

# Packaging Materials Dual-Sourcing as Business Contingency Plan to Mitigate Operational Production Disruption

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**ABSTRACT:** PT XYZ is one of the leading fast-moving consumer goods companies producing packaged mineral water in Indonesia. Water is a daily necessity and one of life's most basic needs. Therefore, providing healthy hydration through safe and ready-to-consume drinking water aligned with the company's mission to deliver health through food to as many Indonesian consumers as possible through sustainable operational production.

Operational production is one key enabler in delivering these objectives. Dual-sourcing of validated packaging materials could catalyse sustainable production operations through supply risk mitigation, whose root causes come from internal and external factors. This paper uses quantitative, PDCA, and decision tree methods to analyse the supply and demand of packaging materials in short to mid-length timeframes to ensure capacity availability and redundancy, trial, and validation processes.

Prioritization through risk assessment of potential net sales loss and probability leads to several implementation phases, periodic monitoring to track initiatives and ensure they stay on course, the timely escalation of solutions, and visibility of acceptable calculated risk.

**KEYWORDS:** Capacity Redundancy, Dual Sourcing, Operational Management, Risk Mitigation.

## 1. INTRODUCTION

### 1.1 Background

PT XYZ has a broad network of operational footprints across the nation, consisting of 21 plants, 16 distribution centers, and 19 third-party manufacturing plants. This setup enables the company to produce a product with unique traits, providing consumer needs in a relatively short time. Moreover, a huge amount of manpower, with as many as 12,000 people and more than 107 production lines, generates challenging and complex operations management.

The company has objectives measured by the number of liters produced and net sales results are assessments parameters when recommending a business solution prioritization.

However, many internal and external factors) could keep the company from reaching its objectives. One of these factors is operational downtime. Operational downtime has a wide breadth of interrelated factors and causes, but this research focuses on its relationship with the supply of packaging materials. Therefore, understanding the business needs and risk mitigation actions for packaging materials supply is the objective of this research.

### 1.2 Operational and Packaging Business Processes

The end-to-end operational business process, with its key relevance from packaging to producing finished products (FP), starts from spring water, filtration, filling, and packing, when the finished goods are ready for delivery. Some processes are done internally (inhouse), while others are conducted externally (suppliers).

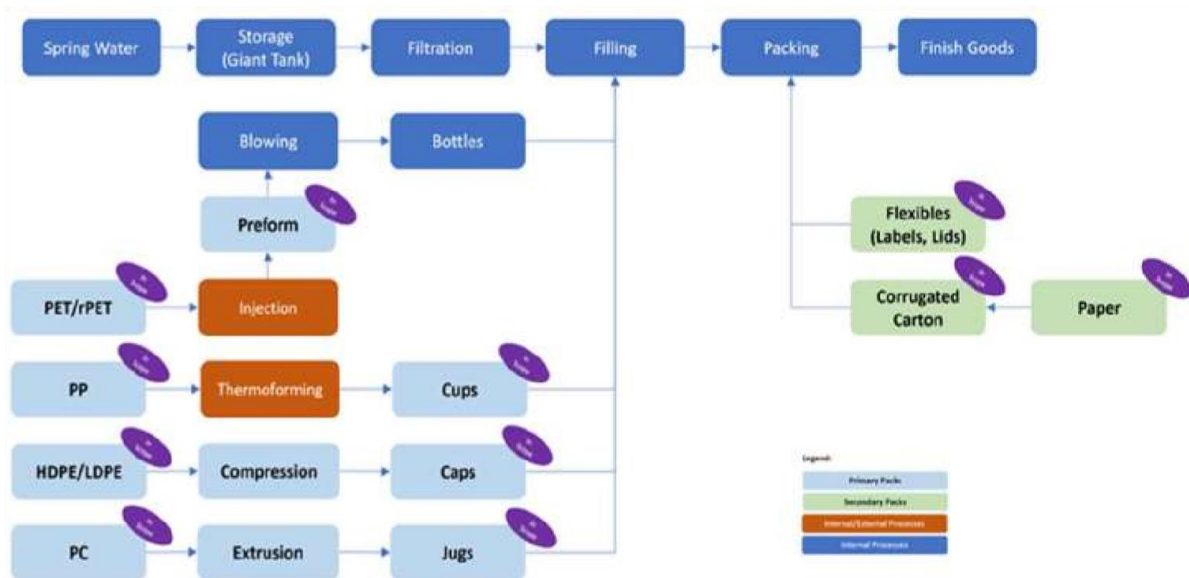


Figure 1. PT XYZ Operational and Packaging Material Flows

### 1.3 Research Aims and Objectives

Develop and implement Business Contingency Plan (BCP) for packaging material supply as an anticipative action against production downtime due to material availability.

