delayed essential handovers to the Finance and Production teams.

By restructuring the workflow around strict Stage-Gate management rules, this study has provided a roadmap for turning the existing paper protocols into an automated, multi-tiered digital architecture. Moving from manual tracking states to automated workflows driven by Power Apps and Power Automate removes critical delays. The new tool enforces accountability through a tailored task matrix, safeguards recipe version histories, and locks in target turnaround timelines. Ultimately, this digital transition shifts the R&D unit from a reactive team dealing with administrative fires into a data-driven, strategic innovation engine capable of maintaining a sharp competitive edge in a fast-moving consumer goods market.

A. Contributions of the Study

Eradication of the Communication Gap

The digital framework bridges the manual divide between Sales Managers and R&D team running lab tasks, ensuring accurate alignment on the technical details during early project phases.

Enforced Institutional Governance

The software eliminates the tribal knowledge trap by consolidating all product attributes, raw material limits, and recipe adjustments into a secure, fully auditable centralized system.

Automated Cross-Functional Synergy

The automated set-up removes the visibility vacuum using instant back-end notifications, immediately routing finalized technical data to Finance and Production for current costing and manufacturing reviews the moment a request hits “COMPLETED” status.

Mitigation of Costly Production Risks

The workflow minimizes the cost of poor quality and prevents batch failures during the large factory scale-up trials by enforcing permanent digital audit trails that block unapproved recipe versions or unmapped material codes.

B. Contributions to Similar R&D Organizations

Blueprint for Low-Code Digitalization

This research serves as a practical deployment model for small-to-medium food manufacturing enterprises looking to digitize manual workflows using existing low-code infrastructures (such as Microsoft 365) without incurring heavy capital expenditures for enterprise PLM software.

Operational Validation of Stage-Gate Controls

The study provides empirical evidence of how embedding automated quality gates within the NPD framework could successfully prevent unstructured project creep (“zombie projects”) from wasting finite laboratory resources.

C. Suggested Areas For Future Study

Future studies could add prescriptive data analytics to the low-code framework. This tool would automatically calculate team workloads and laboratory space based on active project timelines,

Expanding the tool to include a secure portal for raw material suppliers would automate how the company gathers technical data sheets and allergen documentation during early screening phases.

Engineering an automated application programming interface (API) to link the data architecture directly to the master SAP system would eliminate the final manual data entry steps needed to upload completed product codes for mass production roll out.

VII. PERSONAL LESSONS LEARNED (REFLECTIVE ESSAY)

A profound takeaway from this project is the realization that ambiguity serves as the primary antagonist to institutional innovation. In many corporate environments, Research and Development (R&D) is often romanticized as a "black box" or a purely "creative" endeavor that must remain unencumbered by formal rules to flourish. However, this project fundamentally challenges that notion, demonstrating that a lack of formal structure inevitably leads to the "zombie project" phenomenon—initiatives that consume resources and linger indefinitely without ever delivering tangible value. As Cooper (2011) posits, a structured Stage-Gate system does not stifle the creative spirit; rather, it provides the necessary scaffolding to focus it. By partitioning the R&D lifecycle into distinct, sequential phases and rigorous gates, the team is liberated from administrative chaos. This structural clarity allows personnel to migrate away from managing "process noise" and instead devote their full cognitive bandwidth to scientific inquiry and complex problem-solving.

Prior to the implementation of this framework, accountability at S-Line International was largely a "soft" concept—a sentiment echoed in meetings but rarely enforced in practice. By embedding a RACI Matrix directly into the Microsoft Power Platform architecture, accountability has been transformed into a "hard" technical feature. I have learned that while manual oversight is inherently fallible and prone to social biases, a digital workflow provides an impartial "source of truth." When the system physically prevents a project from progressing without a specific digital signature or a "Go" decision, it creates an inescapable culture of ownership (Kerzner, 2017). Features such as "Locked" or "Read-Only" records effectively remove the social friction typically associated with management enforcement. In this environment,

governance becomes a seamless, natural component of the workday rather than a perceived bureaucratic hurdle.

