



LEAN SIX SIGMA GREEN BELT PROJEKAT

*Decreasing number of pinning mistakes
on Daimler NGA IP line*

Vođa projekta: Branislav Žujović

21.03.2023.

General Information about Serbia, PKC Wiring Systems d.o.o ■



**Motherson
Wiring Harness
Division plants in
Serbia**

SMEDEREVO factory size: **23,200** sqm total space

- 21,600 sqm ground floor,
- 1,600 sqm upper floor

• **Production space:** 20,750 sqm total

Extension (7,000sqm) finished in May 2020.

Employees: Active June Headcount: 2,981

Direct: 2,266

Indirect: 715



POZAREVAC factory size: **8,930** sqm total space

- 4,300 sqm ground floor,
- 1,250 sqm first floor (645 sqm for Production)
- 3,380 sqm second floor

Extension phase 1 (2,000 sqm) finished in April 2022

Phase 2(6,930 sqm) to be finalized June 2022

Employees: 700

Proud to be
part of our
customers'
success



- PKC Group started its operations in Smederevo in Serbia in 2014.
- Within a few years, the company has multiplied the number of customer projects
- Growth journey continues as new plant in Pozarevac starts operations in June 2022.



Our main products and customers

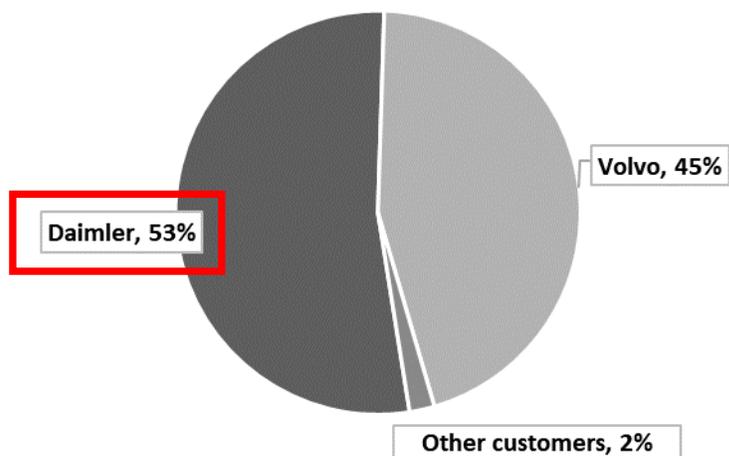
DAIMLER:	IP, Chassis, Cabin, Engine
VOLVO MT/HT:	Dashboard, Chassis, Front Face, Header Shelf
VOLVO ELECTRICAL TRUCK:	Dashboard, Chassis, Battery Cables
DAF:	BEM sensor
KNORR BREMSE:	Clutch actuators
DEUTZ:	Engine
MAN:	Headlights, Floor
RENAULT HT:	Batch Harnesses

Decreasing number of pinning mistakes on Daimler NGA IP line

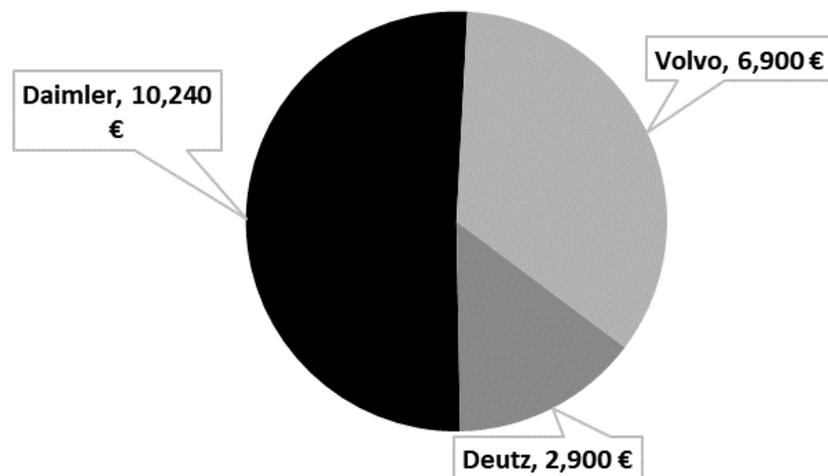
– WHY this project?



