Smart Supply Chain Transparency

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Global Supply Chain and Maket Dynamics

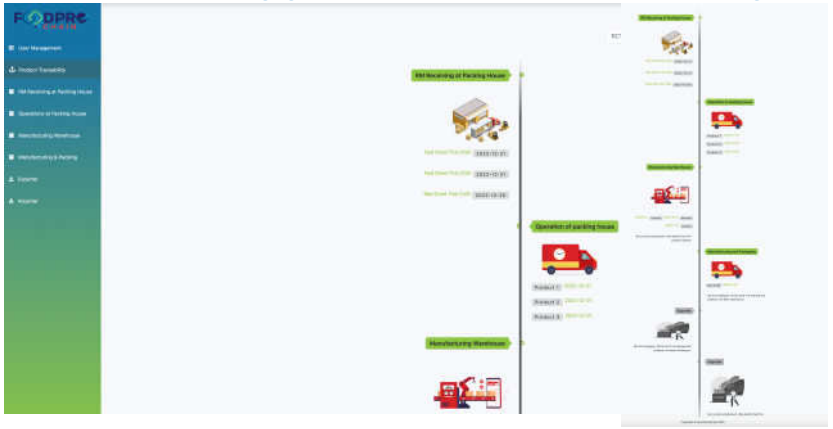
Smart Supply Chain Transparency

การประเมินความเสี่ยง

- ของปัจจัยการผลิต
- โลจิสติกส์การผลิต และ
- บรรจุภัณฑ์

เทคโนโลยีดิจิทัลและระบบอัจฉริยะเพื่อลดความเสี่ยงจากการเรียกคืนสินค้า

Blockchain Application for Traceability



แหล่งที่เกิดอันตรายด้านความปลอดภัยอาหาร

Ingredient-Related Hazards (Inherent Hazard) — อันตรายทางชีวภาพและเคมีตามธรรมชาติที่สัมพันธ์กับผลิตภัณฑ์แต่ละชนิด

Process-Related and Facility-Related Hazards — อันตรายทางชีวภาพและเคมีตามธรรมชาติที่เกิดขึ้นจากกระบวนการผลิตและสิ่งแวดล้อมในการผลิต

People-Related Hazards — อันตรายทางชีวภาพลายภาพที่เกิดขึ้นจากการปนเปื้อนของพนักงานในสถานที่ผลิต

Source: ดัดแปลงจาก FSPCA Preventive Controls for Human Food V 2.0 Participant Manual

การวิเคราะห์อันตราย (Hazard Analysis)

ขั้นตอนที่ 1: Hazard Identification

- ระดมสมองเพื่อระบุรายการอันตรายทางชีวภาพ เคมี และกายภาพที่เป็นไปได้
- ระบุอันตรายทั้งหมดที่เป็นไปได้ (Potential Hazard)
  1. วัตถุดิบและส่วนผสม
     - Ingredient-Related Hazards (Inherent Hazards)
     - AND Supplier's Process-Related and Facility- Related Hazards
  2. ขั้นตอนในกระบวนการผลิต
     - Manufacturing Facility Process-Related and Facility-Related Hazards

ขั้นตอนที่ 2: Hazard Evaluation

- พิจารณาว่าอันตรายที่ระบุจะเป็นอันตรายต่อผู้บริโภคหรือไม่หากไม่ได้มี **preventive control** หรือ **Controls Measures** โดยพิจารณาจาก
  - severity of the illness or injury
  - likelihood of occurrence
- การกำหนดอันตรายที่เป็น Significant Hazard จำเป็นต้องมี preventive control หรือ **Controls Measures**

Source: ดัดแปลงจาก FSPCA Preventive Controls for Human Food V 2.0 Participant Manual

ขั้นตอนที่ 1:การระบุ Potential Hazard

SUPPLIER LEVEL

Raw materials & other ingredients

- Ingredient-Related Hazards (Inherent Hazards)
- AND Supplier's Process-Related and Facility-Related Hazards

***Salmonella* in untreated Peppercorns (inherent hazard)**

Allergen Cross-contact (supplier process-related hazard)

MANUFACTURING FACILITY

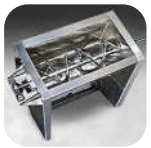
Manufacturing process steps

- Process-Related and Facility-Related Hazards

that may be introduced or associated with the manufacturing process and the facility (**e.g., mixing, packing in glass**)