The development of the Master Project Tracker underscored the critical intersection between Information Trust and operational speed. In the high-velocity food and beverage industry, a product formulation is far more than a simple recipe; it is a vital proprietary asset that defines the firm's competitive edge. This project taught me that robust data governance is not merely a security concern—it is a primary driver of organizational velocity (Davenport & Prusak, 1998). When stakeholders have absolute confidence that the information within the "Single Source of Truth" is 100% accurate, verified, and current, the massive time-wastage associated with "double-checking" data or "version hunting" through disparate emails completely evaporates. We have proven that organizational efficiency is, in many ways, a direct byproduct of data integrity.

The transition from "reactive firefighting" to "proactive intervention," facilitated by the NPD Real-Time Monitor, offered important lesson in modern leadership. Without access to live Key Performance Indicators (KPIs), managers are often forced to make decisions based on "lagging indicators"—essentially managing based on yesterday's problems. Real-time dashboards fundamentally redefine the managerial archetype; the leader shifts from a "policeman" constantly demanding status updates to a "strategic coach" who can visualize bottlenecks as they form. According to Parmenter (2015), this visibility allows for the strategic deployment of resources to at-risk projects before a timeline slip occurs, shifting the organizational culture from one of crisis management to one of disciplined execution.

Ultimately, this project serves as a testament to the fact that true digital transformation is less about the sophistication of the software and more about the radical alignment of people and processes. By leveraging tools like Power Apps and Power Automate to mirror human accountability and departmental SOPs, we have done more than just build a database; we have engineered a more disciplined, transparent, and resilient organization. The enduring success of the Stage-Gate SOP lies in its unique ability to aggregate individual effort into a collective, predictable, and scalable success for S-Line International.

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IX. APPENDICES

APPENDIX A

New Product Development Request Form

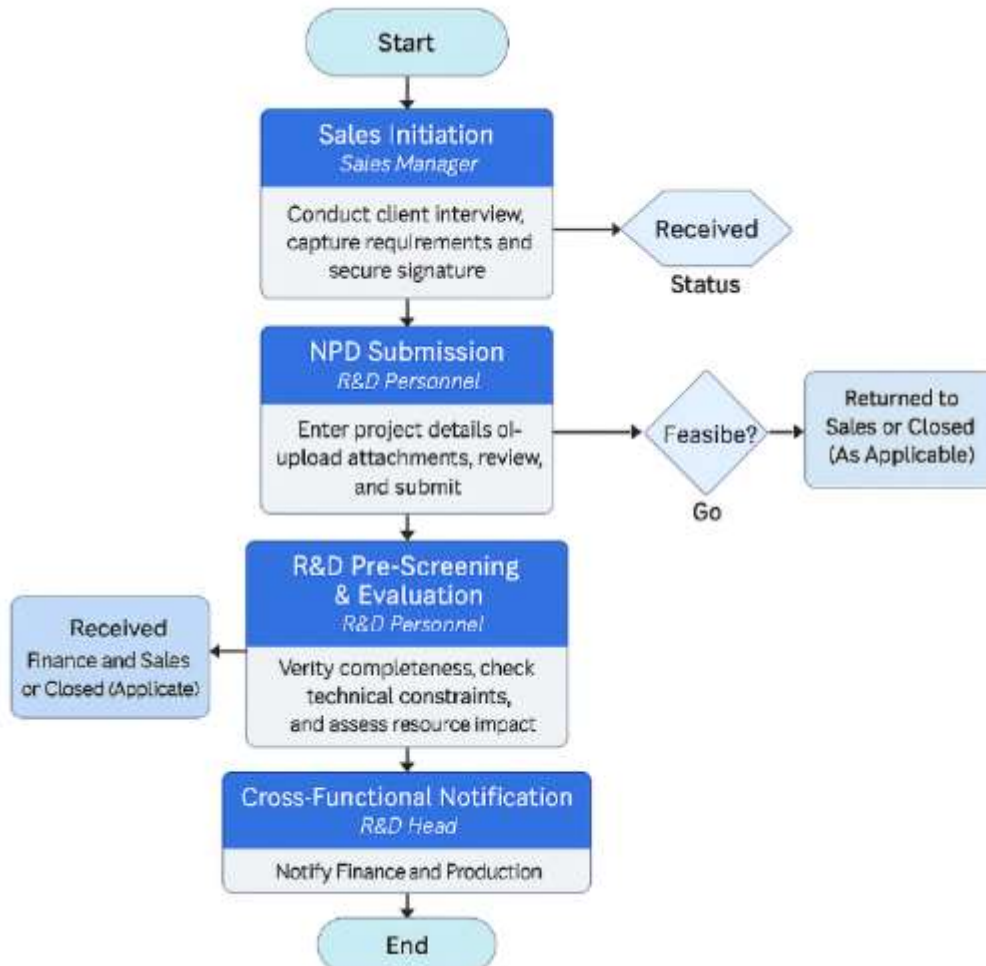
NEW PRODUCT DEVELOPMENT REQUEST FORM				
Name	Employee No.	Department/ Unit Name	NPD Reference number	Date
No.	Product Category	Brief Narrative	Quantity	Quantity
1				
2				
3				
<p>Therby certify that the information provided are true and correct and that the expenser incurred are for legitimate business purpose.</p>				
Endorsed by		Approved by		Approved by
Name of Requestor/ Date		Name of R&D Personnel/ Date		Name of R&D Head/ Date

