

Fault Tree Analysis

For Root Cause Analysis of Sporadic Events



Debra Detwiler, Bridgestone Americas

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Agenda

- Welcome
- Introduction of MBB Webcast Series
 - Larry Goldman, MoreSteam.com
- "Fault Tree Analysis for Root Cause Analysis of Sporadic Events"
 - Debra Detwiler, Bridgestone Americas
- Open Discussion and Questions





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- Founded 2000
- Over 250,000 Lean Six Sigma professionals trained
- Serving 45% of the Fortune 500
- First firm to offer the complete Black Belt curriculum online
- Courses reviewed and approved by ASQ
- Registered education provider of Project Management Institute (PMI)





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- Go to <u>http://www.moresteam.com/master-black-belt.cfm</u> for more information about curriculum, prerequisites, and schedule





Today's Presenter



Debra Detwiler

Master Black Belt, Bridgestone Americas

- Responsible for Six Sigma training and coaching primarily for North American sites
- 33 years experience training, coaching, auditing, operations, management, and quality consulting
- Certified Quality Engineer (CQE)
- B.S. in Statistics from Bowling Green University, M.B.A. from the University of Akron



Today's Topics

- Bridgestone's Integrated Quality Strategy
- Problem Solving Challenges
- The use of Fault Tree Analysis
- The Challenger Case Study
- Event Fault Tree Analysis Process
- Tire Manufacturing Example
- Keys to Success

Major Facilities



Bridgestone Retail & Commercial Operations



AMERICA'S HOME FOR TIRES & SERVICE

COBRE TIRE

2,200 Tire & Vehicle Service Centers across the U.S.















Problem Solving Challenges

- Lack of defined problem solving methodology
- Lack of appropriate triggers and level of activity necessary
- Lack of management attention and critique
- Jumping to conclusions without data and evidence
- Formulating cause and countermeasures before analysis has been conducted
- Focus on physical causes, with little regard to human causes
- Behavior is difficult to modify

The Use of FTA

Problems encountered and application of FTA

Priority

- Misproductions
- Accidents
- Environmental Releases
- Explosions
- Product Freezes
- Major Customer Concerns

- Spec Errors
- Mold Problems
- Production Delays
- Manufacturing Errors
- Quality Issues
- Near miss Accidents or Injuries

The Use of FTA for Root Cause Analysis of Sporadic Events

Analyze **I**mprove Control **Define & Measure** 5 3 Confirm 2 Conduct Implement Define Develop **Results and Fault Tree** Counter-Problem **Timeline** Change Analysis measures **Standards** С D&M Α The thought process resembles DMAIC, but we use a different set of tools. We are addressing the sporadic event (isolated incident) rather than the chronic variation.

Do you remember where you were on January 28, 1986 ?

"The Challenger Case Study"

Challenger STS 51-L : 11:38 A.M.

Ellison Onizuka Christa McAuliffe Greg Jarvis Judy Resnik



At 58 seconds into the flight ...



Telemetry data showed that there was a loss of pressure in the right Solid Rocket Booster (SRB)

Challenger STS 51-L: Jan 28, 1986 11:38 A.M.



Do you remember what the root cause was reported as ?

At 73 seconds... Oxygen and Hydrogen Escaped at 44,000 ft





Why TreeTM - as presented by Bob Nelms, Failsafe Networks

http://failsafe-network.com/



Why did the Flame Escape ?...



Investigators ran the tape frame by frame from the launch pad ...

- at t-3 seconds, orbiter engines ignited to create initial thrust
- at t=0 seconds, Solid Rocket Boosters ignited (SRB's + fuel = 2,400,000 lbs)
- Attachment bolts are popped
- "Wawa" effect begun (3 / sec.)
- Multiple smoke puffs timed (3 / sec.)

@ 0.5 sec. after ignition, smoke appears

Why did the Flame Escape ?...



Why the **right** SRB and not the left ?

- Right SRB was in the shade (internal temp estimated at 32°)
- Left SRB was in the sun (internal temp estimated at 55°)

Why was this launch different ?

Challenger was doomed on the launch pad

Cold temperature launch



This was the launch tower in Cape Canaveral, Florida

This was the coldest launch ever

- 32° at launch
- 26 °earlier that morning

It was the O-Rings

- SRB's are manufactured in segments
- Shipped from Morton Thiokol (Utah) and sent by railroad to Florida
- SRB segments assembled and sealed using two flexible O-rings



It was the O-Rings

True, but was there more evidence?

