

Lean Six Sigma Black Belt Certification

PEOPLE AND
PROCESS



Project 4: Elite Elegance



Learning Objectives

On completion of this project, you will be able to:

- 👁 Understand the Elite Elegance plant project background
- 👁 Analyze the various factors that led to the losses in manufacturing of viscose filament yarn
- 👁 Infer how the recommended pilot run actions improved the hotel revenue



Define Phase

Project Background



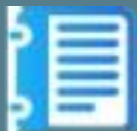
Mr. Cheg, the plant head of Elite Elegance, has been extremely worried due to the losses in manufacturing of viscose filament yarn, a comparatively new line of business that they have been running since the past 5 years.

He calls for a meeting with the production line head Mr. James Wright and the production line manager Mr. R. Cook to discuss the situation. After a long discussion they agree to involve Ms. Caroline Holmes to look into the matter.

Customer Sentiment Trend Analysis

Ms. Caroline Holmes starts collecting the customer sentiment and does the trends analysis

Analysis results										
Base				Base				Base		
1000	VOC CSY			1000	VOC PSY			1000	VOC for SSY	
	Positive	Negative			Positive	Negative			Positive	Negative
Q1 '17	379	621		Q1 '17	670	330		Q1 '17	721	279
Q2 '17	342	658		Q2 '17	689	311		Q2 '17	732	268
Q3 '17	280	720		Q3 '17	663	337		Q3 '17	727	273
Q4 '17	253	747		Q4 '17	681	319		Q4 '17	735	265
Q1 '18	189	811		Q1 '18	690	310		Q1 '18	728	272
Q2 '18	157	843		Q2 '18	687	313		Q2 '18	742	258
Q3 '18	119	881		Q3 '18	677	323		Q3 '18	725	275
Q4 '18	97	903		Q4 '18	679	321		Q4 '18	734	266



Note : Negative sentiments have been very high

CSY: Driver-wise Sentiment Trends

- On further analysis of the VOC data, Caroline realizes that the pain is due to customers buying CSY.
- She further conducts interviews and focus group discussions, with the different buyers of CSY.

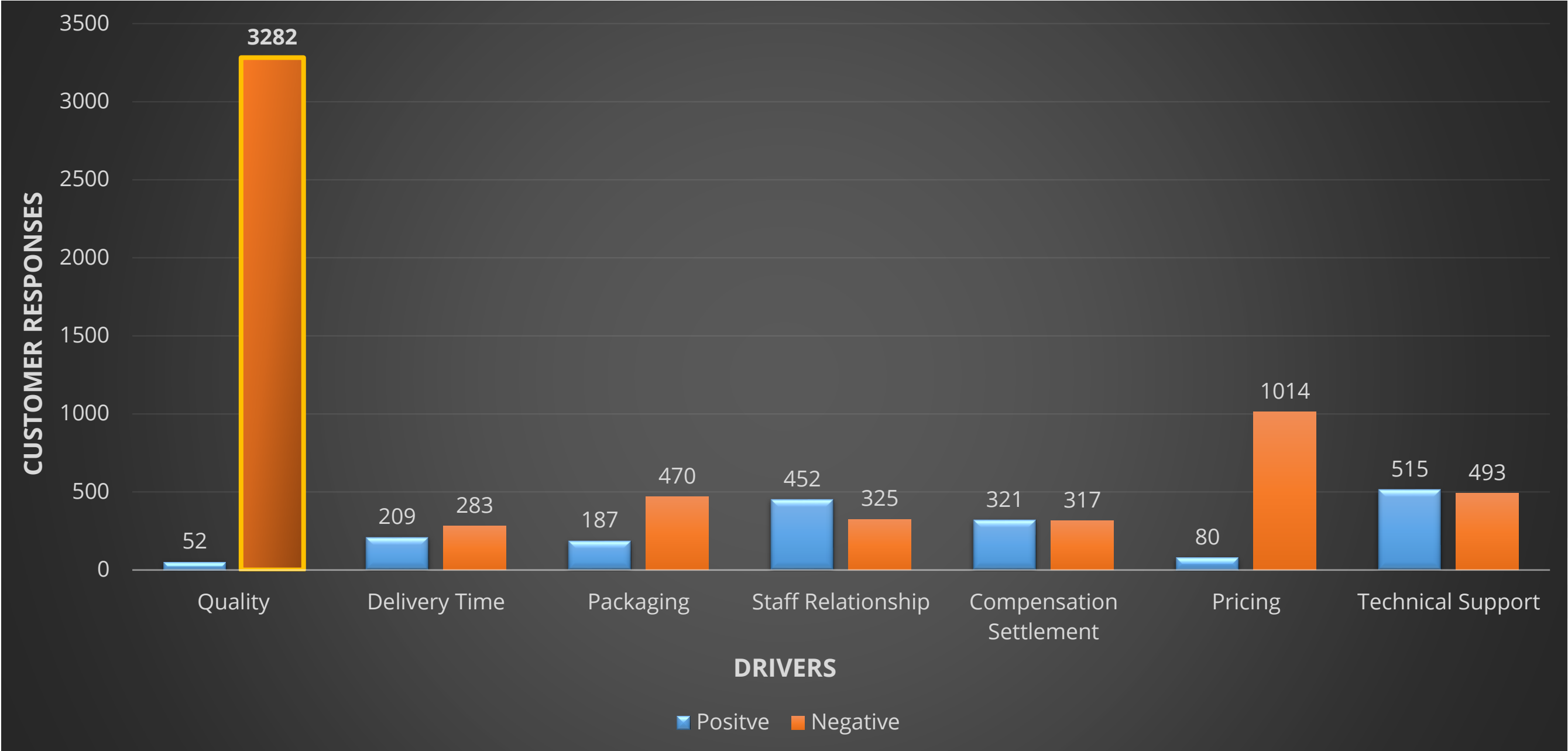
Drivers	Positive	Negative
Quality	52	3282
Delivery Time	209	283
Packaging	187	470
Staff Relationship	452	325
Compensation Settlement	321	317
Pricing	80	1014
Technical Support	515	493



Note : Customers are extremely dissatisfied with the quality of the CSY that they are procuring



CSY: Driver-wise Sentiment Trends (Contd.)