Production share by customers

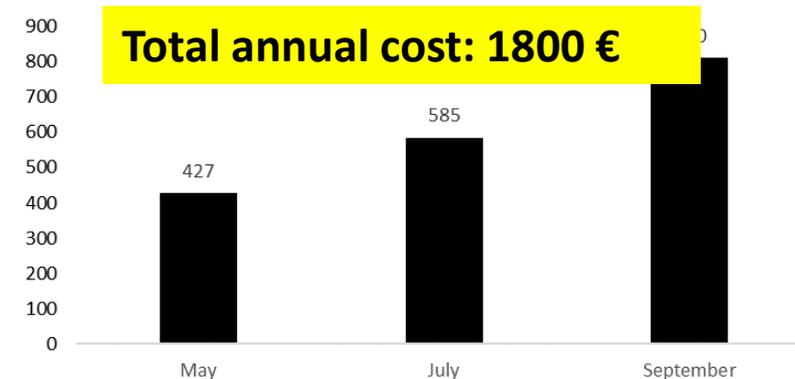


External claims cost per customer



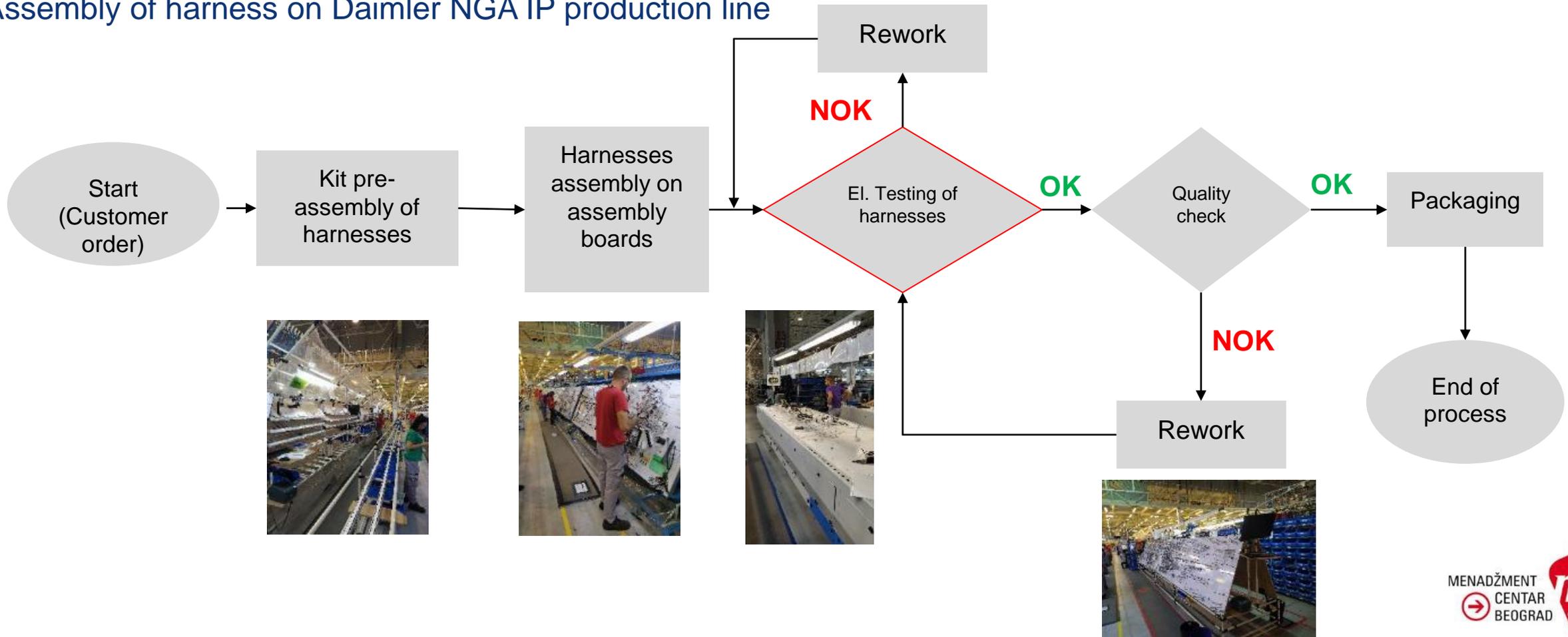
Total annual cost: 20040 €

Wrong pinning external claim cost in 2022 (euros)



