

8D case – Manufacturing environment

Case description: Cable Incorporated, a producer of fiber optic cable based in the US, is specialized in supplying reels of customized cable from 50 meters up to 500 meters. What sets them apart from the competition is their ability to produce small quantities to customer specification. Their customers are typically small to medium size manufacturers of patch cords for the data and telecom industry and are willing to pay the extra money for the flexibility offered by Cable Incorporated. The market in which they operate is rather competitive, but they have managed to effectively defend their ground for the past decade and have built quite a strong reputation of reliability. The table below represents their customers and turnover per region.

Region	Data / Telecom Sector (# of customers / \$)	Other Sectors (# of customers / \$)	Total (# of customers / \$)
Africa	1 / \$85,000	-	1 / \$85,000
Asia	3 / \$113,000	1 / \$56,000	4 / \$169,000
Australia	6 / \$512,600	-	6 / \$512,600
Europe	11 / \$11,850,000	3 / \$889,000	14 / \$12,739,000
North America	23 / \$43,345,000	7 / \$4,610,300	30 / \$47,955,300
South America	9 / \$1,100,500	2 / \$470,500	11 / \$1,571,000
<i>Total</i>	<i>53 / \$57,006,100</i>	<i>13 / \$6,025,800</i>	<i>66 / \$63,031,900</i>

Table 1: Overview of last year's turnover for Cable Incorporated

Producing in three shifts of eight hours for five days per week, the production capacity is approximately 300,000 meters per day. They have four production lines to manufacture what the customers demand. The reels are produced in increments of 50 meters, and the product mix varies per week. Cable Incorporated only produces to order, and does not retain any customer orders in stock. All of the reels that are produced in a certain shift are uniquely identified by a date code and shift reference in the event that customers have a complaint. The code consists of five digits, one letter, and one more number. The first two digits are the last two numbers of the calendar year in which it was produced, the following two


are the week, and the last digit is the day. The letters indicate the shift: the "A" shift, which operates from six o'clock in the morning until two in the afternoon, the "B" shift that runs from two in the afternoon until ten o'clock at night, and the "C" shift that operates from ten in the evening until six o'clock the next day. Each working week begins with an "A" shift and ends with the "C" shift on Friday night. Shifts rotate per week, meaning that the "C" shift from this week will be an "A" shift next week, "A" will become "B", and "B" will become "C". In case the customer demand exceeds the available production capacity, the weekends will be used to fulfill it. These shifts will be indicated by the letter "W" for the weekend shift. Finally, the last digit indicates which production line was used. Below are a couple examples of such a date code:

Date code	Explanation
16033A1	Produced in calendar year 2016, week 03, day 3 (Wednesday), A shift, #1 production line
15231C3	Produced in calendar year 2015, week 23, day 1 (Monday), C shift, #3 production line
07515B4	Produced in calendar year 2007, week 51, day 5 (Friday), B shift, #4 production line
16476W2	Produced in calendar year 2016, week 47, day 6 (Saturday), Weekend shift, #2 production line


Table 2: Examples of date codes

For years, customer complaints were minimal and usually regarded shipping related issues that were mostly caused by the different transport carriers that were used to ship the goods to the customers. However, about three months ago, one of the smaller North American customers complained he received ten reels of 300-meter cable and that six of those reels were each a couple of meters short. This resulted in the customer not being able to complete a full order for his customer and having to re-order a new reel to make up for the difference. Cable Incorporated handled the issue as a customer error and closed without any further follow up. For a couple of weeks, there were no additional complaints about reels being short on length. After three weeks, another North American customer reports the same of one 300-meter reel being a couple of meters short. Again, since this customer did not formally launch a complaint so nothing was investigated.

For six weeks, it was business as usual, and there were no additional complaints. However, over the last three weeks, an increasing number of complaints were received regarding 300-meter reels being short. In total, nine customers from multiple regions have addressed their dissatisfaction. The head of sales has serious concerns that these will not be the last. Since the company's reputation is at stake, he decides to assemble an 8D team to determine what is happening. He asks the production manager to lead the 8D team, who willingly accepts.