Thus, follows with below points:

1. How can PT XYZ ensure uninterrupted operation due to packaging material availability?
2. Is all BCPs for packaging material supply must be implemented by PT XYZ?
3. How do we measure the effectiveness and success of implemented BCPs?

### 1.4 Literature Review

#### 1.4.1 Supply Risk Management

Managing supply risk requires (1) the identification and classification of risks, (2) an impact assessment, and (3) a risk strategy. The identification of risk requires an understanding of end-to-end processes and a consideration of all factors or parameters that may later impact or interrupt supply. It involves a classification of the risks of catalyzing such structures and an effective approach at later stages to assess the impact based on probability and severity.

Impact assessment requires the ability to assess the consequences of supply interruptions and price or cost exposure. Correct impact assessment likely requires input from other functions, such as operations, marketing, sales, and finance. Assessment involves identifying the potential impacts of risks and classifying them as low, medium, or high. Combining this with the probability of events produces a table of risks, with low probability/low impact events on one end and high probability/high impact events on the other. High-probability and high-impact risks must be addressed or avoided if possible. Impact assessment is a critical process for helping top management make informed prioritization and resource allocation decisions (Sodhi & Tang, 2012).

Managing supply risk requires strategy. It may start with simple actions such as avoiding high-risk suppliers or high-risk geographical locations, using dual or triple sourcing, carrying safety stock, hedging, and using longer-term or fixed- or declining-price contracts and protective contract clauses.

#### 1.4.2 Strategic Approaches for Mitigating Supply Risk

There are three methods (Simchi-Levi et al., 2021) for managing supply chain risk:

- Capacity redundancy: This requires designing a supply chain that can effectively respond to unforeseen events without significantly increasing costs. This approach can be achieved through carefully analyzing supply chain cost trade-offs and finding a balance between cost reduction and risk management.

- Speed in sensing and responding: This method requires a sense of urgency and criticality when issues arise and allows one to prioritize an action plan before it is too late, thus avoiding negative impacts due to unresponsiveness.
- Flexible supply chain community: This approach requires collaborative cross-functional supports and suppliers that can better respond to sudden crises.

### 1.4.3 Safety Stock (Buffer Inventory)

Safety stock is defined as the amount of inventory carried beyond the expected demand (Jacobs & Chase, 2018). Safety stock or buffer inventory plays an important role in ensuring operations sustainability in the face of unforeseeable events. The major decision variable is how much buffer inventory to carry for the desired service level or coverage. Holding a large inventory to prevent stockout and thus maintain a high service coverage is expensive. Similarly, frequent stockouts are costly. Stockout costs are often difficult and expensive to determine but are nevertheless real.

### 1.4.4 Stockout Costs

Stockout costs are the costs of not having the required materials on hand when and where they are needed. Costs include lost contributions on lost sales (both present and future), changeover costs necessitated by the shortage, the costs of substituting less suitable or more expensive parts or materials, rescheduling and expediting costs, labor costs, and machine idle time, and so forth. Often, customer and user goodwill are impacted, and occasionally penalties must be paid. The impact of stockouts on customers will vary.

In a seller's market, an unsatisfied customer may not be lost as easily as in a buyer's market. In addition, each customer will react differently to a shortage. In many organizations, stockout costs are very difficult to assess accurately. The general perception, however, is that stockout costs are substantial and much larger than carrying costs (Sodhi & Tang, 2012).