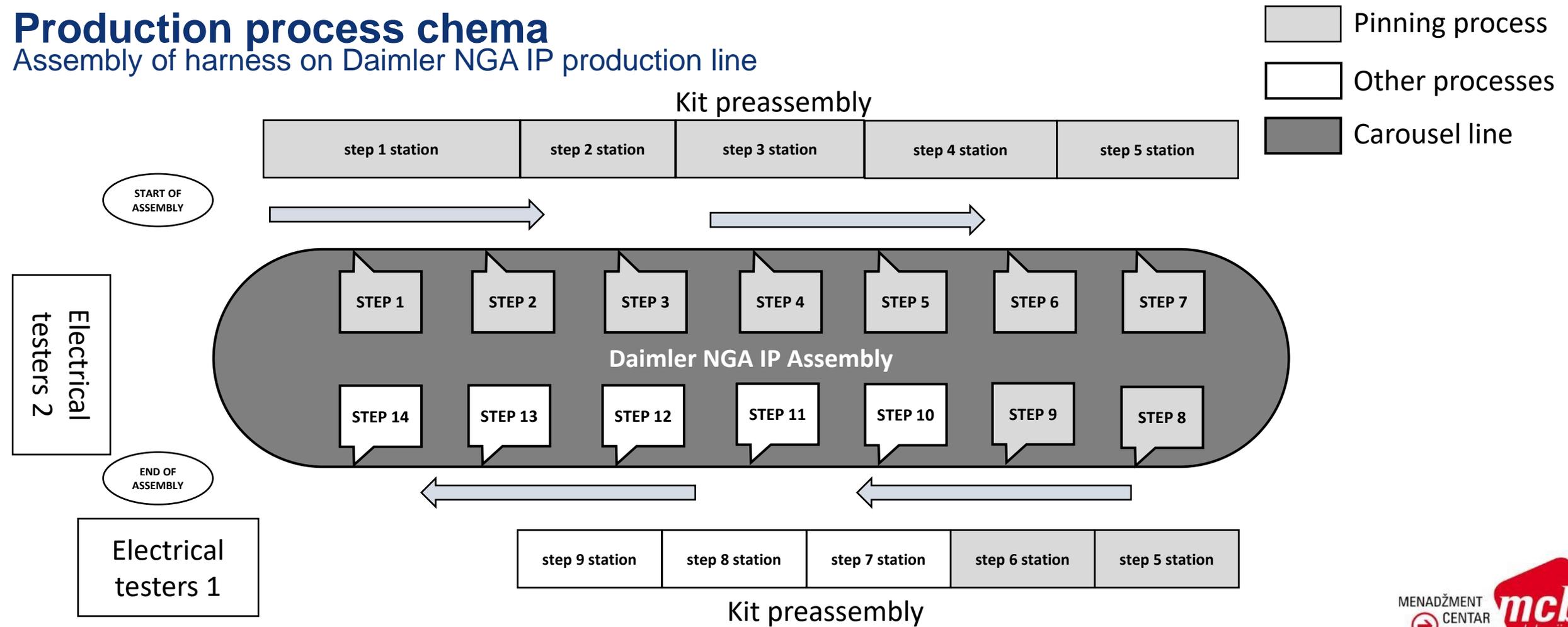
Flow chart

Assembly of harness on Daimler NGA IP production line



Production process chema

Assembly of harness on Daimler NGA IP production line



DEFISANJE

MERENJE

ANALIZA

POBOLJŠANJE

KONTROLA

5W2H method

What	Where	Who	When	Why	How much	How often
Wrong pinning	Assembly line Daimler NGA IP	Electrical tester	From beginning of project (2020)	New and untrained operators	FTT 9% on both electrical testers and monthly more than 1900 mist.	Each working day in each shift

SMART method

S	M	A	R	T
Increase FTT of electrical testing on electro tester 1 and 2 on Daimler NGA IP line	Increase of FTT (First time through) from 9% to 50%	Analysis of this problem wasn't done in past	Expert support (green belt). External training of for six sigma yellow & green belt	28.02.2023.

