
Problem Analysis Example

Problem Background

Our nutritional drinks were once bought only by athletes and bodybuilders, but the increasing number of diabetics, the graying population, and the popularity of high-protein diets has tripled the demand for our products. Needless to say, we are delighted with the results and want this trend to continue to grow.

Our drinks are available in 8-fluid-ounce (237 ml) servings and come in four flavors: chocolate, vanilla, strawberry, and the newly added tropical fruit of which consumers cannot seem to get enough. As a result, inventory turns every three weeks.

The bottles are made of recycled plastic, heat sealed for good shelf-life, with a tamper-evident cap for maximum security. Tropical fruit's bottle is of thinner plastic material and the supplier of that material recently changed. The safety seal on this bottle requires higher temperatures for better adhesion. Eventually, bottles for all flavors will use this thinner material and the new safety seal.

As tropical fruit's popularity increased, a few changes were introduced to accommodate the growth in demand. Marketing switched its shipping carton from an 18-pack to 24-pack. Shipping switched palletizing the cartons from bottom down to side stacking to improve loading efficiencies when shipping a full truck load of a single product. For partial loads or when mixed products are shipped, the cartons continue to be palletized bottom down.

Recently we have received numerous complaints about leaking tropical fruit bottles from distributors and customers in three of nine districts. They say the leaks are caused by a thin crack near the bottle's neck. We need to find out what is causing this to happen. Quality Control has been tasked with solving this problem.

Describe Problem		Identify Possible Causes	
State the problem (one object, one deviation)		Use knowledge and experience OR...	
What object (or group of objects) has the deviation? What do we see, hear, feel, taste, smell, or measure that tells us there is a deviation?	What deviation does it have? What data tells us it exists?	What pairs in the Problem Specification are surprising? What else could have caused this deviation?	
Tropical Fruit 8-floz bottles are cracking.		...Use distinctions and changes	
Specify the problem		Look for Distinctions	
Pattern = continuous, periodic, sporadic, single occurrence Trend = increasing, decreasing, stable		What is different, odd, unusual, special, unique, or peculiar about each IS compared to its IS NOT? What else is different...? • New information • Based on facts • True only of the IS	
	IS	IS NOT	Distinctions
WHAT			
What object?	Tropical Fruit 8-floz bottles	Chocolate 8-floz, Vanilla 8-floz, Strawberry 8-floz bottles	Bottle made from thinner plastic material Shipping carton
What deviation?	Cracked	Missshapen, dented, squashed	
WHERE			
Where geographically?	Districts 1, 3, and 8 Random distributors and customers within Districts 1, 3, and 8	Districts 2, 4, 5, 6, 7, and 9 Distributors/customers in specific areas; all distributors	Greater demand for Tropical Fruit 8-floz bottle Shipping method
Where on the object?	Around the neck of the bottle	Cap, sides, body, bottom of bottle	Safety seal operation
WHEN			
When first?	20-May (first complaint)	19-May and before	
When since?	Every day since 20-May (21-May; 22-May; 23-May; 24-May, and so on including today)	Alternate days; occasionally; none at all	
What pattern?	Continuous (getting complaints daily)	Periodically, sporadically, single occurrence	
When in the life cycle?	During unpacking by distributor	During Quality Control; during storage in production warehouse	
EXTENT			
How many objects?	District 1—369 cracked bottles District 3—285 cracked bottles District 8—750 cracked bottles Total—1,404 (5% of 28,000 bottles shipped are cracked)	More or less; all	
What is the trend?	NMD (complaints are increasing, but no data on trend in number of cracked bottles)	NMD	
What is the size?	Very thin crack (1-3 mm long)	Wider or longer crack	
What is the trend?	Stable	Increasing, decreasing	
How many deviations?	One crack per bottle	More than one	
What is the trend?	Stable	Increasing, decreasing	