- 1977 test using strain gauges at ignition (4 yrs before the first shuttle flight)
- Booster segment walls were more flexible than expected and joints were stiffer than expected
- We must have had an O-Ring leak but there was no leak, no smoke puffs
- The O-Rings were damaged but no leak
- The wall took 15 milliseconds for max deflection
- It took the O-Rings 5 milliseconds to expand (3:1 safety factor)



It was the O-Rings

True, but was there more evidence?

- NASA was presenting the test results to congress
- Dr. Richard Feynman, Noble physicist challenged NASA "What temperature did you run these tests ?"
- Demonstration with a C-clamp, a caliper, and a bucket of ice
- How long do you think it took the O-Ring to fully expand ?







Launch Decision Flow 2 weeks prior to launch



Launch Decision Flow 16 hrs prior to launch

Weather Report : 26° launch temp predicted



Launch Decision Flow 16 hrs prior to launch

In case of problems, NASA uses the Anomaly Feedback Flow



Morton Thiokol Go / No Go Decision on Low Temp Launch

- We suspected O-Ring problems since 1977
- We confirmed it in 1981 after first shuttle launches had 30% O-Ring damage
- Of 24 flights, 7 have experienced O-Ring damage
- This is way beyond the known flight envelope of 53°
- The worst O-Ring damage was at 53°

<u>Conclusion : No Go – delay launch until 53°</u>

NASA

Marshall Spaceflight Center – Huntsville, Ala

- We've already had 4 major delays here's another schedule we'll miss
- State of the Union Address is 1/28 and President Reagan intends to speak with Christa McAuliffe in orbit
- The spacecraft is qualified to 40°
- We've approved the waivers 24 times before
- The second O-Ring will seal
- There might not even be a temperature problem – data inconclusive
- There is an element of risk in every launch

Conclusion : Let's test them, if they hold, we'll delay

Morton Thiokol Go / No Go Decision on Low Temp Launch

- They are the customer and they are resisting
- Contract renewal is tomorrow : It's Rockwell or us (40,000 people depend on these jobs)
- We've gotten away with this before, maybe engineering is being too cautious
- The data is inconclusive



What Was the True Root Cause?

Was it the temp at launch?

Was it the design of the SRB?

Was it the O Rings?

Was it the decision process of MMT?

Was it the nature of Morton Thiokol's CEO or NASA's leadership ?

"Root Cause" Analysis Don't Neglect the Human factor

"Human beings cause problems"

It's not always -

- Systems
- Designs
- Culture

Life : A seemingly endless series of situations to which we must respond

Bob Nelms – Failsafe Networks

We All Must Accept Responsibility for Our Role When Problems Occur

It is rare to find individuals who can <u>see their own role</u> in things that go wrong.

If you ask them to, they will!

Event FTA Process

1 Define Problem

- Preserve the scene, if appropriate
- Gather data (i.e. statements, photographs and records)
- Genbutsu Genba
- Capture the product and evidence (containment)
- Situation analysis
- Lot traceability
- Temporary countermeasure
- Release / restart of process

2 Develop Timeline

D&M

- Investigate and discern facts
- Interviews / statements
- Understand the process and what happened
- Analyze data and current state
- Chronology of events (sequence)
- Process map / timeline / event analysis
- Compare process to standard

Event FTA Process

- **3** Conduct Fault Tree Analysis
 - Structured brainstorming of possible causes
 - Identification of major phenomena
 - Cause analysis
 - Identification of root cause
 - Develop countermeasures

Event FTA Process

4 Implement Countermeasures

- Develop "Should" process and implement
- Short and long term countermeasures
- Countermeasure causes
- Kaizen (improve) process
- Conduct necessary training
- Develop control plans and/or standards, if appropriate

Event FTA Process

5 Confirm Results and Change Standards

- See countermeasures through
- Monitor "Should" process
- Develop/change standards, as necessary
- Control and standardize
- Standardize and institutionalize
- Evaluate results

С

Track progress via audits

Timeline : What Happened

Key TOON The Fault Tree : Why It Happened

HDCT Tires Treaded with the Wrong Compound

Event FTA Template

Date: February 2009

Triggering Event

Insert basic description of TRIGGERING EVENT here.