### 1.4.5 Net Sales Exposure

It is difficult to accurately assess stockout costs. Thus, another pragmatic approach is to estimate the potential loss of sales exposure caused by material supply issues (unavailability), regardless of the root issue or causes, with the exception of force majeure. The estimation is made by calculating the volume lost due to downtime and multiplying the result by net sales figures. Once again, such calculations allow a business to be as quantitative as possible in defining prioritization and resource allocation to mitigate, avoid, or accept the calculated risks.

## 2. METHODOLOGY

This research uses a few different methodological approaches to analyze a single case study: quantitative data analysis, the Plan-Do-Check-Action (PDCA) method, and a decision tree methodology.



Figure 2. PDCA Steps

The quantitative data used in this research is based on historical supply and demand, projections of future supply and demand, the supplier’s supply-base, material supply mapping validated for commercial use, and supplier performance reports (“on time in full” and “nonconformity” reports).

A root cause analysis (RCA) was conducted to find the underlying problem. A fishbone diagram was used in this step.

3. RESULTS

3.1 Root Cause Analysis (RCA)

Using a fishbone diagram to conduct root cause analysis of the causes of operational downtime due to material supply captured a few aspects: method, machines and equipment, people, and materials. The results are further categorized into two factors: internal and external.

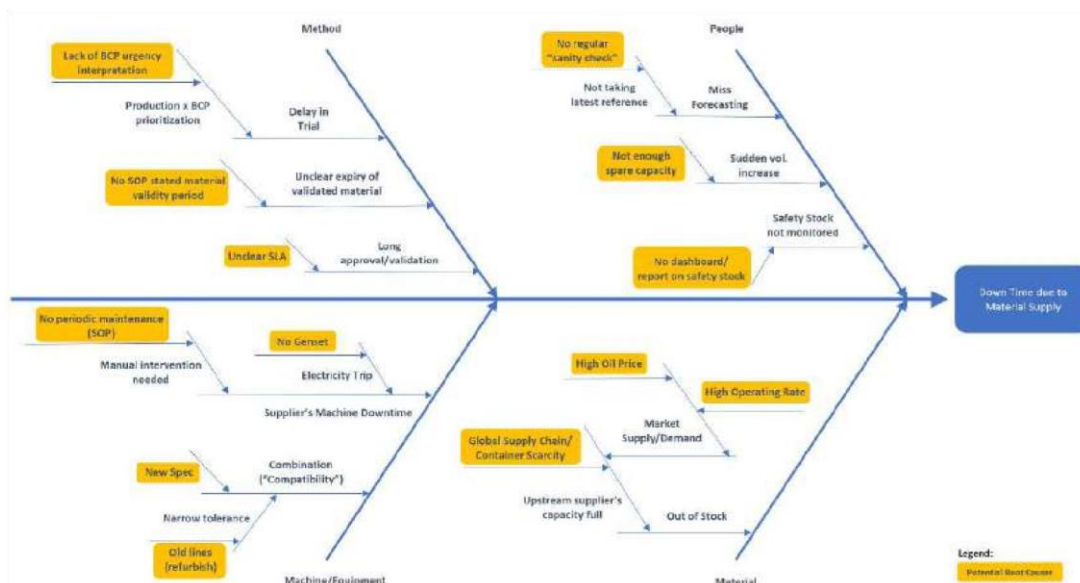


Figure 3. Fishbone: Material Supply Downtime Root Causes

3.1.1 Internal Factors

Below are the main factors influencing PT XYZ that can be improved to avoid or mitigate risk.

- Aligned and validated ways of working: Standard Operating Procedure (SOP), Service Level Agreement (SLA), and BCP initiative prioritization
- Reviewing and revalidating specifications relevant to current business and filling machines
- Reviewing and refurbishing old lines that do not match the latest material specifications
- Internal cross-checking and reporting: correcting forecast references, periodic dashboards, and scorecards, as well as planning to develop new capacity.

3.1.2 External Factors

Some factors are outside of PT XYZ’s control but can be influenced to a certain extent and mitigated with accurate market intelligence. Some strategies for mitigation include the following:

- Discuss and review with suppliers as part of annual performance assessment, not limited to operational topics (e.g., maintenance procedures, forecast/actual vs. their maintenance schedule, etc.)
- Define clear action plan and strategy with respective supplier to align with company’s expectation to move forward and growth together (e.g., new capacity development, equipment investment, etc.) as part of Supplier Relationship Management (SRM)
- Catching up with the latest updates on the global market situation and managing sourcing strategy, such as by buying now and stocking up.