Major area of concern is the CSY quality

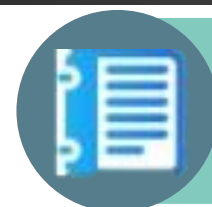
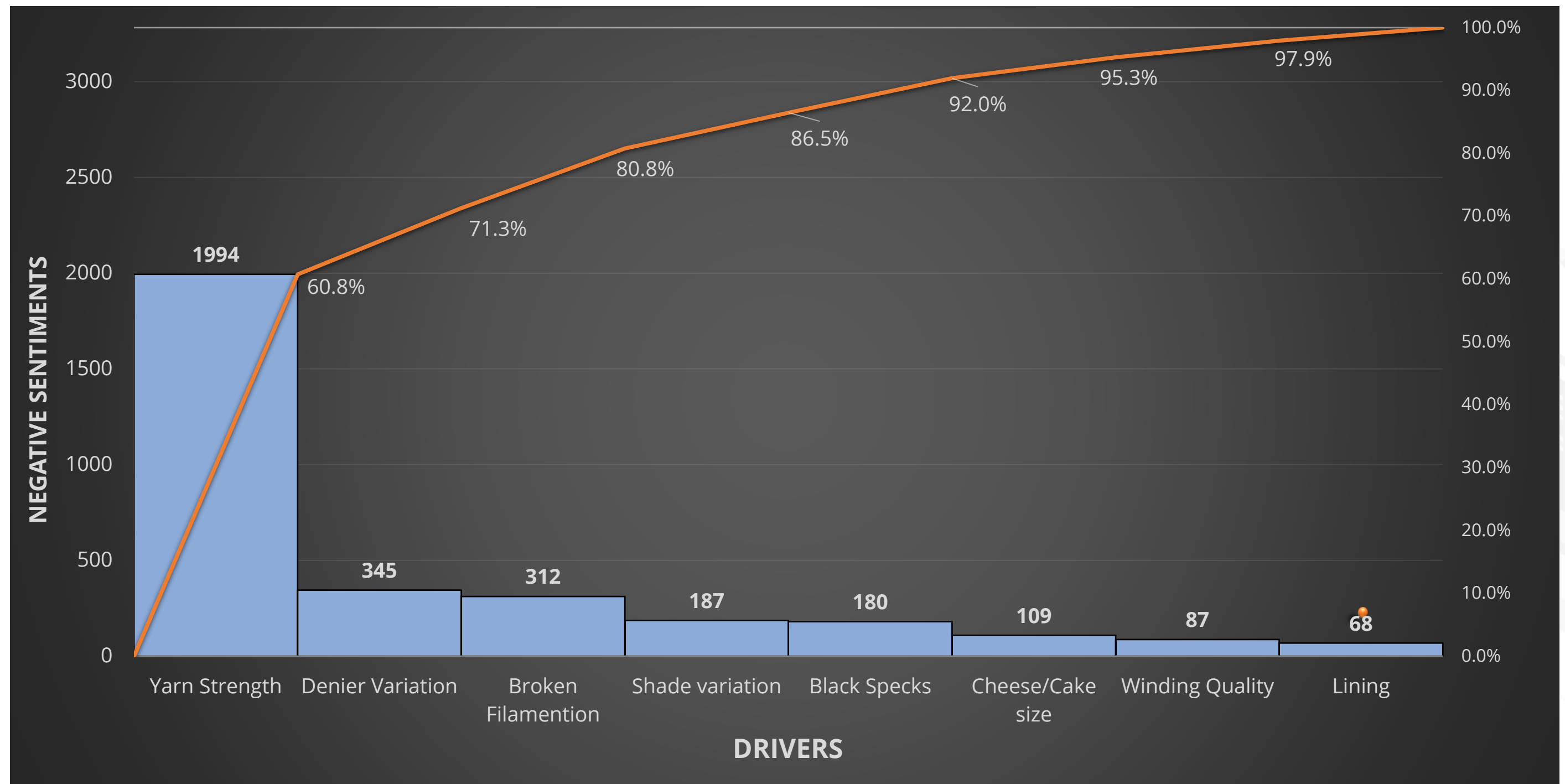
Deep-dive into Quality

- Caroline visits the major dealers, weavers, knitters, embroidery thread manufacturers who are procuring the CSY Yarn of Elite Elegance to understand the problems that they are facing at large with respect to quality.
- She gets to understand the following situation:

Quality drivers	Positive	Negative
Yarn strength	8	1994
Shade variation	22	187
Black specks	3	180
Broken filamentation	4	312
Denier variation	2	345
Winding quality	7	87
Cheese/cake size	4	109
Lining	2	68



Driver Quality



Yarn strength turns out to be the major area of concern

Project Charter

Problem statement

CSY Yarn buyers are extremely dissatisfied with the product asking for replacements or refund on an average of 70% of the times which is taking the CSY Yarn line of manufacturing into losses by 45% as on date. The quality of the product is the main area of concern where the buyers find the strength of the yarn to be less than the required strength by 25% due to which the weavers are incurring huge losses resulting in replacement requests or refunds for the product.

To increase the strength of the CSY Yarn by 35% in next 8 months so as to save the weavers from their current losses and reducing the replacement and refunds for Elite Elegance saving 45% of its current revenue loss in 12 months time.

Goal statement

Project Charter (Contd.)

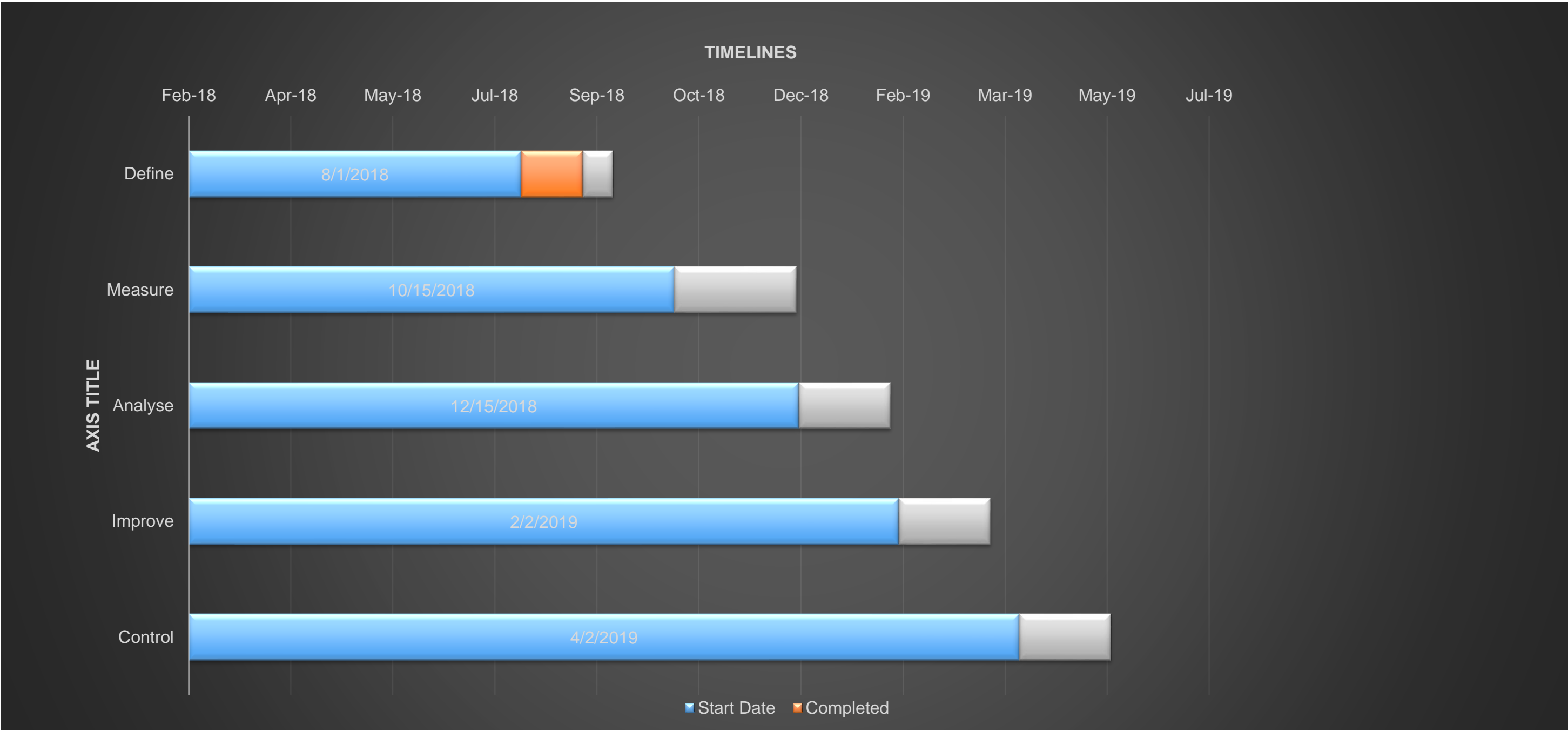
Business case

The 35% increase in CSY Yarn strength will save CSY buyers of Elite Elegance the current losses that they are incurring every month and stop them from switching over to the more expensive competitors like Bemberg and Jenis Impex. The improved quality of CSY Yarn produced by Elite Elegance will be able to attract the current buyers from its expensive competitors who are opting for more expensive yarns due to current poor quality.