Packing in Glass

Ribbon Blender (metal on metal contact)



Source: ดัดแปลงจาก FSPCA Preventive Controls for Human Food V 2.0 Participant Manual

ประเด็นที่ต้องพิจารณาเมื่อต้องระบุ Potential Hazard

- คำอธิบายผลิตภัณฑ์ พร้อมบริโภคหรือพร้อมปรุง ลักษณะการกรจายสินต้า
- ประสบการณ์จากการผลิตในโรงงาน เช่น ผลทดสอบผลิตภัณฑ์ ประวัติการร้องเรียนจากลูกค้า กรรมโดยทั่วไปของพนักงานในโรงงาน
- กิจกรรมที่ต้องทำในแต่ละขั้นตอนของกระบวนการผลิต
- เครื่องมืออุปกรณ์ที่ใช้ในการผลิตสินค้า
- ประเภทของวัสดุบรรจุภัณฑ์
- การปฏิบัติงานในขั้นตอนการทำความสะอาด เช่น ความสะอาดของอุปกรณ์ สิ่งแวดล้อมในกระบวนการผลิต และสุขลักษณะของพนักงาน
- ข้อมูลจากข่าสารภายนอก ผลงานวิจัย การเปิดปัญหาปนเปื้อน เจ็บป่วยเรียกคืนสินค้า industry guidance

Source: ดัดแปลงจาก FSPCA Preventive Controls for Human Food V 2.0 Participant Manual

Biological Ingredient-Related Hazards (Inherent Hazards)

Source	Bacteria	Parasites	Viruses
Ingredient-related (ตัวอย่างการปนเปื้อนจากวัตถุดิบและส่วนผสม) (Hazards that may be associated with specific food products)	***Salmonella* spp.** (e.g., poultry, produce, nuts) ***E. coli* O157:H7 and similar STEC** (e.g., ruminant animals, dropped fruit, sprouts) ***Campylobacter* spp.** (e.g., poultry and raw milk) ***B. cereus*** (e.g., rice and other grains ***C. botulinum*** (certain root crops) ***C. perfringens*** (e.g., spices) ***L. monocytogenes*** (e.g., RACs, other contaminated products used as ingredients)	***Cryptosporidium parvum*** (ปนเปื้อนจากน้ำที่ใช้เป็นส่วนผสม) ***Cyclospora cayetanensis*** (berries) ***Toxoplasma gondii*** (meat)	**Norovirus** (produce, shellfish) **Hepatitis A virus** (produce, fruits)

Source: ดัดแปลงจาก FSPCA Preventive Controls for Human Food V 2.0 Participant Manual

Chemical Ingredient-Related Hazards (Inherent Hazards)

Source	Examples
Ingredient-related chemical hazards	Pesticide residues on produce RACs
	Drug residues in milk
	Heavy metals in or on produce RACs
	Environmental contaminants (e.g., dioxins)
	Mycotoxins in grains
	Histamine in some aged cheeses
	Radiological hazards in foods from areas after a nuclear accident
	Unapproved food or color additives
	Food allergens and substances associated with a food intolerance (e.g., sulfites, gluten)

Source: ดัดแปลงจาก FSPCA Preventive Controls for Human Food V 2.0 Participant Manual

Biological Process-Related and Facility-Related Hazards

Quick Reference Guide for Common Sources of Biological Hazards

Primary Source	Bacteria	Parasites	Viruses
Process-related (การควบคุมกระบวนการที่ไม่มีประสิทธิผลดีพอโดย Suppliers)	• *Salmonella* spp. survive **inadequate heat treatment** • *C. perfringens* **(improperly cooled cooked foods**) • *L. monocytogenes* (raw agricultural commodities, contaminated products)	*Cryptosporidium parvum* (contaminated water source)	N/A
Facility-related (เกิดจากการทำความสะอาดที่ไม่ดีพอ) e.g., inadequate cleaning and sanitizing of potential harborage sites), poor plant and equipment design, and poor pest management practices)	• *L. monocytogenes* (e.g., reservoirs include floors, cold wet areas, equipment, drains, condensate, coolers, and soil) • *Salmonella* spp. (pests)	N/A	Norovirus (only when active shedding occurs in facility through vomiting and diarrhea)
People-related (individuals who are carriers, showing no signs of disease, who are shedding the hazard, or who are infected and are actively ill)	• *S. aureus* • *Shigella* spp. • *Salmonella* spp.	*Cryptosporidium parvum*	• Hepatitis A virus • Norovirus • Rotavirus