DEFISANJE

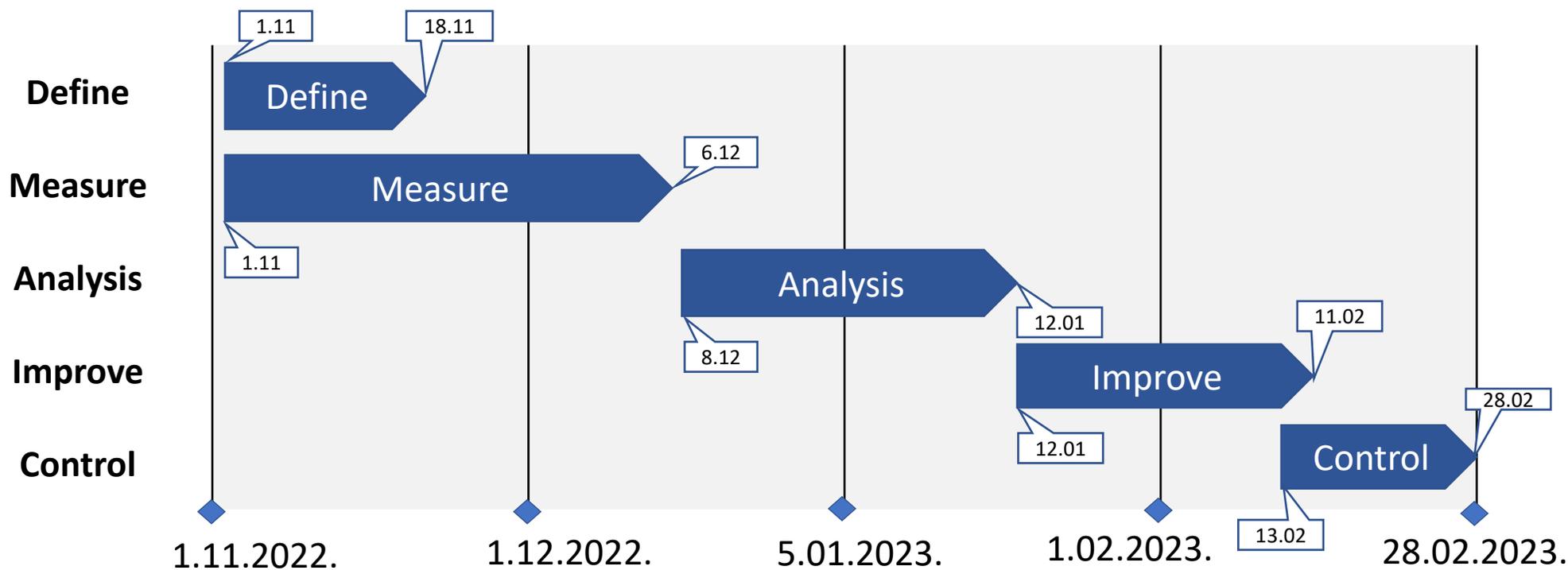
MERENJE

ANALIZA

POBOLJŠANJE

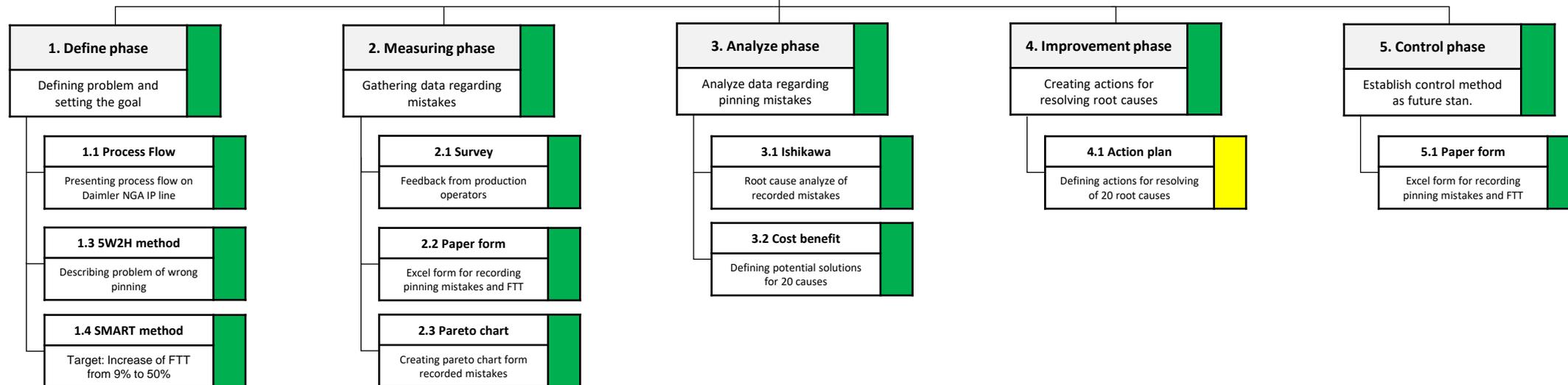