		Evaluate Possible Causes			
Record possible causes		Test possible causes			
What causes do they suggest? What would experts say? What was our initial hunch?		For each IS/IS NOT pair, answer the following question: If (Possible Cause) is the cause of (Problem Statement), then how does it explain both the IS and IS NOT information? (Y) YES, explains because... (N) NO, does not explain because... Record supporting data			
Look for Changes What changed in, on, around, or about each distinction? When did the change occur? Record date and time What else has changed...? If no change, use NKC—No Known Change	How could this... Change Change plus distinction Change plus change Distinction ...cause this deviation?			(A) Explains ONLY IF assumption... List all assumptions	
			Possible Cause		Possible Cause
		MPC	Sub-standard material from new supplier causes cracking during shipment	MPC	Higher temperature heat seal weakens top of bottle causing it to crack
Changes	Date	Y, N, A		Y, N, A	
New supplier: Thin Plastic Increased from 18-pack to 24-pack carton	11-May 1-Apr	Y	...only Tropical Fruit 8-floz bottles use material from new suppliers	Y	...only Tropical Fruit 8-floz bottles use the higher temperature seal
		A	...the defective material is vulnerable to cracking and not to other deviations	A	...the higher temperature applied to the seal causes the neck to crack
		N	...Tropical Fruit bottles made from this material shipped to all districts	A	...the neck which is weakened by the higher temperature seal cracks during shipping and distribution to Districts 1, 3, and 8 ...only if these distributors and customers handle the product in a way that creates the cracking
				A	
				Y	... (given the 3 week inventory turn) inventory containing bottles with new hightemp seal would just be starting to be used
				Y	... (given the 3 week inventory turn) inventory containing bottles with new high-temp seal would continue to be used
				Y	... (given the 3 week inventory turn) inventory containing bottles with new high-temp seal would continue to be used
				A	...something during transport stresses the bottle causing it to crack
				A	...heat sealing is affecting some bottles and not others
				A	...heat sealing is affecting more bottles over time
				A	...heat sufficient to make plastic brittle; only penetrates <3mm from top of bottle
				A	...heat sealing process does not vary significantly from bottle to bottle
				A	...a single crack sufficiently relieves pressure so no more cracking occurs
				A	...a single crack sufficiently relieves pressure so no more cracking occurs