Source: ดัดแปลงจาก FSPCA Preventive Controls for Human Food V 2.0 Participant Manual

Chemical Process-Related and Facility-Related Hazards

Quick Reference Guide for Common Sources of Chemical Hazards

Source	Examples
Process-related chemical hazards	• Undeclared allergens due to mislabeling • Unintended food allergen presence due to cross-contact • Improper addition of substances associated with a food intolerance (e.g., sulfites) • Improper use of a color additive such as Yellow No. 5 • Contamination with industrial chemicals such as cleaners or sanitizers • Radiological
Facility-related chemical hazards	Heavy metals due to leaching from equipment, containers, or utensils

Source: ดัดแปลงจาก FSPCA Preventive Controls for Human Food V 2.0 Participant Manual

Physical Process-Related and Facility-Related Hazards

Quick Reference Guide for Common Sources of Physical Hazards

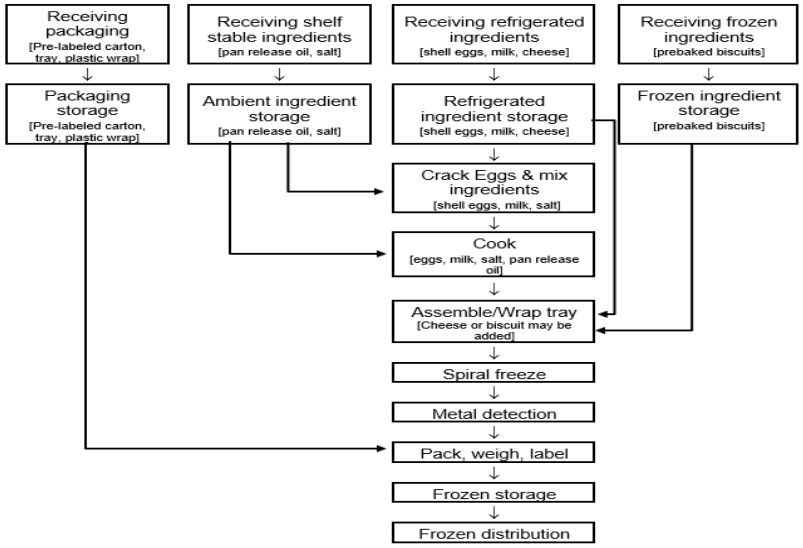
Source	Metal – Ferrous & Non-ferrous	Plastic, Ceramic, & Glass	Other

Facility-related and process-related (processing/production environment, equipment, and pests (insects, birds, rodents, reptiles))	• Equipment
	• Grinders, slicers, knives
	• Sieves, screens, wire-mesh belts
	• Mixing paddles
	• Metal cans (shavings, lids)
	• Pumps
	• Cook Kettles with swept surface paddles
	• Drop buckets
		• Equipment (inspection belts, small wares, buckets)
		• Facility (glass light fixtures, glass windows in doors, plastic strip curtains)
		  • Glass containers
		  • Scoops
		  • Mixing paddles
		  • Buckets
			• Incomplete removal of pits or pit fragments, shells
			• Poor Design -- Particle size of food inappropriate for consumer – choking hazard

People-related (actions or behaviors)	• Jewelry • Hair pins	• Buttons • Zipper pulls	N/A

Source: ดัดแปลงจาก FSPCA Preventive Controls for Human Food V 2.0 Participant Manual

Process-Related and Facility-Related Hazards



Source: ดัดแปลงจาก FSPCA Preventive Controls for Human Food V 2.0 Participant Manual

Hazard Identification Columns 1 & 2

การระบุ Potential Hazard

PRODUCT(S): Omelet – Plain, Cheese, and Cheese Biscuit							**PAGE X of Y**	
PLANT NAME: E.G. Food Company							**ISSUE DATE:**	4/13/2024
ADDRESS: 360 Culinary Circle, Mytown, USA							**SUPERSEDES:**	02/20/2023
(1) **Ingredient/ Processing Step**		(2) Identify potential food safety hazards introduced, controlled, or enhanced at this step	(3) Do any potential food safety hazards require a preventive control? Yes	(3) No	(4) Justify your decision for Column 3	(5) What preventive control measure(s) can be applied to significantly minimize or prevent the food safety hazard? *Process including CCPs, Allergen, Sanitation, Supply-chain, other preventive control*	(6) Is the preventive control applied at this step? Yes	(6) No
List each Ingredient	B	?						
	C	?						
	P	?						
List each Processing Step	B	?						
	C	?						
	P	?						