### 3.2 Rules and Criteria Setup for BCP

Defining dual-source framework by setting up criteria, the “BCP Pack Golden Rules,” that will govern the material validation or trials and prioritization to mitigate the biggest business risks first.

The criteria should cover multi-angle respective material natures and origin assessments such as the following:

- Packaging vs. Plastics  
These two materials are fundamentally different. Plastic is commodity-based, while packaging is locally sourced and consists of conversion costs.
- Primary vs. Secondary Packs  
The distinction between primary and secondary packs lies in the capacity-building nature. Primary packs have a specific capacity and require a longer development lead time (9–15 months), whereas secondary packs have more spare capacity, with no or very low specificity and short development lead times (4–6 weeks).
- Imported vs. domestically-sourced materials  
The origin of materials should be considered, as it affects many aspects, mainly the delivery lead time. Because of the global supply chain situation, the recent pandemic has created a prolonged scarcity of containers with significant impacts, including longer delivery times as well as a hike in shipping rates and prices.
- Dual sources vs. dual sites  
Although they sound almost similar, dual sources and dual sites are completely different. “Dual sources” refers to materials from two different producers (legal entities), while “dual sites” refers to materials sourced from the same producer but different plants or factories.

Thus, the formalized criteria for the “BCP Golden Rules” are as follows:

1. A minimum of two validated producers per plant, of which at least one is a domestic source
2. A minimum of one active and one passive validated material source per line
3. A minimum spare capacity of 20%
4. “Dual site” applies should there is proprietary formula involved
5. “Stock management” applies, should below described situation assessment happens:
  - a. Investment costs are higher than the exposed risk
  - b. Small volume or demand vs. effort to validate

The above rules are illustrated below.

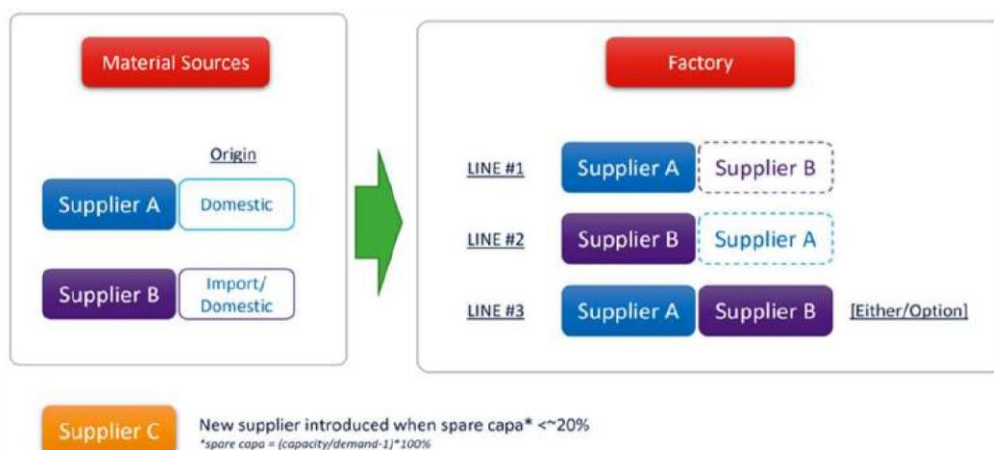


Figure 4. BCP Golden Rules

### 3.3 Capacity Redundancy and Spare Capacity

Spare capacity is a prerequisite for supply flexibility and dual sourcing. This means that it is mandatory to have enough extra unutilized capacity from the machine (to be able to produce more than the demand or requirement). Such a setup can be used or activated during times of urgent need of shorter lead times or to build a safety stock.

Spare capacity is calculated by dividing the realistic capacity by demand, then translating it into a percentage. The figures indicate how much capacity is left that can be utilized to cover the same demand.