Use the word "Anonymous" if the person's identity must be protected. Keep it simple.

Who (did it happen to)?	Des Moines Cold Feed Extruder Area (Agricultural Tire)						
What (was the undesired actual/potential consequence)?	18 tires treaded with the wrong tread compound. Employee used V2887 rubber, but spec rubber is V2807						
Where (did it happen)?	B2B3 Dept. 178						
When (did it happen)?	8:10am 1-6-2009						
How do you know it is contained (esp. product)?	Used PICS data to track down tires treaded on B2B3 on 1-6-2009. Held all tires treaded on this shift. Cut rubber samples from each tire and took them to the lab to have the stock tested.						
How did you know it was OK to restart (stabilization)?	All tires that passed the MRC lab retest were released from hold.						
Your Name:	Manager						
Completion Date:	1-8-2009						

Summary of Data Gathering Approach

A few **BULLETS**, in **GENERAL** terms, referring to containment and collection of data

Containment

- Stop: Once warm up sample was found to test bad, production in curing stopped.
- Assess: Verified what tires were involved.
- Isolate: All tires were frozen in PICS and placed in storage with hold tags on them.
- Stabilize: Due to complications, it took 16 hrs. to locate all tires.
- Re-Start: Until all suspect tires were verified to have been placed on hold, curing was shut down. Production resumed after 16 hours.
- Evidence Plan (What do I need to know?)

Paper:

See photo's on next page for outline

What is the Problem? (what question will you answer in this FTA -- should relate to <u>WHAT</u> on page 2)

Why were tires treaded with wrong stock?

Process High Level (Actual)

Insert labeled schematics identifying the issue so the reader can understand the remainder of this document.

Can be hand drawn. Keep it simple.

Stabilization Overview

Insert schematic, drawing, data table, etc. indicating containment and stabilization. Keep it **simple** yet informative. Review with others to confirm your thinking. Effective **Containment** and **Stabilization** is critical.

090106-WI	QVGV-	VI	1	1/7/2009 02:21	14.95	>	2.59	>	0.43	0.70	0.9	3	0.110	MDR1	Fail
090106-WI	QVGW-	1.	1	1/7/2009 02:22	15.10	N	2.66	>	0.44	0.71	0.9	4	0.111	MDR1	Fail
090106-WI	QVGX-	1	2	1/7/2009 02:24	14.88	>	2.56	>	0.43	0.71	0.9	5	0.109	MDR1	Fail
090106-WU	QVMV-	1.	2	1/7/2009 02:15	10.62	>	2.07		0.39	0.67	1.1	3	0.136	MDR1	Fail
090106-WI	QVN4-	1	1	1/7/2009 02:16	15.34	>	2.73	>	0.44	0.70	0.9	3	0.111	MDR1	Fail
) 090106-WI	QVNB-	1	1	1/7/2009 02:19	14.99	>	2.63	>	0.44	0.71	0.9	4	0.110	MDR1	Fail
090106-WU	QVT8-	1	1	1/7/2009 02:27	7.96		1.87		0.42	0.75	1.3	5	0.171	MDR1	Pass
! 090106-WI	QVT9-	1	1	1/7/2009 02:30	6.95	-	1.19	<			?		0.168	MDR1	Fail
: 090106-WU	QVTB-	1	1	1/7/2009 02:32	7.66		1.95		0.43	0.74	1.3	3	0.157	MDR1	Pass
. 090106-WL	AVTC-	1	1	1/7/2009 02:35	7.99		1.93		0.44	0.76	1.3	3	0.160	MDR1	Pass
090106-WU	AVTD:	1	1	1/7/2009 02:37	7.99		1.85		0.43	0.74	1.3	2	0.169	MDR1	Pass
i 090106-WU	QVTF-	1	1	1/7/2009 02:40	8.06		1.96		0.44	0.76	1.3	4	0.170	MDR1	Pass
090106-WU	QVTG-	1	1	1/7/2009 02:43	7.99		1.87		0.43	0.74	1.3	3	0.169	MDR1	Pass
090106-WU	QVTH-	1	1	1/7/2009 02:45	7.86		1.80		0.43	0.74	1.3	3	0.163	MDR1	Pass

Physical Evidence

Insert labeled photos and sketches of PHYSICAL EVIDENCE here.

Make sure ALL items referred-to in other portions of this document are included. Keep it simple.