Source: ดัดแปลงจาก FSPCA Preventive Controls for Human Food V 2.0 Participant Manual

แหล่งข้อมูลที่จะนำมาใช้ในการระบุและประเมิน Hazard

- **Company specific information:**
  - Employee knowledge
  - Facility data (e.g., lab results, consumer/customer complaints)
  - Facility's supplier's performance history
- **Technical experts:**
  - Subject matter experts (e.g., university specialists, trade associations)
  - U.S. and International government agencies
  - FSPCA Technical Assistance Network
- **Reliable internet site examples:**
  - FDA
  - FSPCA
- **Publications:**
  - Trade Association guidance
  - Scientific publications (e.g., peer reviewed literature)
  - FDA Guidance Documents (FDA Hazard Guide, Seafood Hazard Guide, and Juice Hazard Guide)

Source: ดัดแปลงจาก FSPCA Preventive Controls for Human Food V 2.0 Participant Manual

Hazard Identification Columns 1 & 2

Potential Biological and Chemical Ingredient-Related Hazards

(1) Ingredient		(2) Identify potential food safety hazards introduced, controlled, or enhanced at this step	(3) Do any potential food safety hazards require a preventive control? Yes	(3) No	(4) Justify your decision for Column 3	(5) What preventive control measure(s) can be applied to significantly minimize or prevent the food safety hazard? *Process including CCPs, Allergen, Sanitation, Supply-chain, other preventive control*	(6) Is the preventive control applied at this step? Yes	(6) No
Refrigerated Sliced Cheddar Cheese								
Ingredient-related hazards (inherent hazards)	B	Pathogenic *E. coli, Salmonella, L. mono, S. aureus*						
	C	Drug residues						
Supplier process-related and facility-related hazards	B	Bacterial pathogen growth/toxin formation due to poor time/temp control						
	B	Recontamination with environmental pathogens *L. mono*						
	C	Undeclared allergen – milk						
	P	Metal						

Source: ดัดแปลงจาก FSPCA Preventive Controls for Human Food V 2.0 Participant Manual

Preventive Controls คือ อะไร

Those **risk-based, reasonably appropriate procedures, practices, and processes** that a person knowledgeable about the safe manufacturing, processing, packing, or holding of food would employ **to significantly minimize or prevent the hazards identified under the hazard analysis** that are consistent with the current scientific understanding of safe food manufacturing, processing, packing, or holding at the time of the analysis.

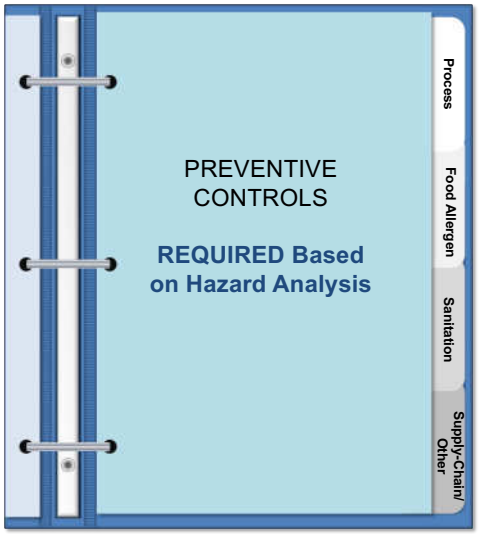
Source: ดัดแปลงจาก FSPCA Preventive Controls for Human Food V 2.0 Participant Manual

ทำไม Preventive Controls จึงจำเป็น

- The facility must identify and implement preventive controls to provide assurances that any hazards the facility has identified requiring a preventive control will be significantly minimized or prevented
- Preventive controls required include critical control points (CCPs) and other controls that are appropriate for food safety
- Preventive controls must be written

Source: ดัดแปลงจาก FSPCA Preventive Controls for Human Food V 2.0 Participant Manual