Spare capacity will be primarily focused on material that has specificities and long lead times to develop new capacity. Thus, it's critical to see in longer time horizons (3-years), to "health-check" when new capacity is required, and to take action to maintain a "healthy" spare capacity (> 20%).

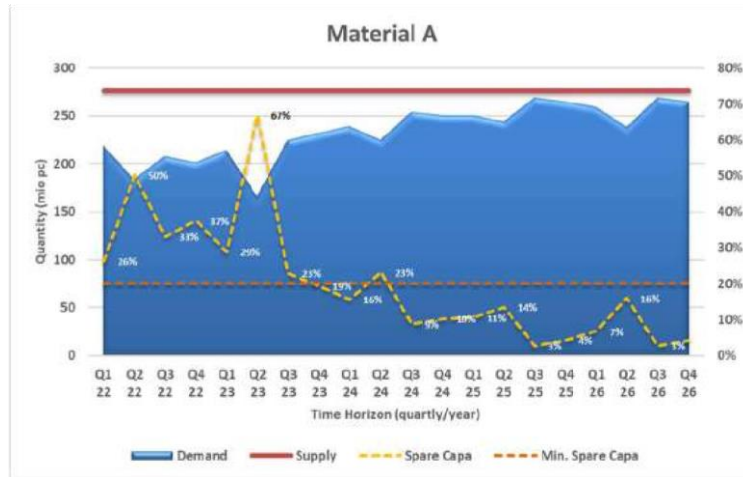


Figure 5. Example of Spare Capacity Assessment by Material

The figures show that new capacity should be available by Q2 2024 at the latest and took respective lead-time development by material accordingly.

3.4 Decision Tree

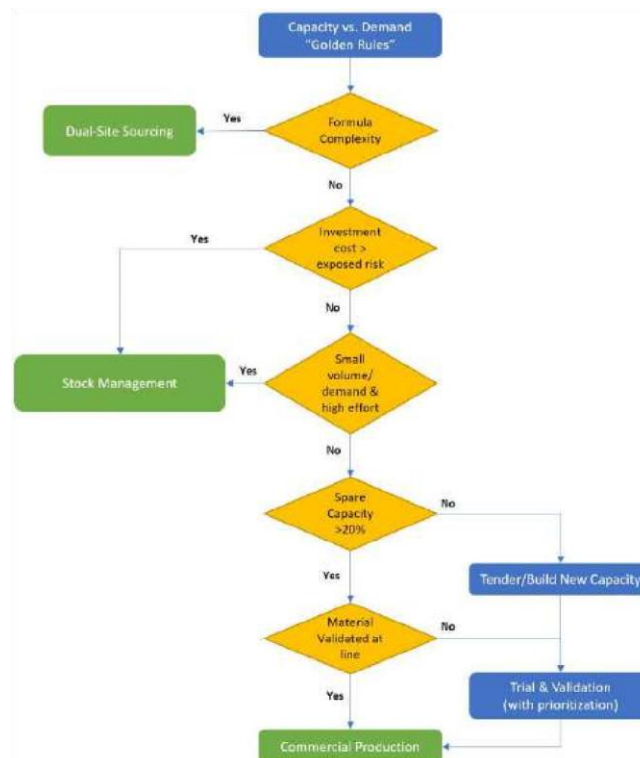


Figure 6. Decision Tree: BCP Golden Rules Implementation



To structure and systematically implement the BCP, the decision tree shown above will clarify each step of preparing dual-source material for commercial production.

**3.5 Dual-Source Material Prioritization**

The identification and prioritization of critical materials are crucial for properly managing required actions with available resources (time and people). Moreover, critical materials list will help to prioritize in mitigating and reducing business pressure by tackling the largest risks sooner rather than later.

Trial and validation processes require interruptions of regular operations. Thus, meticulous scheduling must be in place and aligned upfront so that these processes do not cause unmet business objectives, mainly regarding the volume produced. In such cases, then, the trial and validation process prioritization must be assessed and the risk mitigation must be conducted systematically, properly addressing the most significant risks with high probability and later moving to the risks with lower probability.

**3.5.1 Net Sales Risk Exposure**

The net sales risk exposure is a crucial parameter (its implication to business objectives) that are measured annually: volume produced/sold and net sales made. Therefore, all impacts and implications will be evaluated against net sales and risk equivalents to address those objectives.