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People Evidence

WHO said WHAT

Always interview with someone else present to have dual confirmation of who said what. Develop interview guidelines.

Manager: We had an issue on 1-6-2009 with tires that were treaded with the wrong rubber. How did this happen?

Operator: I don't know, every time I scan a skid I check the ticket and try to find a stamp on the load.

Manager: Why didn't you scan this load into the extruder?

Operator: I always try to.

Manager: Do you always scan the rubber into the cfe?

Operator: Not always if it is a large skid yes, if it is a small skid no.

Manager: You do know you are suppose to scan every load in correct?

Operator: Yes. But I can tell the difference between the rubbers.

Manager: Do you think you can always tell the difference between the right rubber and wrong rubber?

Operator: Yes, but I always try to find the stamp.

Manager: We have 4 different standards that say we scan and verify loads vs. spec for tires. All 4 of these standards could have prevented this from happening. Why didn't you follow them?

Operator: I just didn't scan. It was a small skid and a fast tire.

Paper Evidence

WHAT said WHAT

15 DIGITS	UP SA		NC. OVE	RVIEV	TES	TRES	SULTS	5		1/6/20	009	Page: 1
	1 18-	MPLE	OgRom		V280	7WU						
HNORS	280	5		Bx-	60	-						
- 1 De	EB -		- 111									
1-6	TIRE	NO		P								
11-4		NO	3.5	-	1 2	900						
reparauc	DIETIME	8	51	2	6							
aeina meth	loas BBY		20	474								
		40	Fet F	M								
			- 17 100									
ompound		: V2	2807WU	4700								
estcode		· MI	DB		MDR	Rhee	omete	r				
stoode			5									
Orderno.	Batch	Test	Date/Time	T-Max	T-Min	R10	R50	R90	Td@T-Max	MachineID	Status	
	L'annian I			In.Lb.	In.Lb.	m.m	m.m	m.m	In.Lb.			
Lower specific	ation limit		Sector Contractor	6.50	1.50		0.61					
Upper specific	ation limit			9.50	2.30		0.85					int
00040634011	Papa 0712	1	1/6/2000 00-55	8.00	1.85	0.44	0.77	1 39	0.162	MDB11	Pass	115
090100-000	B2B3- 0712 B2B3- 0851	1	1/6/2009 16:17	14 24 >	2 43 >	0.45	0.73	0.97	0,107	MDR10	Fail	-
000106-14/11	0200 0001		1/6/2009 16:44	14.95 >	2.52 >	0.42	0.69	0.92	0.108	MDR1	Fail	2-113
090106-WU	B2B3-0851				2 40 >	0.10	0.71	0.05	0.106	MDR11	Fail	1
090106-WU 090106-WU 090106-WU	B2B3- 0851 b2b3- 0851	- 1	1/6/2009 15:51	14.56 >	2.40 2	0.43	0.11	0.95	0.100			
090106-WU 090106-WU 090106-WU	B2B3- 0851 b2b3- 0851	1	1/6/2009 15:51	14.56 >	2.40	0.43	0.11	0.551	0.100			
090106-WU 090106-WU 090106-WU Statistics calco	B2B3- 0851 b2b3- 0851 ulated with limits ve	1 ersion:	1/6/2009 15:51 Totals:	14.56 >	2.40	0.43	0.11	0.93	0.100			
090106-WU 090106-WU 090106-WU Statistics calco	B2B3- 0851 b2b3- 0851 ulated with limits ve	1 ersion:	1/6/2009 15:51 Totals:	14.56	2.40	0.43	4	4	4			
090106-WU 090106-WU 090106-WU Statistics calco Number of me Minimum	B2B3- 0851 b2b3- 0851 ulated with limits ve asurements	1 arsion:	1/6/2009 15:51 Totals:	14.56	4	0.43 4 0.42	4 0.69	4 0.92	4 0.106			
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090106-WU 090106-WU 090106-WU Statistics calor Number of me Minimum Maximum Mean value Bange	B2B3- 0851 b2b3- 0851 ulated with limits vo asurements	2 1 arsion:	1/6/2009 15:51 Totals:	14.56 > 4 8.00 14.95 12.94 6.95	4 1.85 2.52 2.30 0.67	0.43 4 0.42 0.45 0.43 0.03	4 0.69 0.77 0.72 0.08	4 0.92 1.39 1.06 0.47	4 0.106 0.121 0.121 0.056			
090106-WU 090106-WU Statistics calco Number of me Minimum Mean value Range Standard devi	B2B3- 0851 b2b3- 0851 ulated with limits ve asurements	ersion:	1/6/2009 15:51 Totals:	14.56 > 4 8.00 14.95 12.94 6.95 3.304	4 1.85 2.52 2.30 0.67 0.304	4 0.42 0.45 0.43 0.03 0.013	4 0.69 0.77 0.72 0.08 0.034	4 0.92 1.39 1.06 0.47 0.223	4 0.106 0.162 0.121 0.056 0.0275			
090106-WU 090106-WU Statistics calco Number of me Minimum Maximum Mean value Range Standard devi	B2B3-0851 b2b3-0851 ulated with limits ve assurements	ersion:	1/6/2009 15:51 Totals:	14.56 > 4 8.00 14.95 12.94 6.95 3.304	4 1.85 2.52 2.30 0.67 0.304	0.43 0.42 0.45 0.43 0.03 0.013	4 0.69 0.77 0.72 0.08 0.034	4 0.92 1.39 1.06 0.47 0.223	4 0.106 0.162 0.121 0.056 0.0275			