Evaluate Possible Causes				Evaluate Possible Causes																																																																														
Test possible causes For each IS/IS NOT pair, answer the following question: If (Possible Cause) is the cause of (Problem Statement), then how does it explain both the IS and IS NOT information? (Y) YES, explains because... (N) NO, does not explain because... Record supporting data				Determine most probable cause Which of these possible causes makes the most sense? Most probable cause (MPC) has: Assumptions that make the most sense in this situation Most reasonable assumptions Overall simplest assumptions Fewest assumptions																																																																														
<div> <div> <input type="checkbox"/> MPC Y, N, A </div> <div> Possible Cause 24-pack does not provide adequate protection for the bottles </div> </div> <div> <div> <input checked="" type="checkbox"/> MPC Y, N, A </div> <div> Possible Cause On-the-side stacking plus full truck load puts too much stress on the bottles </div> </div>				Confirm True Cause Verify assumptions, observe, experiment, or try a fix and monitor What can be done to verify any assumptions made? How can this cause be observed at work? How can we demonstrate the cause-and-effect relationship? When corrective action is taken, what results will indicate that we have identified the true cause? Use the safest, easiest, quickest, cheapest, surest way																																																																														
<table border="1"> <thead> <tr> <th></th> <th>Possible Cause</th> <th></th> <th>Possible Cause</th> </tr> </thead> <tbody> <tr> <td>Y</td> <td>...only Tropical Fruit 8-floz bottles come in 24-packs</td> <td>Y</td> <td>...only Tropical Fruit 8-floz bottles are currently shipped side stacked</td> </tr> <tr> <td>A</td> <td>...the defective material is vulnerable to cracking and not to other deviations</td> <td>A</td> <td>...side stacking and motion during shipment squeezes the bottles just enough to cause the crack but not enough to create the other deviations</td> </tr> <tr> <td>A</td> <td>...there is extra stress on the cartons during distribution to Districts 1, 3, and 8 ...only if these distributors and customers handle the product in a way that creates the cracking</td> <td>Y</td> <td>...these are areas where demand is highest and so bottles are shipped side stacked (single product, full truck load) ...because there is no pattern to the distribution (any carton has an equal chance of going to any distributor or customer)</td> </tr> <tr> <td>A</td> <td>...only if packaging stresses just the neck of the bottle and no other parts</td> <td>A</td> <td>...side stacking and motion during shipment squeezes the bottles just enough to cause the crack around the neck but not enough to create cracks in any other locations</td> </tr> <tr> <td>N</td> <td>...24-pack introduced 1-April; inventory turns every 3 weeks; problem would have occurred earlier than 20-May</td> <td>Y</td> <td>... shipping method changed 15-April which is sufficient time for bottles shipped by new shipping method to have reached distributors and customers</td> </tr> <tr> <td></td> <td></td> <td>Y</td> <td>... shipping method changed 15-April and has not changed since</td> </tr> <tr> <td></td> <td></td> <td>Y</td> <td>...shipping method changed 15-April and has not changed since</td> </tr> <tr> <td></td> <td></td> <td>A</td> <td>...side stacking and motion during shipment squeezes the bottles</td> </tr> <tr> <td></td> <td></td> <td>A</td> <td>...side stacking and full truck load affecting just this number of bottles (are they at the bottom of the stack?)</td> </tr> <tr> <td></td> <td></td> <td>Y</td> <td>...shipments are increasing to meet rising customer demand</td> </tr> <tr> <td></td> <td></td> <td>A</td> <td>...side stacking and motion during shipment squeezes the bottles just enough to cause the thin crack</td> </tr> <tr> <td></td> <td></td> <td>Y</td> <td>...shipping method changed 15-April and has not changed since</td> </tr> <tr> <td></td> <td></td> <td>A</td> <td>...a single crack sufficiently relieves pressure so no more cracking occurs</td> </tr> <tr> <td></td> <td></td> <td>A</td> <td>...a single crack sufficiently relieves pressure so no more cracking occurs</td> </tr> </tbody> </table>					Possible Cause		Possible Cause	Y	...only Tropical Fruit 8-floz bottles come in 24-packs	Y	...only Tropical Fruit 8-floz bottles are currently shipped side stacked	A	...the defective material is vulnerable to cracking and not to other deviations	A	...side stacking and motion during shipment squeezes the bottles just enough to cause the crack but not enough to create the other deviations	A	...there is extra stress on the cartons during distribution to Districts 1, 3, and 8 ...only if these distributors and customers handle the product in a way that creates the cracking	Y	...these are areas where demand is highest and so bottles are shipped side stacked (single product, full truck load) ...because there is no pattern to the distribution (any carton has an equal chance of going to any distributor or customer)	A	...only if packaging stresses just the neck of the bottle and no other parts	A	...side stacking and motion during shipment squeezes the bottles just enough to cause the crack around the neck but not enough to create cracks in any other locations	N	...24-pack introduced 1-April; inventory turns every 3 weeks; problem would have occurred earlier than 20-May	Y	... shipping method changed 15-April which is sufficient time for bottles shipped by new shipping method to have reached distributors and customers			Y	... shipping method changed 15-April and has not changed since			Y	...shipping method changed 15-April and has not changed since			A	...side stacking and motion during shipment squeezes the bottles			A	...side stacking and full truck load affecting just this number of bottles (are they at the bottom of the stack?)			