The calculation of net sales risk uses reference figures from finance calculated as the respective SKU times the potential output or capacity of filling lines that are still mono sourced. Even if this will not give 100% accuracy, in terms of business sense, it is sufficient and pragmatic enough for fast and calculated risk decision-making.

**Table 1.** Net Sales Estimation Per SKU

SKU	Net Sales					
	IDR	per	IDR	per	IDR	per
	Liter		Pc		Box	
SKU #1	2,711		596		14,312	
SKU #2	2,044		450		21,583	
SKU #3	3,184		1,051		25,220	
SKU #4	13,512		4,729		113,499	
SKU #5	15,256		5,797		69,568	
SKU #6	20,929		7,953		95,438	
SKU #7	2,161		1,296		31,113	
SKU #8	4,591		3,444		61,984	
SKU #9	1,854		2,782		33,379	
SKU #10	2,153		3,230		19,380	
SKU #11	468		8,890		8,890	
SKU #12	17,987		13,491		80,943	
SKU #13	18,744		14,058		84,350	
SKU #14	3,625		3,987		47,849	

**3.5.2 Probability of Risk**

Once we have the estimated net sales risk, another important factor is the likelihood of that risk. A few criteria are used for assessment:

- OTIF (On Time in Full)

The parameters of the timeliness and accuracy of fulfillment from a supplier help determine whether the supplier is reliable and demonstrate sustainable performance in meeting company needs.

This criterium indirectly anticipates dynamic situations such as the pandemic that could impair the transportation lead times and cause delayed delivery. Therefore, OTIF is one of the parameters used to assess probability.

• Nonconformity

Another supplier reliability assessment measure is nonconformity. Suppliers should provide conformity, meaning that the materials delivered should meet agreed specifications and pass incoming checks before being used in production. The more reliably a supplier conforms, the less probable it is that interruptions will cause material shortages.

• Geopolitical situation

Some materials are sourced from other countries. Thus, the geopolitical situation and its implications should be considered. For instance, materials sourced locally will have more visible interruptions, as the General Secretary team provides information on the situation in Indonesia, such as travel bans during festive periods and travel restrictions during large-scale social distancing period.

Materials sourced from overseas, mainly from China, pose additional complexity. Some examples include the container scarcity caused when China pooled containers to anticipate a business increase after the Chinese New Year and a possible rise in tensions between China and Taiwan.

Thus, materials sourced within the same country or region (South East Asia) and those sourced from other countries or regions will have different degrees of risk probability. • Financial issues

A supplier’s financial situation is a parameter that defines whether they are able to conduct business with adequate cash or capital. The assessment can be indirectly derived from a D&B credit report, requests to speed up payment that go against the agreed Terms of Payment (ToP), or requests for PT XYZ to pay in advance on certain investment occasions.

Therefore, a supplier’s financial situation will determine the risk probability and allow for managing a healthy volume allocation and dependency.

3.6 Grid of Net Sales Risk vs. Probability

Having the result of both axes calculation in terms of net sales risk against probability, below are the grids for defining the implementation plan and prioritization.

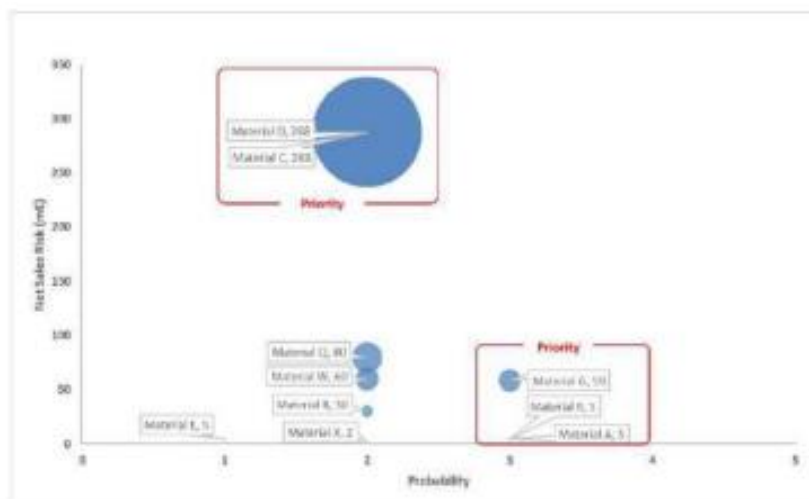


Figure 7. Plastics and Primary Pack Category: Net Sales Risk vs. Probability of Risk