HOL

The follow standards give operator instructions :

Standard 178-26 loading rubber at cfe's Standard 178-23 cfe rubber sampling Standard 178-17 green tire to spec rubber ID Standard 763-20 warm up sampling

Paper Evidence

WHAT said WHAT

The follow standards were not followed by operator :

Standard 178-26 loading rubber at cfe's Standard 178-23 cfe rubber sampling Standard 178-17 green tire to spec rubber ID Standard 763-20 warm up sampling

Summary Sequence of Events

Approximately **10 bullets**, IN **GENERAL** TERMS, referring to the schematic

	Eve	ent Time	eline	e Form
Who/What	TIME	Component - Machine		Comments:
loaded w rong rubber into cfe.	810am			
didn't scan rubber into extruder	811am			
treaded 18 tires ussing v2887 rubber instead of v2807 rubber	850am			
Took rubber sample and information off v2887 ticket	851am			
cfe rubber sample w as taken to the lab	2pm			
LAB CALLED DOWN TO TELL TELL TIREROOM WARM UP SAMPLE FAILED OFF OF B2B3.	415PM	B2B3		More detailed than
LAB REQUESTED A NOTHER SAMPLE FROM AROUND THE SAME TIME FRAME. CUL CUT A SAMPLE OFF OF A TIRE IN FRONT OF THE PRESS	430PM			
DELIVERED SAMPLE TO THE LAB AND WAITED FOR THE SAMPLE TO BE TESTED	445PM			previous nign level ma
SAMPLE FAILED TEST	450PM			
CUL CAME BACK DOWN TO THE AREA AND FOUND WHAT GREEN TIRES WERE PRODUCED WITH THE HELP OF PICS.	510PM			
CUL CALLED CURING TO HAVE ALL hdct PRESSES SHUT DOWN ON QUALITY.	515PM			
CONTACTED PE TO FREEZE THESE TIRES IN PICS	530PM	135 OFFICE		
DID PRODUCTION TURNOVER WITH ON COMING SHIFT	545PM			
ALL TIRES WERE PLACED BY THE 1 & 2 BOOTH WITH HOLD TAGS PLACED ON THE RACKS WITH THE HELP OF CURING.	645PM			
PULLED PICS INFO NUMBER OF TIRES WERE PLACED ON HOLD. MEETING WITH NORVEL.	815PM			
DID TIMELINE ON ISSUES IN MAIN CONFERENCE ROOM.	850PM			
CUL PULLED PICS INFO FOR EACH TIRE AND CUT SAMPLES OFF EACH TIRE.	1230AM			
MILA TOOK SAMPLES TO THE LAB.	1245AM			

Should vs. As Is Process (Brief Description)

Insert labeled schematics so the reader can understand what should have happened vs. what did happen.

Highlight items in the "As Is" process that did not meet standard requirements. Keep it simple.

Should vs. As Is Process (Brief Description)

Insert **labeled schematics** so the reader can understand what should have happened vs. what did happen.