Preventive Controls



- **Process preventive controls:**
  - Process specific controls
- **Food allergen preventive controls:**
  - Cross-contact prevention
  - Accurate labeling
- **Sanitation preventive controls:**
  - Cleanliness of food-contact surfaces
  - Prevention of cross-contamination and allergen cross-contact
- **Supply-chain preventive controls:**
- **Other preventive controls**
  - If needed

Source: ดัดแปลงจาก FSPCA Preventive Controls for Human Food V 2.0 Participant Manual

ตัวอย่าง Preventive Control

Biological hazards

- Process controls that kill pathogens :
  - Cooking
- Process controls that prevent growth such as:
  - Time/temperature controls
  - Formulation
- Sanitation controls that prevent recontamination
- Supply-chain programs for sensitive ingredients used without a kill step

Chemical hazards

- Allergen labeling
- Sanitation controls to prevent allergen cross-contact
- Supply-chain programs

Physical hazards

- Process controls such as:
  - Filtering, metal detection, X-ray devices

FDA Hazard Guide, Chapter 4

การพิจารณาเลือก Preventive Controls ที่เหมาะสม

- เป็นมาตรการที่สามารถควบคุมอันตรายได้หรือไม่
- โรงงานสามารถกำหนดวิธีการที่ตรวจติดตาม (Monitor) ได้หรือไม่
- มีผลกระทบต่อการควบคุมด้วย preventive controls อื่นหรือไม่
- ความเบี่ยงของกระบวนการที่อาจเกิดขึ้นได้มีมากน้อยแค่ไหน (มีผลต่อการกำหนดค่าเผื่อและความถี่ในการตรวจวัด)
- ความรุนแรงที่อาจเกิดขึ้นหากการควบคุมดังกล่าวล้มเหลว
- การควบคุมดังกล่าวออกแบบมาเฉพาะเพื่อกำจัดหรือลดอันตรายให้อยู่ในระดับปลอดภัย
- การควบคุมดังกล่าวทำให้ต้องมีการเพิ่มการควบคุมอื่นๆ หรือไม่

(1) **Ingredient/ Processing Step**		(2) Identify potential food safety hazards introduced, controlled, or enhanced at this step	(3) Do any potential food safety hazards require a preventive control?		(4) Justify your decision for Column 3	(5) What preventive control measure(s) can be applied to significantly minimize or prevent the food safety hazard?	(6) Is the preventive control applied at this step?	
			Yes	No			Yes	No
Pan release oil (highly processed, shelf stable)	C	Undeclared allergen – soy						
Refrigerated sliced cheddar cheese	B	Recontamination with environmental pathogens *L. mono*	X		Ingredients and finished cheese are ready-to-eat, exposed to environment (during aging, slicing), prior to packaging, and can support pathogen persistence.	Supply-chain Preventive Control at receiving step	X	
	C	Undeclared allergen - Milk						
	P	Metal						

Source: ดัดแปลงจาก FSPCA Preventive Controls for Human Food V 2.0 Participant Manual

(1) Ingredient/ Processing Step	(2) Identify potential food safety hazards introduced, controlled, or enhanced at this step		(3) Do any potential food safety hazards require a preventive control?		(4) Justify your decision for Column 3	(5) What preventive control measure(s) can be applied to significantly minimize or prevent the food safety hazard?	(6) Is the preventive control applied at this step?	
			Yes	No			Yes	No
Refrigerated raw shell eggs	B	Vegetative pathogen – *Salmonella*						
	C	Undeclared allergen – egg						
Refrigerated Pasteurized Grade A Milk	C	Undeclared allergen – milk						
Frozen biscuits	B	Recontamination with environmental pathogens *Salmonella*	X		Frozen biscuits are used as a ready-to-eat ingredient, there is exposure to the environment/further handling after the baking at the supplier (slicing) pathogens can survive in frozen biscuits.	Supply-chain Preventive Control at receiving step	x	
	C	Undeclared allergen – wheat, milk						
	P	Metal						