Cost benefit analysis

Year	Cost (in USD)	Benefits	Net benefits (in USD)	Description
			9.50%	Annual discount rates which management wants
0	-286030	0	-286030	Initial project investment
1	-75000	13963	88963	Returns
2	-9500	32658	42158	Returns
3	0	486179	486179	Returns
Totals	-370530	532800	331270	
NPV			183265	
IRR			35.12%	

Project Milestones



RACI Model

Stakeholders	Designations	Define	Measure	Analyze	Improve	Control
James Wright	CSY production head	I, C	C	C, I	C, I	A
R Cook	CSY production manager	C	C	I	I	R
Caroline Holmes	Black belt	R	A	R	R	A
Jeff	Green belt		R		R	
Russel	Sponsor	I	I	I	I	I
Frank	Team member	R				

SIPOC

S	I	P	O	C
Elite elegance	Viscose pulp	<div>Spin bath of the viscose</div> <div>↓</div> <div>Washing</div> <div>↓</div> <div>Winding</div> <div>↓</div> <div>Sizing</div> <div>↓</div> <div>Rewinding</div>	CSY Cheese	Dealers
Pulp supplier	Spinnerate		CSY Cake	Weavers
Spinneret supplier	Chemical solution			Knitters
Chemical supplier	Pump			Embroidery thread manufacturers
Water supplier	Water			
Jacket supplier	Tfo			
Glue supplier	Winding jacket			
Electricity board	Glue			
	Electricity			

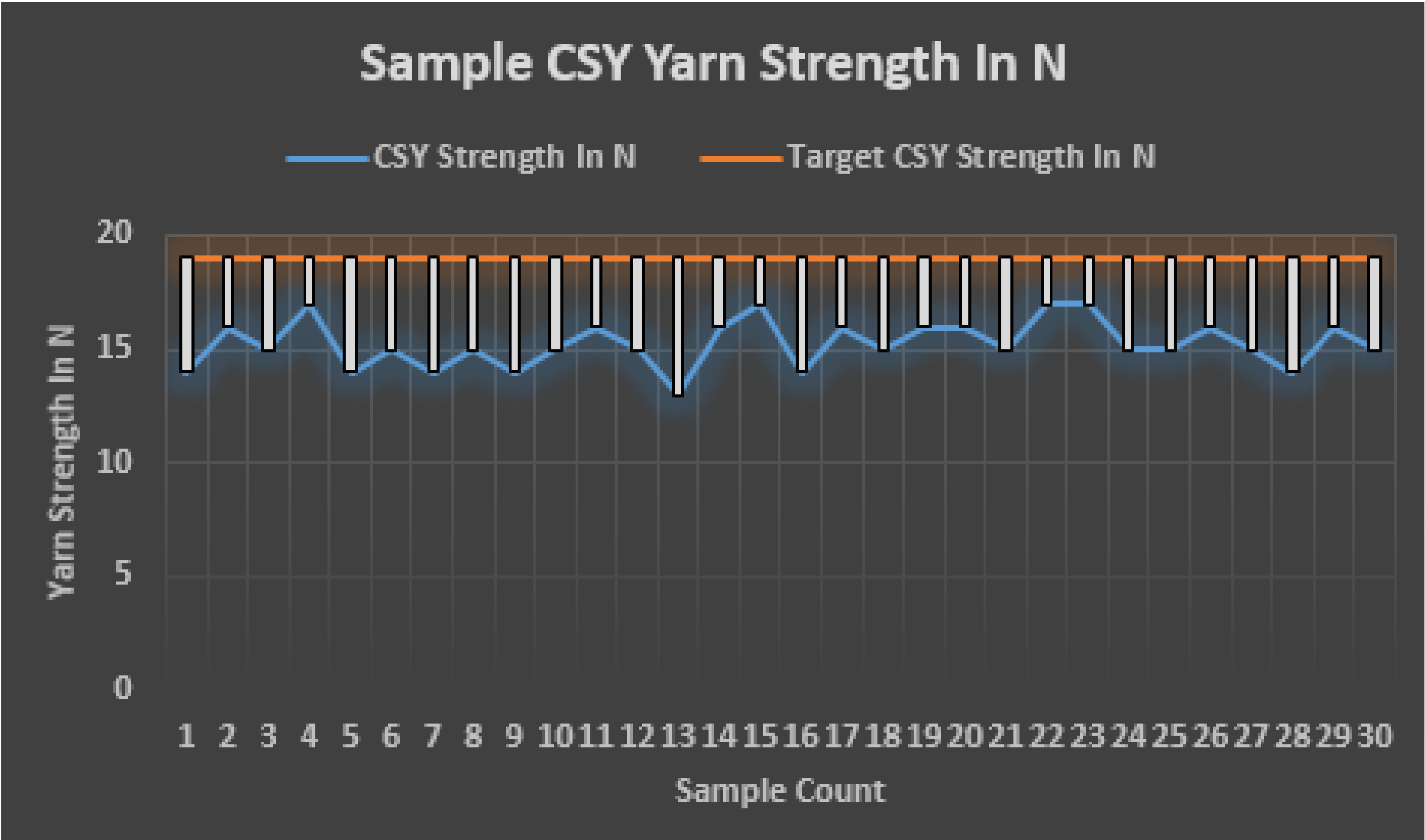
Measure Phase

CSY Yarn Breaking Strength

CSY yarn breaking strength : Random sampling for 10 consignments		
Consignment 1	Lot 1	14 N
	Lot 2	16 N
	Lot 3	15 N
Consignment 2	Lot 1	17 N
	Lot 2	14 N
	Lot 3	15 N
Consignment 3	Lot 1	14 N
	Lot 2	15 N
	Lot 3	14 N
Consignment 4	Lot 1	15 N
	Lot 2	16 N
	Lot 3	15 N
Consignment 5	Lot 1	13 N
	Lot 2	16 N
	Lot 3	17 N
Consignment 6	Lot 1	14 N
	Lot 2	16 N
	Lot 3	15 N
Consignment 7	Lot 1	16 N
	Lot 2	16 N
	Lot 3	15 N
Consignment 8	Lot 1	17 N
	Lot 2	17 N
	Lot 3	15 N
Consignment 9	Lot 1	15 N
	Lot 2	16 N
	Lot 3	15 N
Consignment 10	Lot 1	14 N
	Lot 2	16 N
	Lot 3	15 N



CSY Yarn Breaking Strength (Contd.)