 **Special cause event type**

What kind of special cause event type is applicable here?

 **Symptom description**

From the above, you should be able to derive the symptom of the problem. What is the symptom?

 **D0 – Emergency Response Actions**

Can you think of an ERA for this case?



D1 – Establish 8D team

Take a couple of minutes and put yourself in the position of the head of sales. He has decided to establish an 8D team led by the production manager to investigate the matter. Who else should be in the team and why?

Who?	Why?

Case continues:

The first thing the 8D teams wants to know is if the reels are indeed short in length and, if so, how many meters they are short. They contact one of the complaining customers and ask them to return a reel. After two days, one of the suspected reels arrives. The 8D team unwinds the reel and measures the cable length: 294.2 meters. Date code of the reel is 16272B1.



D2 – Problem statement

The above story provides enough information to derive a problem statement that describes the process performance gap.

Object: _____

Deviation: _____



D2 – Problem description

The above story provides enough information to come up with a SMART defined problem description. Can you do so?



D3 – Interim Containment Actions

What containment actions would you set up and execute for this problem, and what is it they should contain?

Case continues:

The customers seem to be right with their complaints. Certain cable reels are short, and some are not. The returned reel is from fourteen weeks ago, so this leaves the team wondering how long the issue has already been going on. Puzzled by their findings, the team decides to map each customer complaint and the quantity claimed together with the date codes. Since customers only complain about the 300-meter reel, the team decides to only focus on these products. For completeness, they also include the first two North American customers that complained, A and B, in the table. This to ensure that no critical data is lost. The table below is the result and, in order to make it more complete, they decide to include the region that the customer is in as well.

Customer	Region	Quantity rejected	Date code	Date shipped	Date of complaint
A	North America	6 reels	16274B1	08 JUL 2016	14 JUL 2016
		11 reels	16344B1	30 AUG 2016	27 SEP 2016
B	North America	1 reel	16295A1	26 JUL 2016	09 AUG 2016
		4 reels	16345B1	31 AUG 2016	26 SEP 2016
		3 reels	16341C1	23 JUL 2016	26 SEP 2016
C	Europe	30 reels	16342C1	25 AUG 2016	28 SEP 2016
D	Europe	8 reels	16293A1	22 JUL 2016	27 SEP 2016
		22 reels	16341C1	24 AUG 2016	03 OCT 2016
E	Africa	2 reels	16274B1	08 JUL 2016	26 SEP 2016
F	Asia	35 reels	16345B1	30 AUG 2016	27 SEP 2016
G	Australia	4 reels	16345B1	31 AUG 2016	10 OCT 2016
H	Australia	11 reels	16343B1	26 AUG 2016	05 OCT 2016
		63 reels	16344B1	30 AUG 2016	08 OCT 2016
		23 reels	16345B1	30 AUG 2016	09 OCT 2016
J	Australia	8 reels	16343B1	26 AUG 2016	08 OCT 2016
<i>TOTAL</i>	-	<i>231 reels</i>	-	-	-

Table 3: Overview of the reels that customers complained about

As part of their containment, they randomly check ten reels from any of the three shifts of that are produced today and yesterday to verify if the length is meeting specifications. These all turn out to be correct with a range in length between 300.4 and 302.1 meters. However, this result raises even more questions. Why six meters short? Although the failure seems intermittent, why are the customer complaints suddenly increasing? Why only the 300-meter reels, and not the others? The team takes a closely examines at the data collected so far and attempts to identify possible leads. They notice that the problem was first reported on July 14 and that the product belonging to that complaint was produced in week 27, on Thursday, July 7. They also noticed from the date codes listed in the table above that all of the complaints appear to originate from production line #1. The 8D team decides to compare a returned reel from one of the

complaining customers to one of the reels that were used to verify yesterday and today's production. The drawing below depicts the two reels that were compared.