Y	...shipments are increasing to meet rising customer demand			A	...side stacking and motion during shipment squeezes the bottles just enough to cause the thin crack			Y	...shipping method changed 15-April and has not changed since			A	...a single crack sufficiently relieves pressure so no more cracking occurs			A	...a single crack sufficiently relieves pressure so no more cracking occurs	Confirmation <table border="1"> <thead> <tr> <th>Use:</th> <th>Actions to Confirm</th> <th>Responsibility/Timing</th> </tr> </thead> <tbody> <tr> <td>Verify Assumptions</td> <td>Check the loads before and after shipment to verify the location of the bottles with cracks</td> <td>Shipping Manager 2 days' sampling of shipments (28-31 May)</td> </tr> <tr> <td>Observe</td> <td>Measure the amount of movement inside the truck</td> <td>Quality Control Engineer 2 days (28-31 May)</td> </tr> <tr> <td>Experiment</td> <td>Experiment in the lab how much pressure would be needed for the bottle to crack</td> <td>Quality Control Engineer 2 days (28-31 May)</td> </tr> <tr> <td>Try a Fix and Monitor</td> <td>Return to bottom-down stacking and check the loads before and after shipment to see if the problem disappears</td> <td>Shipping Manager 2 days' sampling of shipments (28-31 May)</td> </tr> </tbody> </table>				Use:	Actions to Confirm	Responsibility/Timing	Verify Assumptions	Check the loads before and after shipment to verify the location of the bottles with cracks	Shipping Manager 2 days' sampling of shipments (28-31 May)	Observe	Measure the amount of movement inside the truck	Quality Control Engineer 2 days (28-31 May)	Experiment	Experiment in the lab how much pressure would be needed for the bottle to crack	Quality Control Engineer 2 days (28-31 May)	Try a Fix and Monitor	Return to bottom-down stacking and check the loads before and after shipment to see if the problem disappears	Shipping Manager 2 days' sampling of shipments (28-31 May)
	Possible Cause		Possible Cause																																																																															
Y	...only Tropical Fruit 8-floz bottles come in 24-packs	Y	...only Tropical Fruit 8-floz bottles are currently shipped side stacked																																																																															
A	...the defective material is vulnerable to cracking and not to other deviations	A	...side stacking and motion during shipment squeezes the bottles just enough to cause the crack but not enough to create the other deviations																																																																															
A	...there is extra stress on the cartons during distribution to Districts 1, 3, and 8 ...only if these distributors and customers handle the product in a way that creates the cracking	Y	...these are areas where demand is highest and so bottles are shipped side stacked (single product, full truck load) ...because there is no pattern to the distribution (any carton has an equal chance of going to any distributor or customer)																																																																															
A	...only if packaging stresses just the neck of the bottle and no other parts	A	...side stacking and motion during shipment squeezes the bottles just enough to cause the crack around the neck but not enough to create cracks in any other locations																																																																															
N	...24-pack introduced 1-April; inventory turns every 3 weeks; problem would have occurred earlier than 20-May	Y	... shipping method changed 15-April which is sufficient time for bottles shipped by new shipping method to have reached distributors and customers																																																																															
		Y	... shipping method changed 15-April and has not changed since																																																																															
		Y	...shipping method changed 15-April and has not changed since																																																																															
		A	...side stacking and motion during shipment squeezes the bottles																																																																															
		A	...side stacking and full truck load affecting just this number of bottles (are they at the bottom of the stack?)																																																																															
		Y	...shipments are increasing to meet rising customer demand																																																																															
		A	...side stacking and motion during shipment squeezes the bottles just enough to cause the thin crack																																																																															
		Y	...shipping method changed 15-April and has not changed since																																																																															
		A	...a single crack sufficiently relieves pressure so no more cracking occurs																																																																															
		A	...a single crack sufficiently relieves pressure so no more cracking occurs																																																																															
Use:	Actions to Confirm	Responsibility/Timing																																																																																
Verify Assumptions	Check the loads before and after shipment to verify the location of the bottles with cracks	Shipping Manager 2 days' sampling of shipments (28-31 May)																																																																																
Observe	Measure the amount of movement inside the truck	Quality Control Engineer 2 days (28-31 May)																																																																																
Experiment	Experiment in the lab how much pressure would be needed for the bottle to crack	Quality Control Engineer 2 days (28-31 May)																																																																																
Try a Fix and Monitor	Return to bottom-down stacking and check the loads before and after shipment to see if the problem disappears	Shipping Manager 2 days' sampling of shipments (28-31 May)																																																																																
Think Beyond the Fix Extend the cause What other damage could this cause create? <ul style="list-style-type: none"> Work hazard at distributor's (slippery floors) Distributors request replacements (increased cost/lower gross margin) Customers stop buying product (concerned about product tampering) Where else could the cause create problems? <ul style="list-style-type: none"> This stacking method is being considered for other products; it could cause the same issue there What caused the cause? <ul style="list-style-type: none"> Shipping loaders completed review of workflows and loading efficiencies. While this change created better workflows and efficiencies for them, not fully testing it created this unintended problem 																																																																																		
Extend the fix Record proposed fix → Return to bottom-down stacking What identical things need the same fix? <ul style="list-style-type: none"> None at this time What problems could this fix cause? <ul style="list-style-type: none"> It will reintroduce the workflows and loading inefficiencies back into the loading process 																																																																																		