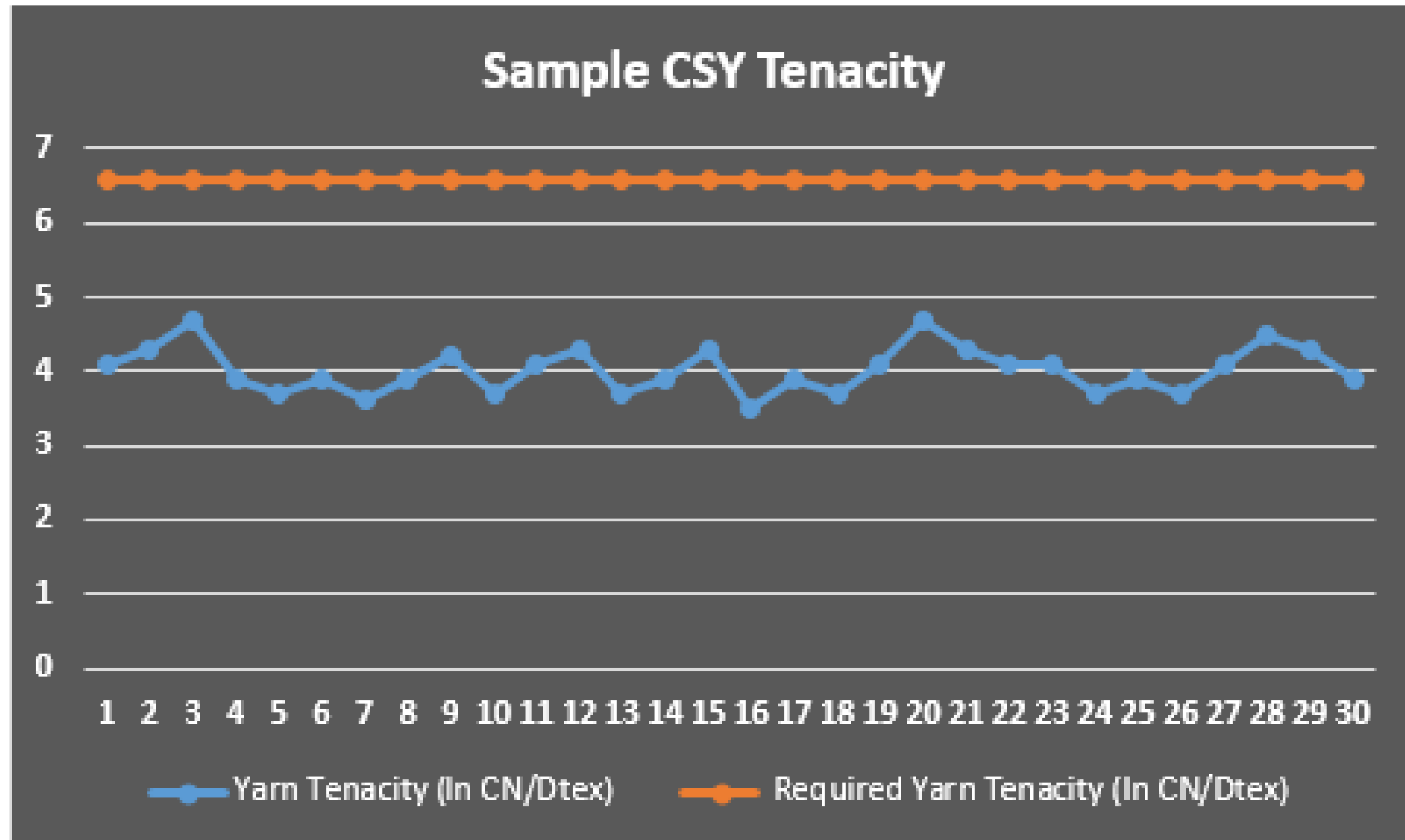


CSY Yarn Tenacity Strength

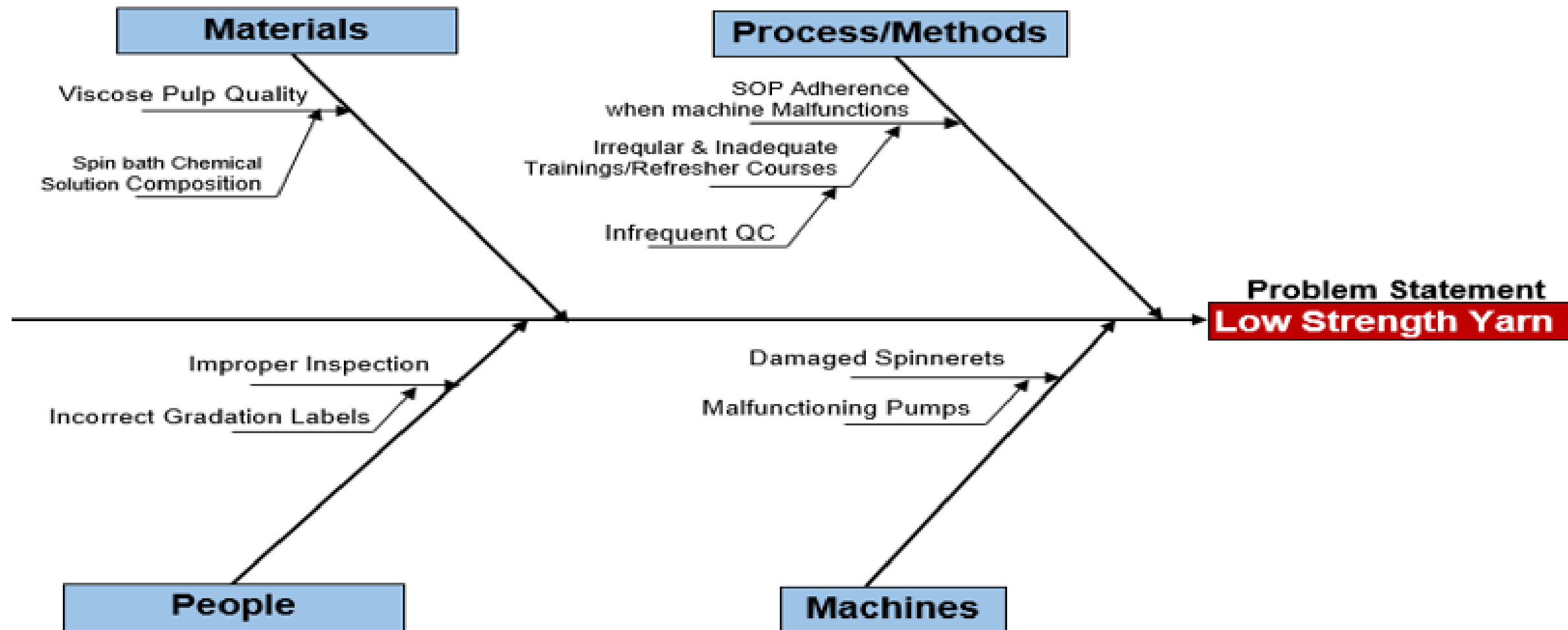
CSY tenacity strength			
Consignment no.	Sample lot	Elastane denier	Yarn tenacity (in CN/dtex)
Consignment 1	Lot 1	40	4.1
	Lot 2	40	4.3
	Lot 3	40	4.7
Consignment 2	Lot 1	40	3.9
	Lot 2	40	3.7
	Lot 3	40	3.9
Consignment 3	Lot 1	40	3.6
	Lot 2	40	3.9
	Lot 3	40	4.2
Consignment 4	Lot 1	40	3.7
	Lot 2	40	4.1
	Lot 3	40	4.3
Consignment 5	Lot 1	40	3.7
	Lot 2	40	3.9
	Lot 3	40	4.3
Consignment 6	Lot 1	40	3.5
	Lot 2	40	3.9
	Lot 3	40	3.7
Consignment 7	Lot 1	40	4.1
	Lot 2	40	4.7
	Lot 3	40	4.3
Consignment 8	Lot 1	40	4.1
	Lot 2	40	4.1
	Lot 3	40	3.7
Consignment 9	Lot 1	40	3.9
	Lot 2	40	3.7
	Lot 3	40	4.1
Consignment 10	Lot 1	40	4.5
	Lot 2	40	4.3
	Lot 3	40	3.9



CSY Yarn Tenacity Strength (Contd.)