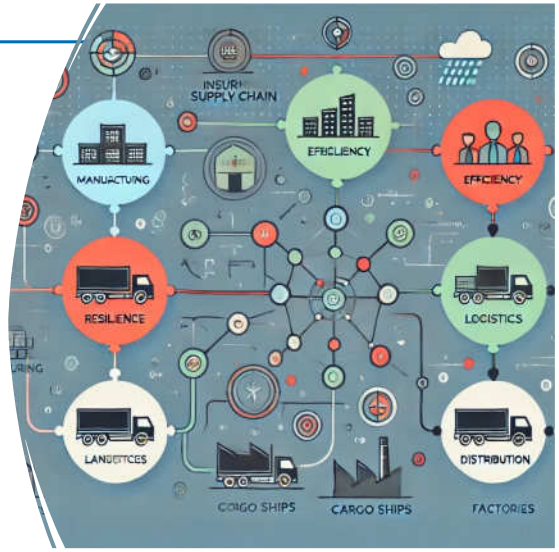
Source: ดัดแปลงจาก FSPCA Preventive Controls for Human Food V 2.0 Participant Manual

(1) Ingredient/ Processing Step Omelet Products	(2) Identify potential food safety hazards introduced, controlled, or enhanced at this step		(3) Do any potential food safety hazards require a preventive control?		(4) Justify your decision for Column 3	(5) What preventive control measure(s) can be applied to significantly minimize or prevent the food safety hazard? *Process including CCPs, Allergen, Sanitation, Supply-chain, other preventive control*	(6) Is the preventive control applied at this step?	
			Yes	No			Yes	No
Receiving Pasteurized Grade A Milk	C	Undeclared allergens – milk						
Receiving frozen biscuits	C	Undeclared allergens – wheat, milk						
Receiving Packaging [Paperboard trays and plastic wrap]	C	Undeclared Allergen – eggs, milk, soy (wheat in biscuit only)	X		Eggs, milk, soy, and wheat are major food allergens and must be declared on the omelet finished products label.	Allergen Control #1 – label check at receipt	X	

Source: ดัดแปลงจาก FSPCA Preventive Controls for Human Food V 2.0 Participant Manual

Risk Assessment in Manufacturing Supply Chain

Ensuring Resilience and Efficiency though supply chain network



Importance of Risk Assessment in Supply Chains

- Increasing complexity of global supply chains
- Risk to consumers, investors, operators
- Vulnerability to disruptions
- Need for proactive risk management
- Supply Chain Risks such as Disruptions, Transportation risks, Geopolitical risks, demand fluctuations, and supplier reliability,

EXAMPLE : Xgenex®

- Xgenex® specializes in using safe, FDA and USDA-approved food ingredients to help food companies eliminate pathogens like salmonella, E. coli, and listeria, while maintaining organic, kosher, and halal certifications. Through its proprietary and patent-pending technologies, Xgenex® ensures that families, food producers, retailers, and restaurants can enjoy worry-free, safe, clean, green, culturally compliant, organic and conventional food experiences.

Key Challenges in Risk Assessment

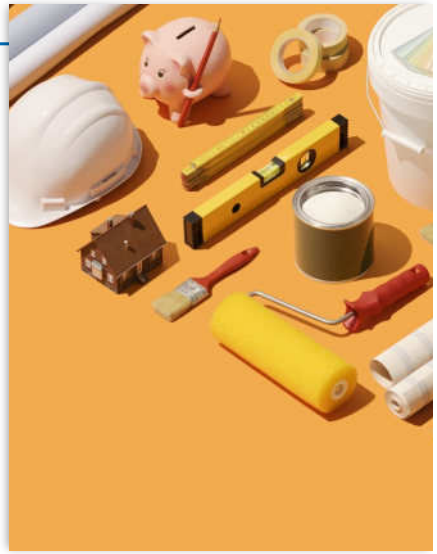
Data availability and accuracy

Complexity of global networks

Evolving risks (e.g., pandemics, cyber threats)

Risk Mitigation Strategies

- Diversification of suppliers
- Implementing technology solutions
- Building inventory buffers
- Strengthening relationships with key suppliers



Case Study: Risk Mitigation

- ABC Foods : Food manufacturing and distribution, **Primary Market**: Global exports (North America, Europe)

Identified Risk : ABC Foods

- High Dependency on a Single Raw Material Supplier
  - **Context**: ABC Foods relied on one key supplier for a critical ingredient.
  - **Problem**: Any disruption—such as supplier bankruptcy, natural disasters, or regulatory shutdown—could halt production and negatively impact sales.