KONTROLA

Project Gath Chart

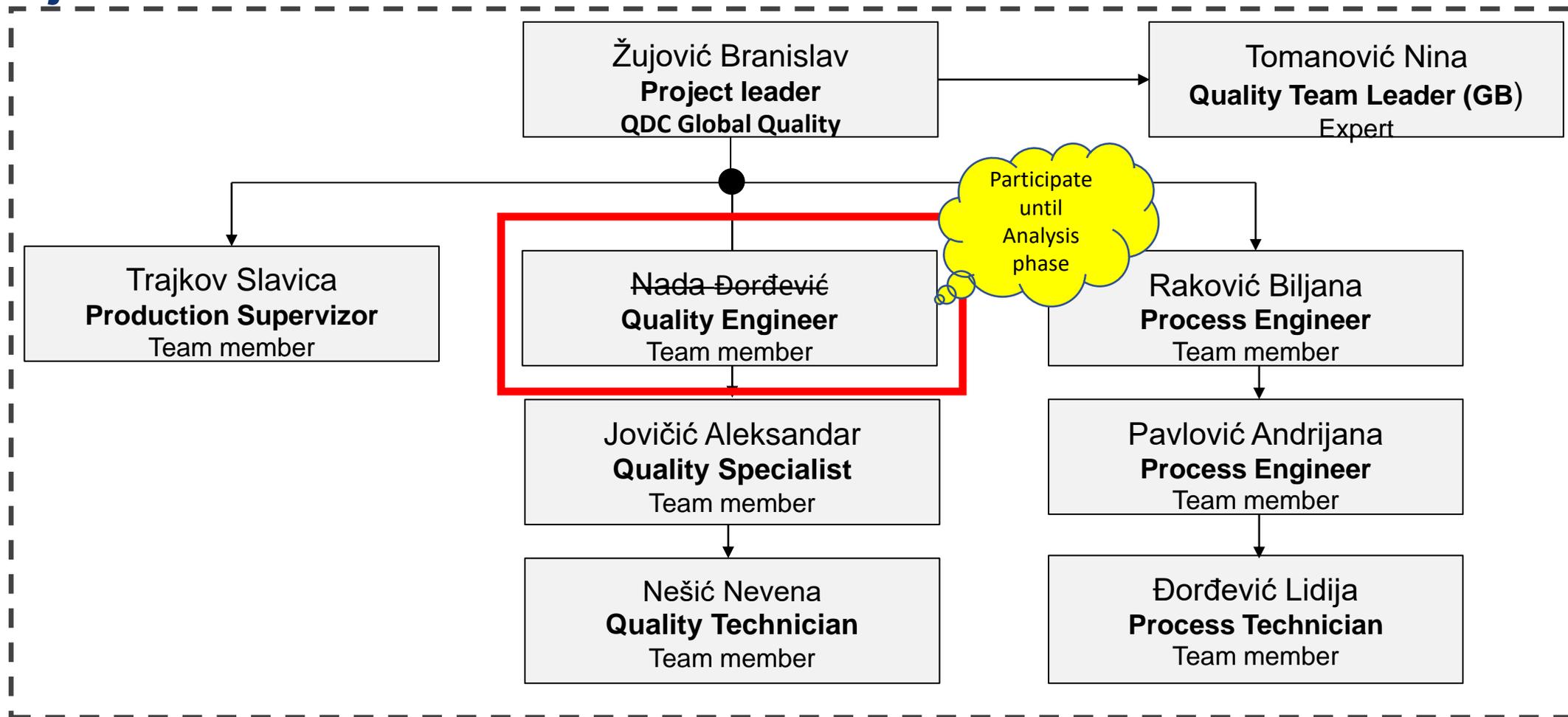


Work Breakdown Structure (WBS)