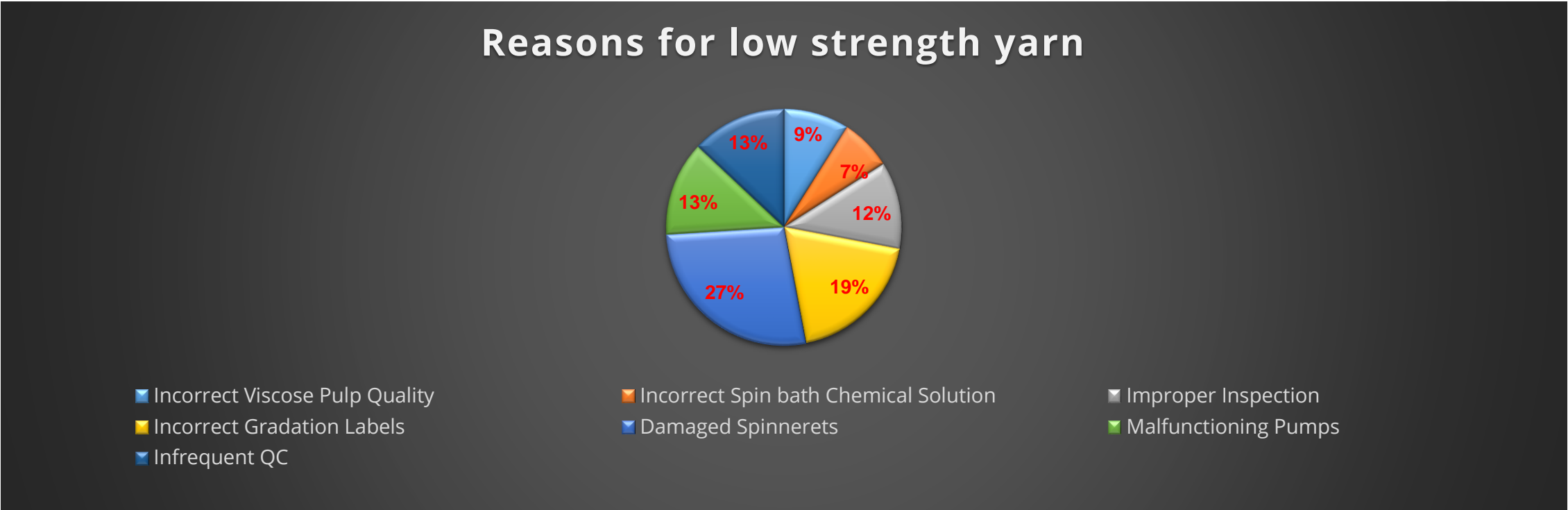


Fishbone Diagram

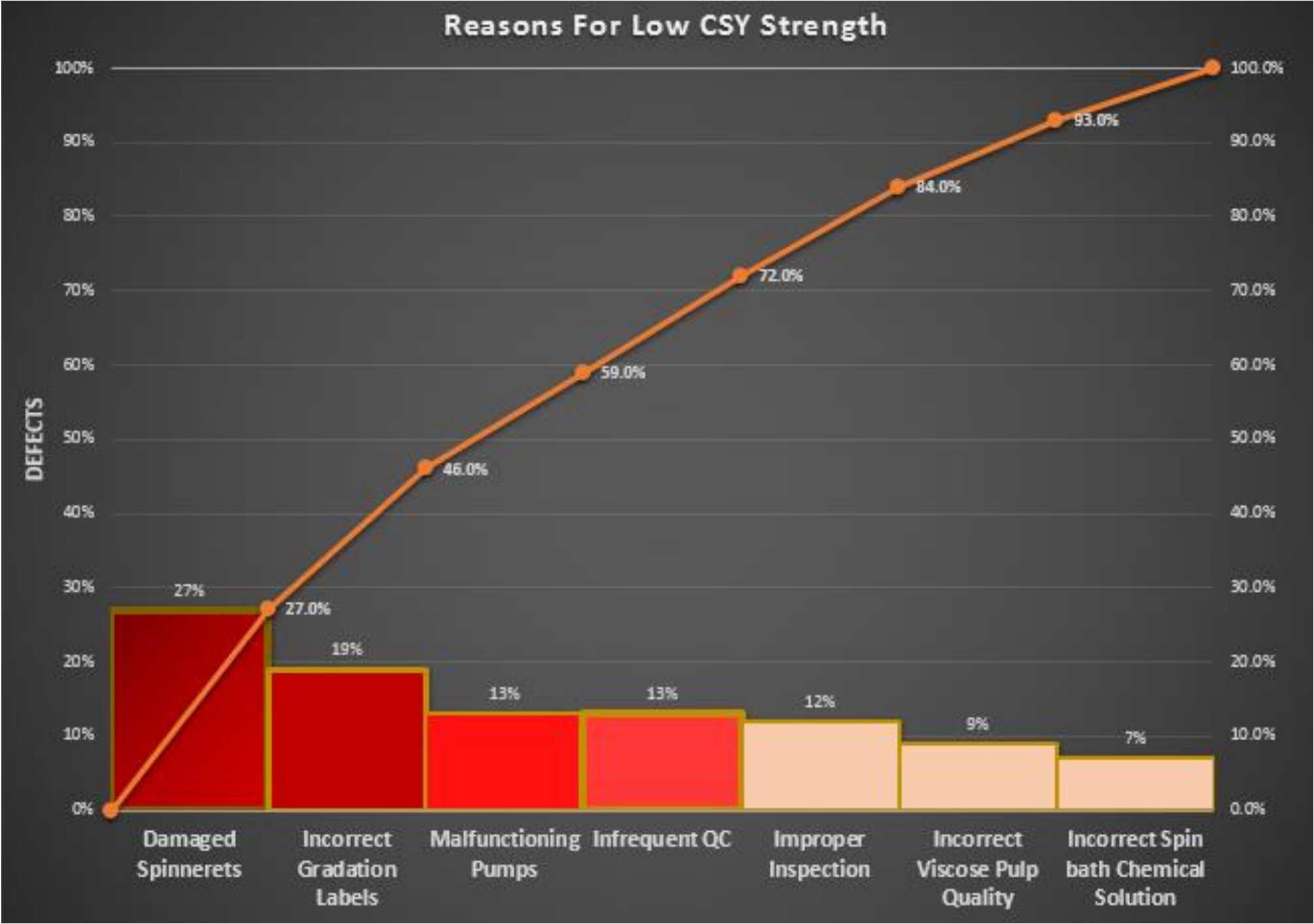


Causes For Low Strength Yarn

Low strength yarn	
Incorrect viscose pulp quality	9%
Incorrect spin bath chemical solution	7%
Improper inspection	12%
Incorrect gradation labels	19%
Damaged spinnerets	27%
Malfunctioning pumps	13%
Infrequent QC	13%



Causes For Low Strength Yarn (Contd.)



Main Causes For Low Strength Yarn

01

Damaged spinnerets

02

Incorrect gradation labels

03

Malfunctioning pumps

04

Infrequent QC



Analyze Phase

Pilot Run: Corrective Actions

Damaged spinneret



Recommended corrective
action



Change the spinneret
heads

Pilot After Changing Spinneret Head Of One Line

CSY break strength in N before changing spinneret head	CSY break strength in N after changing spinneret head
14	19.5
16	19.4
15	18.9
17	19.2
14	19.3
15	19.5
14	18.7
15	18.9
14	19.2
15	19.1
16	19.7
15	19.4
13	18.9
16	19.1
17	18.8
14	18.7
16	19.3
15	19.5
16	19.2
16	19.6
15	19.1
17	19.9
17	18.8
15	19.5
15	19.7
16	19.1
15	19.4
14	19.2
16	18.8
15	18.5



Pilot After Changing Spinneret Head Of One Line (Contd.)

Parameter	CSY strength in N before changing spinneret head	CSY strength in N after changing spinneret head
Mean	15.26666667	19.19666667
Variance	1.098850575	0.118264368
Observations	30	30
Hypothesized Mean Difference	0	
df	35	
t Stat	-19.51135275	
P(T<=t) one-tail	1.0876E-20	
t Critical one-tail	1.689572458	
P(T<=t) two-tail	2.17521E-20	
t Critical two-tail	2.030107928	



Note : Breaking strength impact after changing the spinneret heads have been dis similar to pre-change

Pilot Run: Corrective Actions

Incorrect gradation:
Lower grades getting
labeled as higher grade
(A1/A2 labeled as A grade
or A2 labeled as A1 grade)

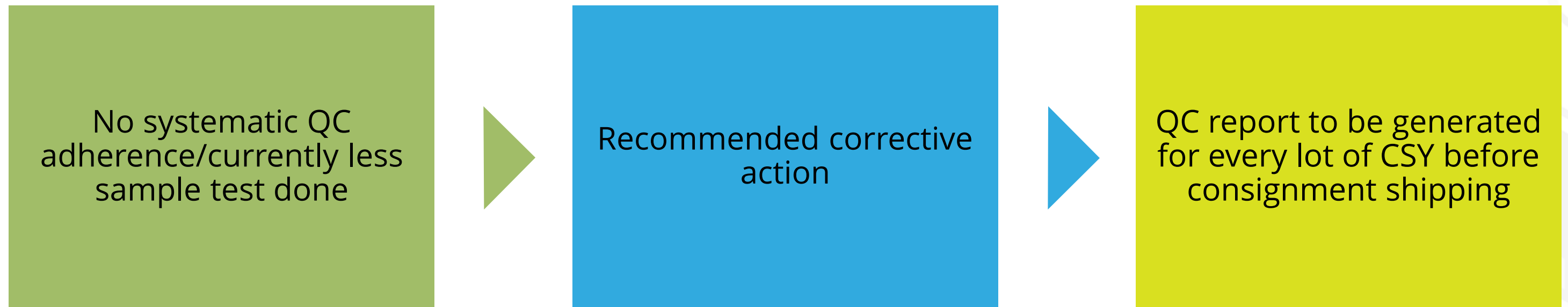


Recommended corrective
action



Train The QC
Personnel/Ensure Correct
Gradation

Pilot Run: Corrective Actions (Contd.)