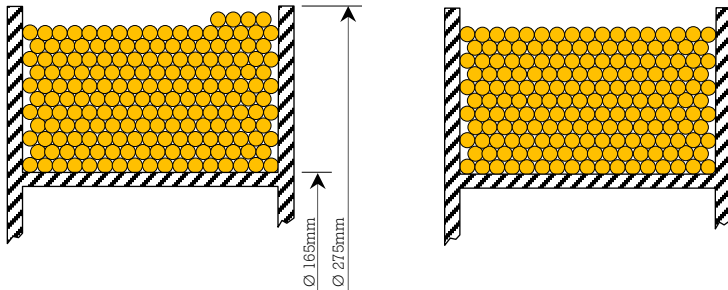



Figure 1: Good 300-meter reel (left) vs a returned 300-meter reel (right)

The good reel is produced on production line #3, the other reel on production line #1. Everything seems to be normal except for the windings on top. The good reel has an additional four windings that are not seen on the returned reel. A quick calculation reveals that these four missing windings are the equivalent of 5.8 meters! Based on this new finding, the team updates the containment actions and after consulting the general manager, it is decided to stop producing 300-meter reels on production line #1. The planning department is informed accordingly, and all production planned on line #1 is moved to production line #3 because the sample check proved that his line produces 300-meter reels with the correct length.

The 8D team now knows where to search for the root causes of the problem. Curious to find out what the differences are between production line #1 and the others, they develop the following thesis: What causes the six meter length difference on production line #1? However, before they continue, they update the problem description to match with the newfound evidence and check if the interim containment actions that were taken are still effective.

 **D2 – Problem description (updated)**

The above story provides new information to update your problem description. Can you update it?

 **D3 – Interim Containment Actions (updated)**

The newfound evidence requires the 8D team to check if their containment actions are still effective. Some of the containment actions are already described in the story above, but can you come up with additional ICAs?

Case continues:

Now that the 8D report has been updated to the actual status, the team is ready for Step D4, being the root cause analysis. Looking at the data collected in the table, the 8D team ponders what the next logical step should be. They know that something is wrong in the production of 300-meter reels coming from production line #1. They also know that the problem has existed since date code 16274B1 (July 7, 2016). In addition, they also know that the deviation is constant, but the occurrence of the problem is not. When examining the production schedules from the past weeks, 300-meter reels were produced each week. All of the customers' complaints are only about the 300-meter reels being six meters short. No other products have yet been reported with the same or a similar deviation. Therefore. It appears as if the problem is isolated to one product but is intermittent. They decide to map the date codes of each complaint to get

an overview of when the non-conforming products were produced. They take an ordinary calendar and begin color indicating the following based on the complaints received thus far:

- The production weeks (in green)
- Letter indicating the shift (in red)
- Highlight the production days that generated customer complaints (in yellow)

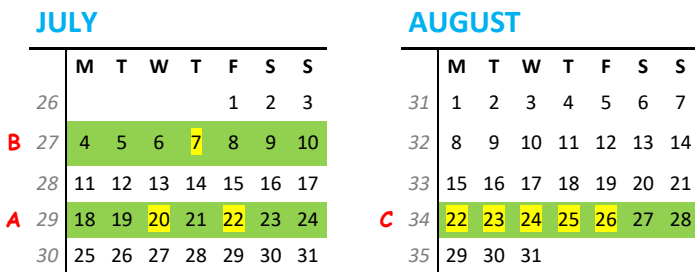


Figure 2: Calendar with the shifts and weeks of defective production marked

What immediately stands out is the fact that not all production days generate defective products. This may be an additional indication that the problem is of an intermittent nature. In week 27 in July, only one out of the five days have complaints whereas, in August, an entire production week is affected. One of the team members then notices that there is a rhythm in the problem. In week 27, the “B” shift was on duty when the problem occurred for the first time. Two weeks later, the “A” shift was producing the problem. From the rotation schedule, the team knows these are the same people: “B” becomes “C”, “C” becomes “A”, and “A” becomes “B”.