Standards Based Improvement Summary Machine Name Countermeasues to close the gap between standard and actual. Reg. No. Date: Improve Improvement implemented Standard restored Item/Step: Shift Dept Originator Manager Expose the Is there a YES Investigate gap between Start s there a gap betw een Phomonom cost plant \$10,987.00 by not tual/ideal and standards Problem standard tandard and actual? Expose problems standards we have in place. NO YES rovement or Restore Make new standard Revise or make new std to reflect improvement Educate to standar 4 Example of Improvement. Educate to standard Improve (Visual explaination of improvement) End Before Improvement After Improveme 1 Identify with (X) how issue was exposed Define Quality Safety Bekido VOR Review Be aware of problems, identify issues (Quantify size of problem) Expose work that can't be done to std from problem detection information Is there a dfference between actual/ideal and standard? sure/Analyze Did you compare with Work Std M/C Std . . Process Std ? Actual Work Difference Standard 5 Educate to follow standards 178-26 loading rubber at cfe's - Verify stock Control No verification or scanning - employee didn't rubber not scanned in and stock not code of rubber and scan ticket when loading verified follow standard (Contents and method of education: What controls are in place to Foll new rubber skid. 178-23 cfe rubber sampling - Deliver warm-up Delivered 3 hours late - employee didn't Action Delivered 5 hrs after sample taken. samples to the lab every 2 hours. follow standard Education to be done by HR for not following standards. 178-17 green tire to spec rubber id - All tags Spec = V2807, tags and impression No match - employee didn't follow standard and impression must match marquee V2887 Re-educate dept, including supervisors, on requirement for delivering samples to lab. 763-20 warm up sampling - warm-up samples sample not taken to lab after morning of sample taken at 8:51 and and delivered at must be delivered at start of shift, after lunch lunch breaks - employee didn't follow 2:00 pm. and after each break standard

Summary of Gaps Identified

IN GENERAL TERMS, referring to should vs. actual schematics

Gaps-Tire Room

Samples taken at 7:15am and 8:10am. Delivered to lab at 2:00pm. We didn't follow standard. Scanned multiple tires at the same time.

Scanned same rubber load ticket twice. No system to prevent this from happening.

Gaps-Curing Room

Tire was scanned ahead of time at the press. PICS system does not allow backing out tire. As a result another tire was laid in the press without needing to scan.

Gaps-MRC Lab

Sample delivered to the lab at 2:00pm. Tire room notification of failed sample at 5:00pm.

Gaps-All

Poor turnover/communication Lack of knowledge to lot trace on all shifts Unable to access lot trace information i.e. CFE run records, rubber scan information etc... Curing presses were down 18 hrs awaiting confirmation of containment. Why did it take until 1:00 to confirm all tires were contained.

Phenomena

HOW did the incident occur (What were the **PHYSICS** of the incident)? BE SPECIFIC. Use sentences/paragraphs. Write in past tense.

Why did tires get treaded with wrong stock?

- Wrong stock was delivered to CFE.
- Wrong stock was not identified by operator.
- Rubber not scanned at start of new load.
- Warm up sample delivered to lab 5 hours late.

Fault Tree (Why Tree)

Complete FTA: Address Man, Material, Machine, and Method. Use "5Why" to get to root.

Countermeasures

Establish SMART (specific, measurable, attainable, realistic, time-sensitive) action items. Keep it **simple** and **realistic**. Address **immediate**, **detection**, and **prevention** needs: from FTA. Utilize SDP process for control.

Corrective Action	ons				
Meeting Date:	1/5/2005	Date:	1/3/2003		
Meeting Due:	1/5/2005	Person Resp.	minor		
Meeting Attendees:	A. Misor, J. Michels, B. Andrew				
			Completed		
Short Term Corrective Action(s)	Owner	Due Date	Date		
Meeting with employee to ask why he chose not to follow standards	minor	1/9/2009	1/9/2009		
Use this incident at start of shift meeting to re-educate employees of following standards	AM	1/9/2009	1/9/2009		
Re-educate employees and supv to requirement for samples to lab every 2 hours. (in process)	AM	1/20/2009			
Change from soanning multiple tires at once to one at a time as treaded.	АМ	2/15/2009			
Lot trace daily by shift for dept 178 for rubber compound tickets.	АМ	2/15/2009			
Add check of sample delivery to supv control points	AM	1/23/2009			
Move tires from PRM bucket to previous bucket if not cured. (CDS)	DG				
Change stock code so that two are not similar (V2807 - V2887) and verify if other codes need changed.	мс				
Make partial use tag/work away/back out for lot trace	AM	2/21/2009			
	ĺ				
	[
			Completed		
Long Term Corrective Action(s)	Owner	Due Date	Date		
Add pics to 412 then add tubber usage from spec to prevent a consumed product from being scanned in to by pass interlocks on machine	sc	nest PICS phase			
Get access to data from B2B machines from scanned rubber loads	JD	3/15/2009			
Audit scanning of loads at B2B 2 and 3. (in process)	AMIRA	3/15/2009			
	1				