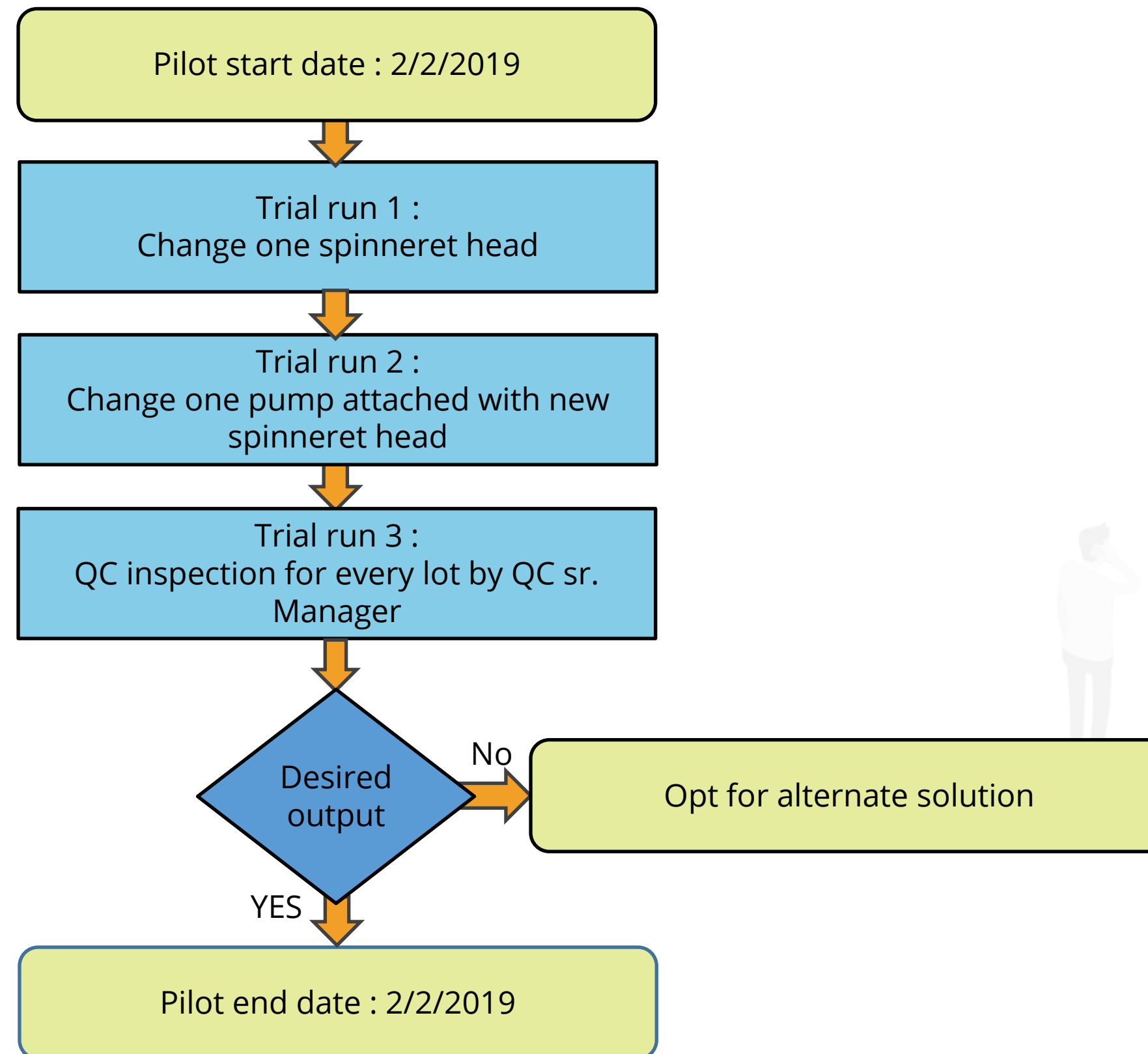


Pilot After Changing Spinneret Head Of One Line

Parameters	Lot Size 2000	
	Current process	Recommended process
Sample size	10	30
Frequency	Twice in a week	Every alternate day
Monitoring level	QC executive	QC Executive + QC Sr. Manager
Training/refresher	Once in six months	Once in a quarter

Improve Phase

Pilot Run: Process Flow



Recommended Broken Filaments On Surface CSY Yarn Gradation

Broken filaments on the surface			
Allowed broken filaments on the surface	Grade	Weight variation	Knots on surface
Up to 3	A	Up to 2.5%	1 knot
3-5	A1	Up to 2.75%	3 knots
5-7	A2	Up to 3.25%	5 knots
More than 7	Waste	More than 3.25%	More than 5

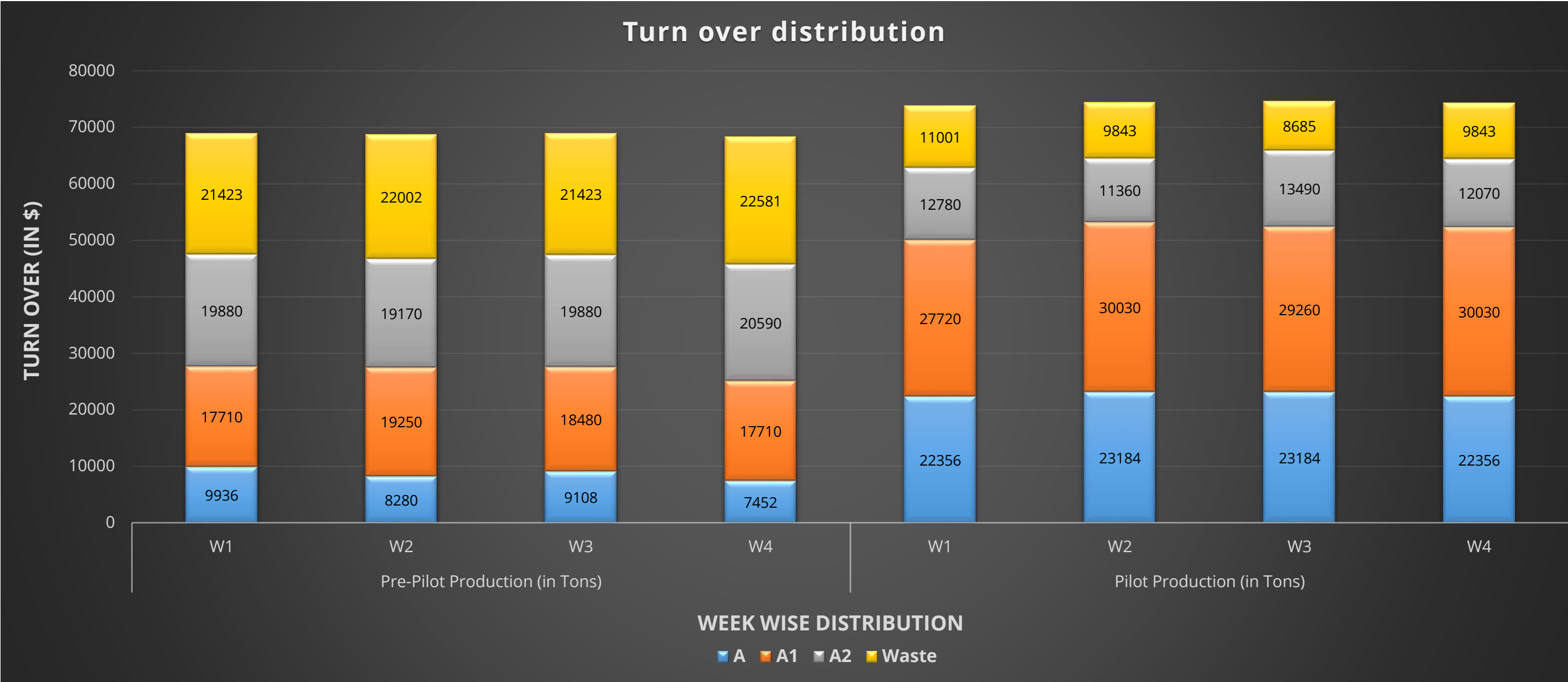
Output Comparison Pre-Pilot and Post-Pilot For CSY Yarn Gradation