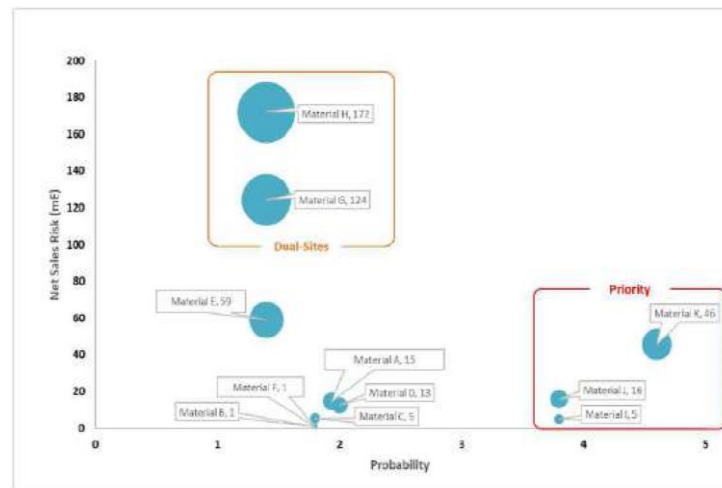


Figure 8. Secondary and Specialty Pack Category: Net Sales Risk vs. Probability of Risk

#### 4. DISCUSSION

The dual-source process will be implemented in several phases:

- Phase 1: Phase 1 will focus on “big bubble”, those are critical materials with high net sales risks, and risks with a probability higher than “3” on the scale (higher scale number means higher probability); it involves 80 sets of trials.
- Phase 2: Phase 2 will move to the next “big bubble,” with net sales risks above 50 million Euro and risk probability below “3”; it involves 30 sets of trials.
- Phase 3: Phase 3 will focus on the remaining “bubbles” and involves 138 sets of trials.

The trial and validation process will require several tests, including a short trial (1 hour-1 shift), a long trial (1 day), and a stacking and transport test (up to 2 weeks). Therefore, there will be a limitation of approximately 48 trials per year, meaning that these phases will be concluded after a multi-year implementation.

The estimation of the current situation is that, in total, 248 sets of trials will be required to secure 100% of the material supply lines, meaning it will take roughly 5.2 years to complete all phases.

Given these figures, there is an opportunity to decrease the very long time period through the following steps:

- Urgently focusing on Phase 1 by putting sufficient and, if possible, extra resources and time toward addressing high priority materials; this will take 1.7 years to conclude
- Simplifying and shortening the trial and validation process; for instance, requiring a full trial and validation cycle only for one plant and conducting only partial critical validation for other plants rather than replicating the full process
- Regular tracking (as part of “Check” on PDCA) for the execution of the plan formalized through SQC forum meetings to avoid repeating a trial if there is a failure during the initial trial.

#### 5. CONCLUSION

Uninterrupted operation, with no “Out of Stock” (OOS) periods caused by material supplies, involves many steps, cross-functional collaboration, and accountability between respective functions.

In this research, procurement function accountabilities ensure that validated materials from dual-sourced suppliers are in place. In developing BCP, it is imperative to understand the business objectives and evaluate the involved risks. Ideally, there should be no or very minimal risks to the business. In a realistic way, the BCP Golden Rules help establish clarity and prioritize, balancing and justifying resources and exposed risk reduction over time.

The success of BCP is measured by the agility and flexibility of switching materials from one validated supplier to another with very minimal downtime and waste and reject rates.



Meet the expected Net Sales risk coverage roadmap as per plan; starting from 2022 at 58% and reach 100% Net Sales risk coverage by 2027.

In the implementation of packaging materials, dual-source initiatives should not compromise the business objective to reach a defined volume produced or sold and a net sales target.

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