Prepare to Understand their Thoughts

For each Human Cause, describe the Triggering Situation. The Triggering Situation is the "**point in time**" when the inappropriate **decision** was made that led to the Human Cause. Describe the **circumstances** at this point in time.

Human Cause #1

B2B3 operator didn't follow standards

Manager: We had an issue on 1-6-2009 with tires that were treaded with the wrong rubber. How did this happen?

Operator: I don't know, every time I scan a skid I check the ticket and try to find a stamp on the load.

Manager: Why didn't you scan this load into the extruder?

Operator: I always try to.

Manager: Do you always scan the rubber into the cfe?

Operator: Not always if it is a large skid yes, if it is a small skid no.

Manager: You do know you are suppose to scan every load in correct?

Operator: Yes. But I can tell the difference between the rubbers.

Manager: Do you think you can always tell the difference between the right rubber and wrong rubber?

Operator: Yes, but I always try to find the stamp.

Manager: We have 4 different standards that say we scan and verify loads vs. spec for tires. All 4 of these standards could have prevented this from happening. Why didn't you follow them? Operator: I just didn't scan. It was a small skid and a fast tire.

Fill-in ONE copy of this page for each of the identified HUMAN CAUSES.

Thought Process – Job Function (Person's Name)

Determine the thought process of the person who behaved inappropriately. Capture the **ACTUAL WORDS** that **MIGHT** have been running through the persons mind. Bullet-style. <u>Complete Balance</u> <u>of Consequences</u>.

As Is - Inappropriate

- Identifying codes similar
- Machine allowed to run without scan
- Re-scan of previously scanned ticket
- Operator doesn't always scan small skids
- Failure to deliver MRC sample for 5 hours
- CFE lot trace times on racks of tires the same

As Desired - Appropriate

- Make codes different
- Machine recognizes skid change and requires new scan
- Machine recognizes previously scanned ticket
- Machine forced scan regardless of size
- Delivery to lab every two hours
- Tires scanned in order of treading when placed back on rack

Hidden Organizational & Personal Causes

What is it about the way we ARE that is evident in the above thoughts? Must be generic, i.e. not specific to only this one incident, and <u>present</u> tense. Bullet-style. Preface all responses with the words "We" and "I". Think about what you are willing to change – add to FTA if possible.

Organizational Causes

- We allow similar stock codes to be used
- We have inadequate compound segregation
- We allow machine to run without scan
- We have no system to detect or alert a failure to deliver sample
- We give supervisors more tasks than they can complete in a 12 hour shift
- We do not define clear consequences for not following standards
- We do not enforce scanning

Personal Causes

- I (name)..push for production
- I (name)..do not do enough audits
- I (name)..do not explain why it is important to follow standards
- I (name)..assume everyone knows what I know
- I (name)...don't think it is important to scan a small skid

Keys to Success

- Training, coaching, and development of expectations
- Definition of appropriate triggers and level of activity necessary
- Management review, critique, and reinforcement
- Emphasis on "Define & Measure" and development of timeline
- Proper identification of phenomena and follow through on "5-Why" analysis
- Don't neglect the human factor
- Weave the process into our culture and work to modify behavior

Thank you for joining us

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Resource Links and Contacts

Questions? Comments? We'd love to hear from you.

Debra Detwiler, Master Black Belt – Bridgestone Americas <u>detwilerdebbie@bfusa.com</u>

Larry Goldman, Vice President Marketing - MoreSteam.com lgoldman@moresteam.com

Additional Resources:

Archived presentation, slides and other materials: <u>http://www.moresteam.com/presentations/webcast-fault-tree-analysis.cfm</u>

Master Black Belt Program: <u>http://www.moresteam.com/master-black-belt.cfm</u>