STB Form 28-001

INTERNAL

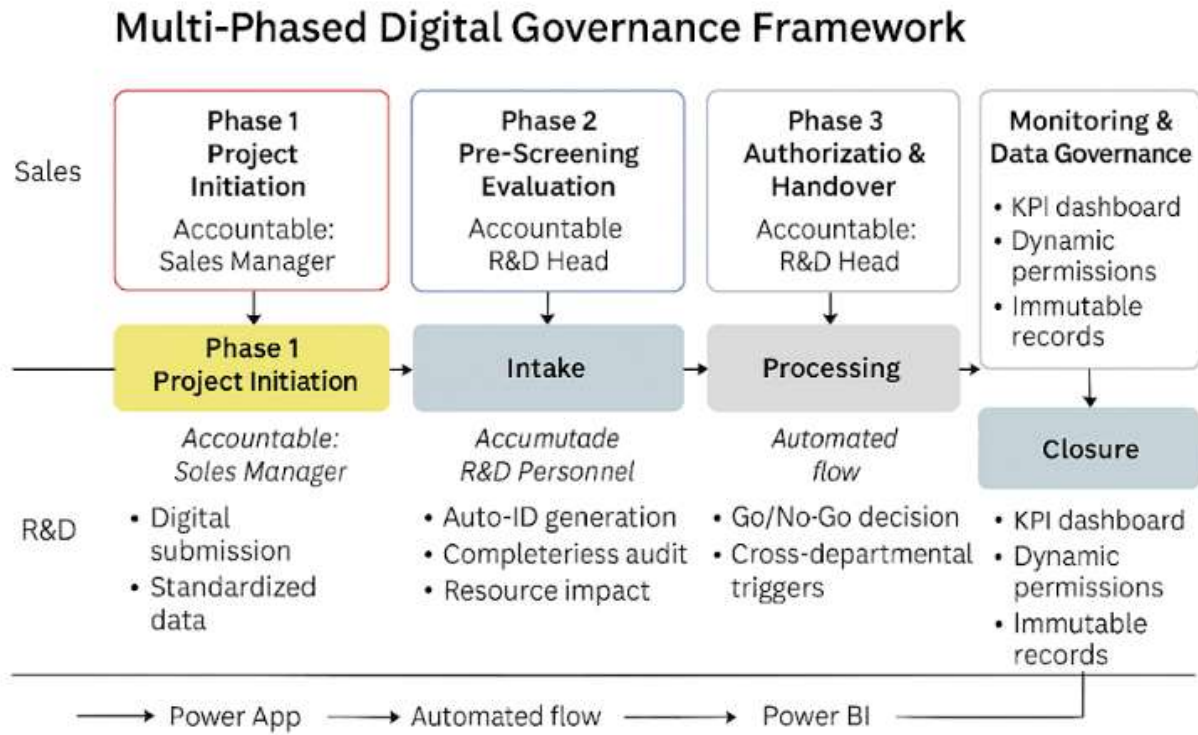
APPENDIX B

Process Flow



APPENDIX C

Multi-phased Digital Framework



APPENDIX D

Standard Operating Procedure



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Document Owner : R&D Unit Date :
 Recipients : All Sales Managers, R & D Personnel, R&D Head
 Subject : HANDLING OF NEW PRODUCT DEVELOPMENT REQUEST