Decreasing number of pinning mistakes on Daimler NGA IP D.M.A.I.C phases



Project team members



Survey on Damiler NGA IP line

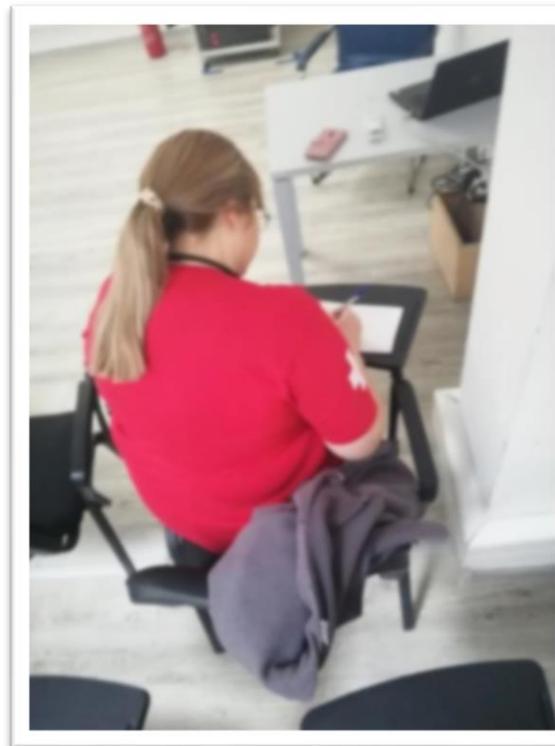
Q1: Which most common issues you have in your production step?

Q2: What is the most complicated production step and process according your opinion?

1. Sa kojim se najčešćim problemima u toku rada susrećete na vašem radnom mestu (zaokružite jedan odgovor)?
 - i) Pomešane komponente (konektori, provodnici, trake,...)
 - j) Nedostaje oznaka komponente na radnim stanicama/kutijama (konektori, provodnici, trake,...)
 - k) Oštećene komponente
 - l) Nejasne instrukcije za rad
 - m) Neodostaje instrukcija za rad
 - n) Nedostaje provodnik (KNB)
 - o) Nedostaje alat - vasilice
 - p) Drugo (upišite): _____

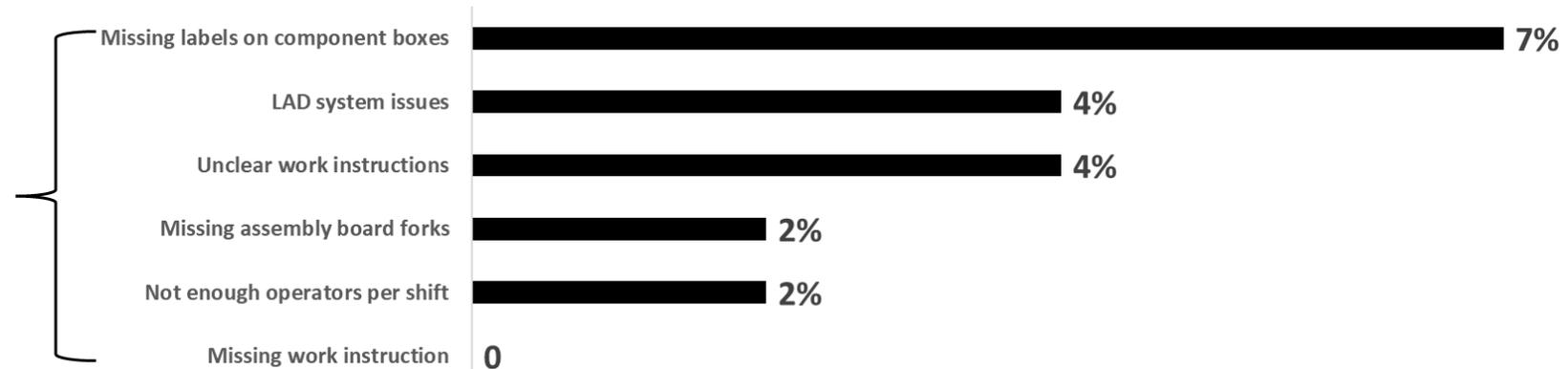
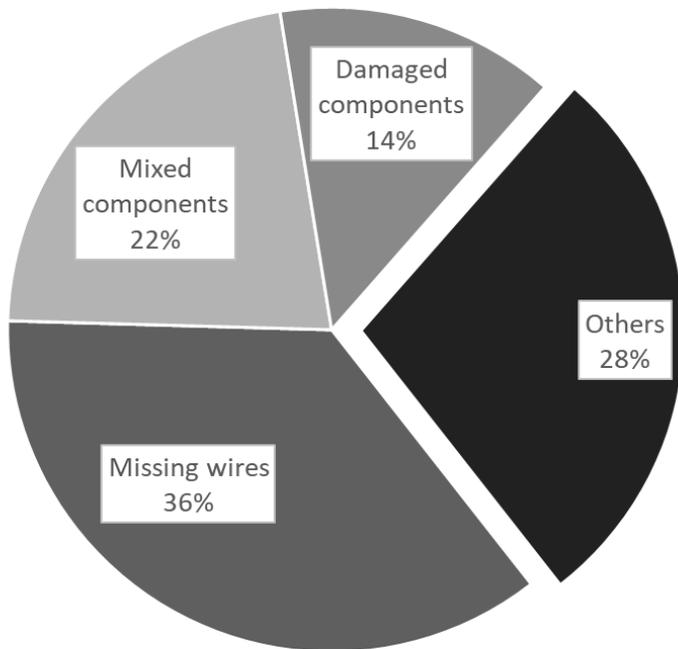
2. Po vašem mišljenju koji proces i na kom koraku je najkomplikovaniji? (zaokružite jedan odgovor i upišite radni korak) --- *npr. a) – sedmi korak*
 - i) Motanje trake _____
 - j) Pinovanje provodnika u konektor _____
 - k) Postavljanje kit-ova na montažnu tablu _____
 - l) Zaključavanje konektora _____
 - m) Postavljanje poklopaca _____
 - n) Postavljanje adaptera _____
 - o) Postavljanje vezica/klipova _____
 - p) Testiranje harnessa _____