Quality grade	Pre-pilot production (in tons)				Pilot production (in tons)			
	W1	W2	W3	W4	W1	W2	W3	W4
A	1.2	1.0	1.1	0.9	2.7	2.8	2.8	2.7
A1	2.3	2.5	2.4	2.3	3.6	3.9	3.8	3.9
A2	2.8	2.7	2.8	2.9	1.8	1.6	1.9	1.7
Waste	3.7	3.8	3.7	3.9	1.9	1.7	1.5	1.7
Gross production	10	10	10	10	10	10	10	10

Pre and Post-Pilot Comparison for CSY Yarn Gradation Output Turnover

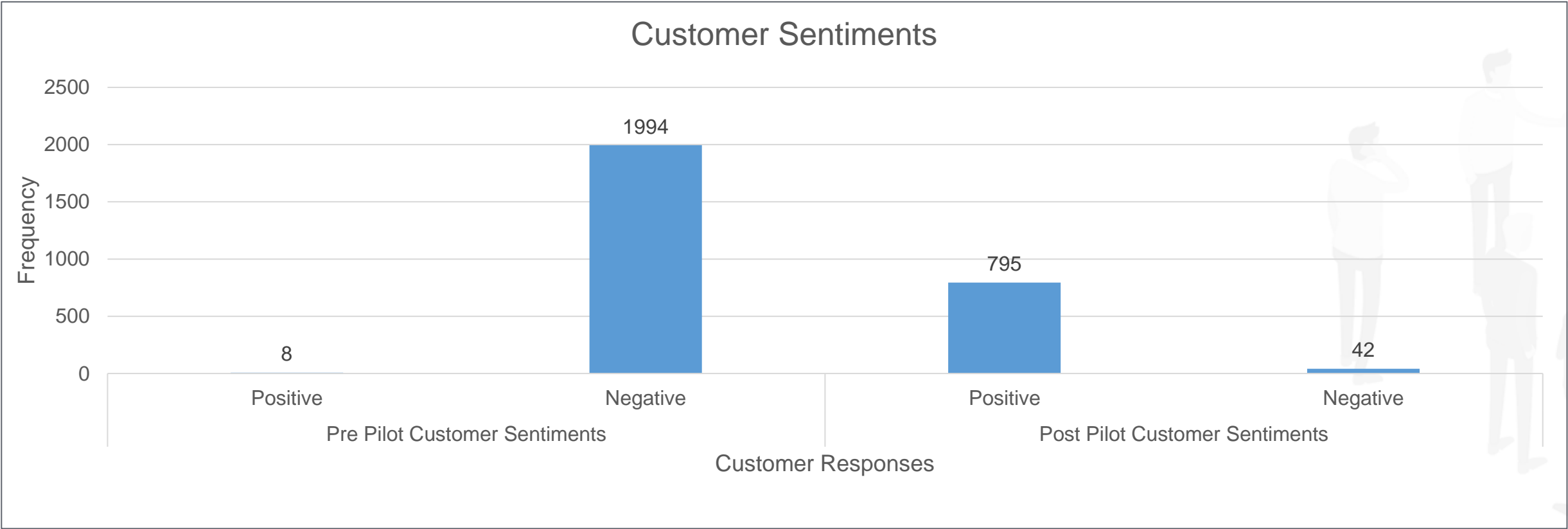
Quality grade	Pre-pilot turn over (in \$)				Pilot turn over (in \$)			
	W1	W2	W3	W4	W1	W2	W3	W4
A	9936	8280	9108	7452	22356	23184	23184	22356
A1	17710	19250	18480	17710	27720	30030	29260	30030
A2	19880	19170	19880	20590	12780	11360	13490	12070
Waste	21423	22002	21423	22581	11001	9843	8685	9843
Gross turn over	68949	68702	68891	68333	73857	74417	74619	74299

Pre and Post-Pilot Comparison for CSY Yarn Gradation Output Turnover (Contd.)



C-Sat Comparison Pre-Pilot and Post-Pilot For CSY Yarn Strength

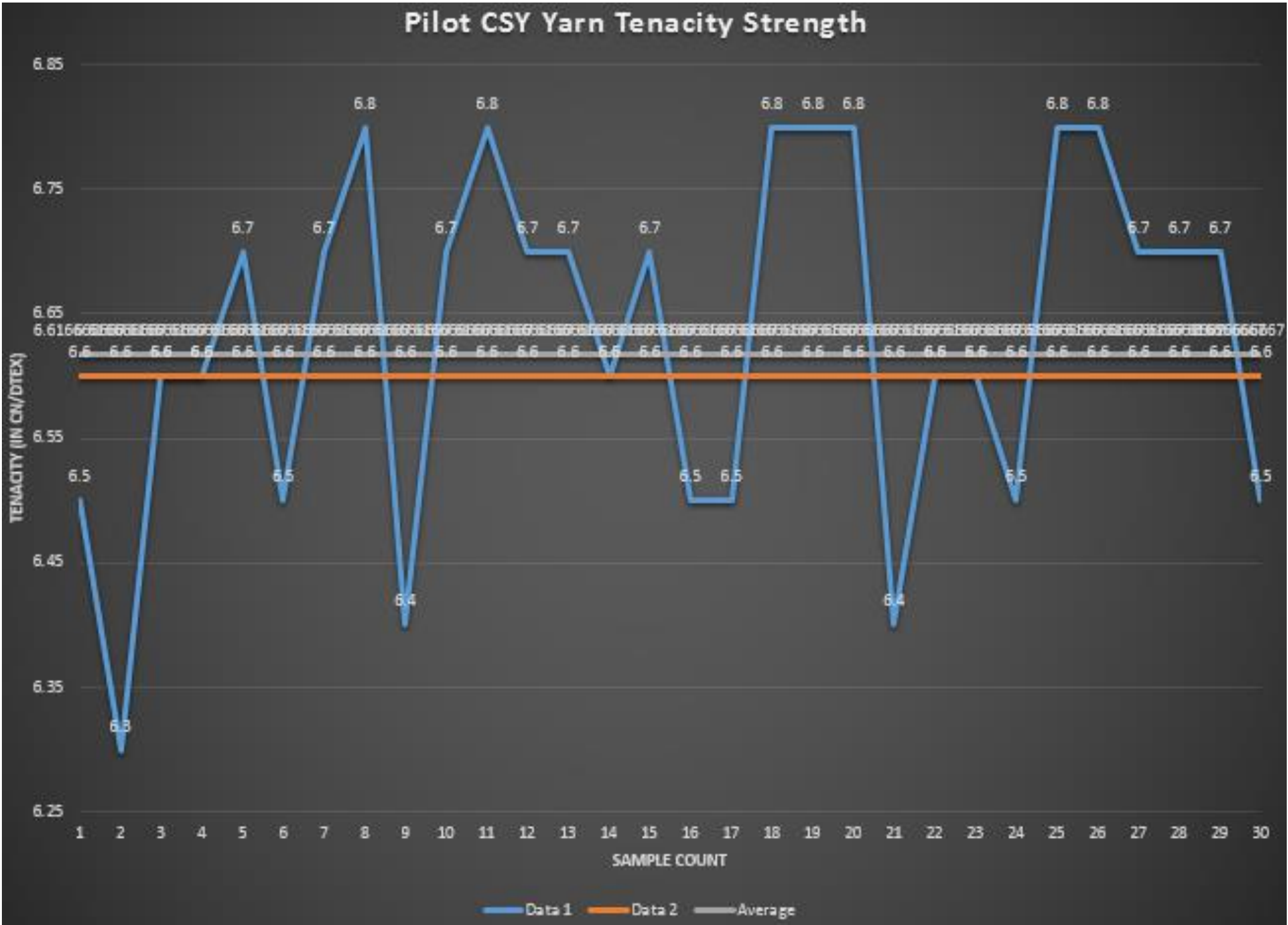
Pre-pilot customer sentiments			Post-pilot customer sentiments	
Quality driver	Positive	Negative	Positive	Negative
Yarn strength	8	1994	795	42