ACTION	UNIT	NAME	DATE
Prepared by	Assigned Personnel		
Reviewed by	R&D Head/Personnel		
Endorsed by	Sales/R&D Head		
Approved by	Executive Management		



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I. RATIONALE AND SCOPE

This procedure provides a standardized process for managing a New Product Development (NPD) request, which initiated by the Sales Department. It covers the systematic steps for data extraction, preparation, validation, and inter-departmental coordination to ensure compliance with internal policies. Furthermore, it ensures that all product innovations are thoroughly documented, reviewed, and approved within the framework of the company.

Proper execution of the NPD request is essential to safeguard client interests, ensure accurate financial reporting, and maintain operational integrity.

This document outlines the procedures for processing NPD requests. It provides clear guidance to ensure consistency, compliance, and accuracy throughout the process.

II. PROCEDURES

A. General Procedures

1. Sales Managers process and upload the New Product Development Request with full client specifications to the designated Shared Folder.
2. Upon receipt, R&D Personnel review specifications for technical capability and submit preliminary findings to the R&D Head.
3. The R&D Head evaluates feasibility. If approved, the status is updated to "COMPLETED" in the tracking log.
 - a. Once the "COMPLETED" status is achieved, R&D must officially notify the Finance (Costing) and Production departments that the project is ready for financial and operational evaluation.

B. Specific Procedures



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a.) New Product Development Request

Sales Manager

1. Client Verification and Documentation.
 - a. Conduct a detailed interview with the client to capture all necessary product attributes and technical requirements.
 - b. Obtain the client's signature on the official request form to formalize the project scope.
2. Processing of NPD request
 - a. Access the NPD portal via the shared folder using valid company credentials.
 - b. Enter the client's name and select the specific project category (e.g., New Formulation, Packaging Change, or Line Extension).
 - c. Complete all required fields. Supplemental files (Product Briefs, physical specs, etc.) must be uploaded via the Attachment icon.
 - d. Perform a final accuracy review and click **Submit/Save**.
 - e. Proactively inform the R&D department of the submission via **Microsoft Teams** to trigger the pre-screening.

b.) R&D Personnel Pre-Screening Evaluation

R&D Personnel

1. Verification of request Completeness
 - a. Audit specifications (materials, dimensions, performance standards) for completeness.
 - b. Validate the Product Brief and identify regulatory/compliance needs (e.g., FDA, ISO).

Note: If data is missing, return the request to Sales immediately.

2. Technical Constraint Check

- a. Conduct an immediate assessment against the company's current technical and manufacturing boundaries.
 - a.1 Determine if the request requires materials that are prohibited or restricted.
 - a.2 Assess if the request necessitates a manufacturing process that the company does not currently possess.

3. Initial Resource Impact Assessment

- a. Categorize the request as either a "**Minor Tweak**" (modification of an existing product) or a "**New Innovation**" (development starting from scratch) to determine the required R&D effort.

4. Technical File Preparation and Handover

- a. Submit the evaluated file to the R&D Head for formal evaluation.
- b. Update the project status in the shared NPD folder from "**Received**" to "**Pending Head Evaluation**."

c.) R&D Head Technical Evaluation and Authorization

R&D Head

1. Review the checked NPD request and the Personnel's pre-screening report.
2. Based on the pre-screening report, the R&D Head makes a definitive "Go" or "No-Go" decision.
 - a. **If Feasible:** Approve the project for the next stage.

- b. **If Not Feasible:** Document specific constraints and notify Sales to officially close the request.

3. Manually update the project status to **COMPLETED** within the Shared Folder to trigger the next phase.

4. Immediately notify the **Finance (Costing)** and **Production** departments that the file is ready for their respective reviews.