66
participants



Survey results

Q1: Which most common issues you have in your production step?



TOP 3 answers:

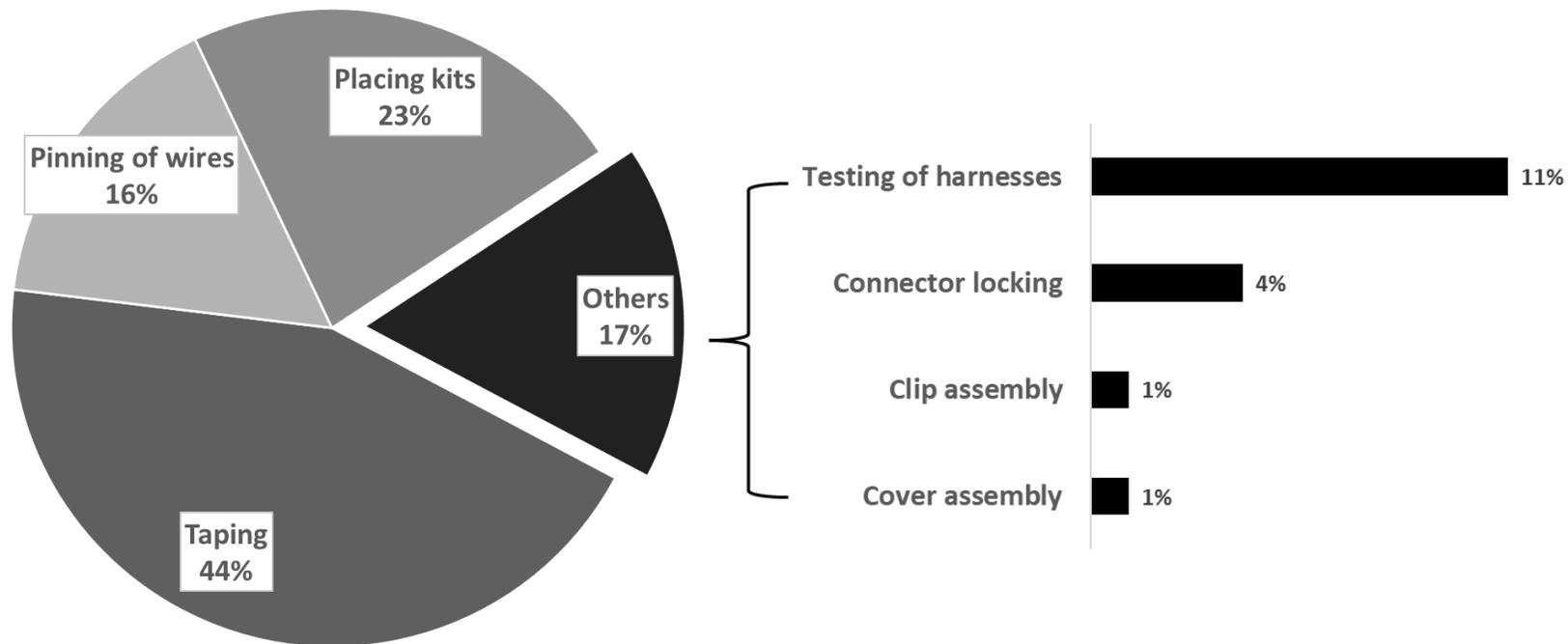
- Missing wires
- **Mixed components**
- Damaged componets