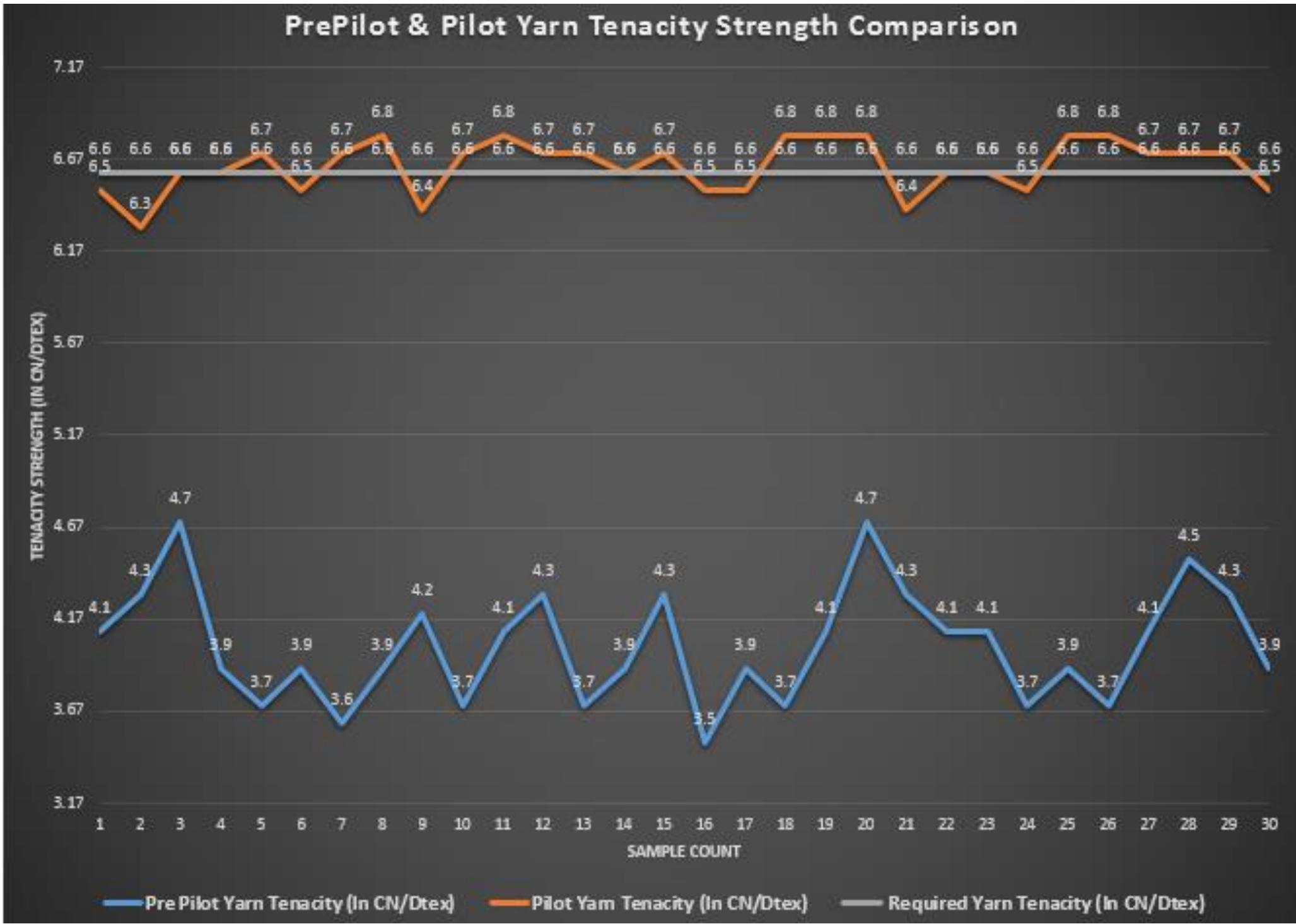
Pilot CSY Tenacity Strengths

Consignment no.	Sample lot	Elastane denier	Yarn tenacity (in CN/dtex)	Required yarn tenacity (in CN/dtex)
Consignment 1	Lot 1	40	6.5	6.6
	Lot 2	40	6.3	6.6
	Lot 3	40	6.6	6.6
Consignment 2	Lot 1	40	6.6	6.6
	Lot 2	40	6.7	6.6
	Lot 3	40	6.5	6.6
Consignment 3	Lot 1	40	6.7	6.6
	Lot 2	40	6.8	6.6
	Lot 3	40	6.4	6.6
Consignment 4	Lot 1	40	6.7	6.6
	Lot 2	40	6.8	6.6
	Lot 3	40	6.7	6.6
Consignment 5	Lot 1	40	6.7	6.6
	Lot 2	40	6.6	6.6
	Lot 3	40	6.7	6.6
Consignment 6	Lot 1	40	6.5	6.6
	Lot 2	40	6.5	6.6
	Lot 3	40	6.8	6.6
Consignment 7	Lot 1	40	6.8	6.6
	Lot 2	40	6.8	6.6
	Lot 3	40	6.4	6.6
Consignment 8	Lot 1	40	6.6	6.6
	Lot 2	40	6.6	6.6
	Lot 3	40	6.5	6.6
Consignment 9	Lot 1	40	6.8	6.6
	Lot 2	40	6.8	6.6
	Lot 3	40	6.7	6.6
Consignment 10	Lot 1	40	6.7	6.6
	Lot 2	40	6.7	6.6
	Lot 3	40	6.5	6.6

Pilot CSY Tenacity Strengths (Contd.)



Pilot CSY Tenacity Strengths (Contd.)



Control Phase

Implementation

Phase-wise spinneret heads change

Phase-wise connected pumps change

TPM for spinneret and pumps maintenance every month

Regular QC adherence

Quarterly training/refresher for staff

Phase-wise spinneret heads change

TPM For Pumps

Pump maintenance process		
Parameters	Current	Recommended
Cleaning	Yearly	Half-yearly
Random line-check	Fortnightly	Weekly
Line-check personnel	Production executive	Production executive + production manager
Report frequency of pump health check from line manager	Weekly	Daily



Note : Monthly pump reports to be published and shared with the plant head

Sample Report

CSY yarn strength sample report									
Yarn sample	Elongation at break		Force		Tenacity		Work to rupture		Breaking time
	E%	CV%	cN	CVF%	cN/tex	CV%	cN(cm)	CV%	



Note: Every lot must have complete report with QC Sr. manager's signature

Summary

You should now be able to:

- 👁 Understand the Elite Elegance plant project background
- 👁 Analyze the various factors that led to the losses in manufacturing of viscose filament yarn
- 👁 Infer how the recommended pilot run actions improved the hotel revenue