Analysis

- **Risk Assessment Method**:
- Conducted a **Failure Mode and Effects Analysis (FMEA)** to see how a supplier failure might affect different parts of the business.
- Created a **Probability-Impact Matrix** to estimate the likelihood and severity of this disruption.
- **Findings**:
- High probability of supply disruption due to geopolitical uncertainties.
- High impact on production, shipping schedules, and financial performance if a disruption occurred.

Mitigation Strategy

Diversification of Suppliers	• ABC Foods onboarded two alternate suppliers from different geographic regions. • Negotiated contracts ensuring consistent supply and stable pricing.
Inventory Buffer	• Built a strategic safety stock of the critical ingredient to cover four weeks of production. • Installed additional temperature-controlled storage to maintain quality.
Technology Implementation	• Implemented a **Blockchain-based traceability system** to monitor supplier shipments in real-time. • Used **AI-driven demand forecasting** to optimize raw material ordering.

Results and Benefits

- **Operational Resilience**:
- Production continued without disruption, even when the primary supplier briefly shut down due to unforeseen regulatory issues.
- No loss in output or missed customer deliveries.
- **Financial Stability**:
- Maintaining a buffer stock and dual suppliers prevented revenue losses.
- Avoided expensive last-minute sourcing or emergency shipments.
- **Enhanced Customer Trust**:
- On-time deliveries strengthened the brand's reputation for reliability.
- Transparent supply chain tracking boosted consumer confidence.

Lessons Learned : ABC Foods

Proactive Planning: Early identification and analysis of critical risks allowed timely mitigation.

Supplier Relationship Management: Building strong relationships with multiple suppliers creates leverage in negotiations and supply flexibility.

Technological Integration: Real-time monitoring and advanced forecasting significantly reduce uncertainties.

Continuous Improvement: Regularly reviewing and updating risk mitigation strategies keeps the organization prepared for evolving challenges.

Role of Technology in Risk Assessment

- Artificial Intelligence and Machine Learning
- Blockchain for traceability
- IoT for real-time monitoring
- Big Data Analytics

Supply Chain Risk Management Framework

Risk Identification

Risk Assessment

Risk Mitigation

Monitoring and Review

Monitoring and Reviewing Risks

Importance:

Continuous improvement

Adapting to new challenges

Tools:

Key Performance Indicators (KPIs)

Risk dashboards

Benefits of Risk Assessment

ENHANCED DECISION-MAKING

REDUCED OPERATIONAL DISRUPTIONS

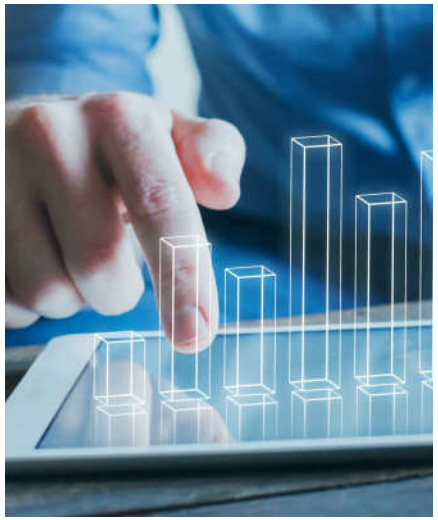
IMPROVED FINANCIAL PERFORMANCE

GREATER CUSTOMER SATISFACTION

Common Pitfalls to Avoid

- Ignoring low-probability high-impact risks
- Overlooking internal risks
- Focusing solely on cost reduction

Future Trends in Risk Assessment



- Increasing use of predictive analytics
- Focus on sustainability risks
- Collaboration across the supply chain

Actionable Steps for Organizations

CONDUCT REGULAR RISK ASSESSMENTS

INVEST IN TECHNOLOGY

TRAIN EMPLOYEES ON RISK MANAGEMENT

COLLABORATE WITH SUPPLY CHAIN PARTNERS

การประเมินความเสี่ยง
และนำเทคโนโลยีสมัยใหม่ไปใช้ในการจัดการ

- เข้าใจขั้นตอนการผลิต
- เข้าใจ Supply Chain
- เข้าใจความเสี่ยงใน Supply Chain
- มองหาเทคโนโลยีที่เหมาะสม
- เตรียมความพร้อมขององค์กร
- **ลงมือทำ**

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