They complete the calendar with the missing shifts, and it looks like the team member was right. When checking the same for week 34, the "C" shift on duty indeed consists of the same people as well. Can it be that they made a mistake?

JULY								AUGUST							
	M	T	W	T	F	S	S		M	T	W	T	F	S	S
A 26					1	2	3	C 31	1	2	3	4	5	6	7
B 27	4	5	6	7	8	9	10	A 32	8	9	10	11	12	13	14
C 28	11	12	13	14	15	16	17	B 33	15	16	17	18	19	20	21
A 29	18	19	20	21	22	23	24	C 34	22	23	24	25	26	27	28
B 30	25	26	27	28	29	30	31	A 35	29	30	31				

Figure 3: Updated calendar with the "missing" shifts

It begins to look like the problem originates from the same shift. A comparison of the production records yields that all of the reels that customers complain about are produced by one and the same person on production line #1. Getting very close to what happened, the 8D team decides to interview the operator, Oscar, in order to determine how the problem could have been created. Patrick, one of the 8D team members, decides to interview him, as seen in the transcript below, because he is on the same shift as Oscar:

Patrick Hey Oscar, can I talk to you for a minute? I have a problem that I need your help with.

Oscar ...Sure... Let me finish this first... All right, what is it?

Patrick You know that we have received many customer complaints on the 300-meter reels lately, right?

Oscar ...Yeah... The shift leader mentioned it a couple of times already. He said that Head of Sales put an 8D team together... You're on the team, aren't you? Is that what you want to talk about?

Patrick That is correct.. Please have a look at the data we have collected so far. I need you to help me in tying things together...

Oscar OK – Show me...

Patrick So far, we have narrowed it down to these three production weeks and these shifts (showing Table 7 to Oscar)...

Oscar ...Man, 231 reels... That is a lot of reels... Oh... Sorry to interrupt, please continue...

Patrick ...You are right; 231 reels is a lot. In addition, we plotted this data onto this calendar (Patrick shows Figure 3 to Oscar). As you can see, all of the customer complaints can be traced back to any of these three production weeks. Do you see the shift indicators before the calendar weeks?

Oscar ...Yeah... Every week it is the same shift... Our shift, if I'm not mistaken... Right?

Patrick Correct. And here is where I need your help. When we crossed checked the date codes of the complaints to the individual production orders your name popped up as the operator.

Oscar What...?!?...Are you kidding me? ...Are you sure...? Let me see those records...!!

Patrick ...Oscar, wait – listen to me first. I am not having this conversation with you to blame you or to turn you into a scapegoat. I really need your help to understand what happened. I am sure that whatever the case is, it could have happened to any of us... So, please help me understand...

Oscar ...Man... I did not see that one coming... OK, what do you want to know...?

Patrick We noticed that when we compare reels with a correct length to a reel that customers complain about, the top four windings on the reel are missing... Here, take a look yourself... By the way, the four windings are exactly the distance the customers complain about – 5.8 meters...

Oscar ...Hmm... Strange...

Patrick We also found out that all of the reels that are six meters short came from production line #1 and that the good ones are from one of the other lines. Do you remember what you did differently when you produced them?

Oscar Look Patrick, it has been a while since these were made... I am not sure... Let me think for a minute... The old production line #1 you say...? I do recall that there were some issues with the in-line wire length counter a couple of months ago.

Patrick What kind of issues?

Oscar Well, I could not set it up properly. The wire constantly ran off the wheels of the counter. I called the shift supervisor to help me out, but he also could not fix it. Apparently, the bearings of the in-line wire counter were worn out.

Patrick What did you do? I suppose you reported the defect in-line counter so that maintenance could repair it?

Oscar No, I did not... Actually, come to think of it, I forgot to do it. Anyways, we just left the wire counter out... Man, now that I think about it, that is exactly what I did in week 29 and 34 as well, leaving the in-line wire counter out...

Patrick But how did you measure the length of the reel to make sure it was correct?

Oscar I proposed to use the off-line counter for measuring the reel lengths, you know, that old gray thing. But the shift supervisor had a better idea that would save a lot of time when using the off-line counter. I just needed to measure the circumference of the reel to verify the length. I still recall it – 170 centimeters...

Patrick 170 centimeters...? How did the two of you came up with that number..?

Oscar ...Oh, simple... The shift supervisor took a 300-meter reel from one of the other lines and measured it.

Patrick How did he measure it? Can you show me?

Oscar Using a measuring tape... Here, this one... You put the reel on the table, hold the beginning of the measuring tape here in the middle and go around... Here, like this... You see, 170 centimeters!

Patrick Yeah, minus the four windings, Oscar!

Oscar ...Huh... Yeah, that's right... Damn, when I look at this situation now, what we did was not the smartest thing to do.

Patrick I'm sure that you are aware that a measuring tape is not a validated measuring device. Why did you decide to use it?

Oscar The shift supervisor told me to do so. At that time, I did not see the harm of it...

Patrick I know enough. Thank you very much for helping me out. I appreciate it. I will go back to the 8D team with these findings and see what countermeasures we can take. I will keep you posted.



D4 – Define and verify Root Cause Analysis

By now, you should be able to derive two RCAs for the occurrence and two for the escape. That means four in total. Can you formulate them from the above story?



D5 – Choose and verify Permanent Corrective Actions

In principle, each RCA requires its own PCA. Can you develop them and think of a way to verify their effectiveness?



D6 – Implement and validate Permanent Corrective Actions

Every PCA needs to be implemented and validated. Can you come up with any ideas how this should be done for the Cable Incorporated problem?

Case continues:

The interview between Oscar and Patrick revealed that the problem has both an executional as well as a behavioral component. The 8D team leader is quite worried about the fact that one of his own shift supervisors chose to use an unapproved and unorthodox method for checking reel lengths. True, approximately seven years ago, using a tape measurer was a common method for quickly checking cable lengths on reels, however, since the introduction of the in-line wire length counter, this practice should have been banned from the production floor. Not only are the in-line systems more accurate, they also allow for a fully automated production of reels. Puzzled by this finding, he checks with all three shift supervisors to ask if this practice is still in use today. He is astonished to learn that the method of measuring with a tape measurer is still used. When he inquires further he finds out that this is done most of the time when the in-line wire counters are defective. Because the off-line wire length counter is very time consuming to use and because there is no spare in-line wire length counter available, production must wait for maintenance to repair it first. To meet the tight production times, the shift leaders often allow for the tape measure method as the most time efficient alternative. However, Oscar has only been with the company since June 1 and lacks the experience of the other operators who knew that an additional four windings are required with 300-meter reels to complete the length of the reel. It appears that, under time pressure, the shift operator forgot to mention this to Oscar.



D7 – Prevent re-occurrence

How would you approach discipline D7 for the Cable Incorporated problem? Can you name at least two systemic causes?

Case continues:

The 8D team now understands the problem to the fullest and is able to draw up a final report. The lessons learned have been implemented, and every member of the organization is informed about what happened. The people from the three production shifts are re-instructed on the importance of using approved tooling only. The unapproved measurement tapes have been removed, and the correct tooling has been made available in the required numbers. A formal letter of apology to all of the customers involved was sent out by the management of Cable Incorporated informing them of what has happened and what countermeasures were taken to prevent recurrence. The 8D team presents their final report to their champion, who agrees that they have done a great job in finding the right solutions to prevent this from happening again.



D8 – Recognize team and individual contributions

You are ready to disband the 8D team. What type of a reward, if any, would you give to the team members? Why this reward?