Survey results

Q2: What is the most complicated production step and process according your opinion?

TOP 3 answers:

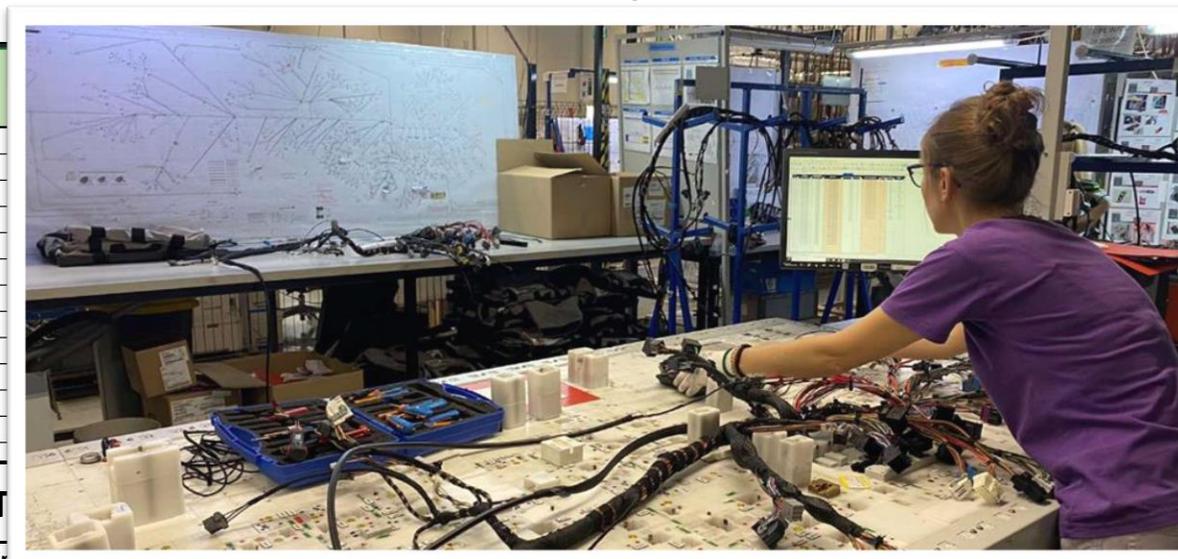
- Tapping
- Placing kits
- **Pinning of wires**



Written formulars

Recording of pinning mistakes and FTT results on two electrical testers in 1 month period

Smena 1/2	Datum -> Format mesec/dan/godina	ID Operatera na testeru.	Operater	Broj Kamiona	Kućište	Kod greške	
1	1-Nov-2022	11898	Jovana Milojević	1147741	a8x10	1	
1	1-Nov-2022	11898	Jovana Milojević	1147741	x32	1	
1	1-Nov-2022	11898	Jovana Milojević	1147741	a8x1	1	
1	1-Nov-2022	11898	Jovana Milojević	1147705	x23	1	
1	1-Nov-2022	11898	Jovana Milojević	1147705	x115	1	
1	1-Nov-2022	11898	Jovana Milojević	1147705	x211	1	
1	1-Nov-2022	11898	Jovana Milojević	1147705	a8x2	1	
1	1-Nov-2022	11898	Jovana Milojević	1147687	a8x1	1	
1	1-Nov-2022	11898	Jovana Milojević	1147687	a3ax3	1	
1	1-Nov-2022	11898	Jovana Milojević	1147687	x43	1	
1	1-Nov-2022	11898	Jovana Milojević	1147322	a7x1	1	
1	1-Nov-2022	11898	Jovana Milojević	1147322	a8x6	1	
1	1-Nov-2022	11898	Jovana Milojević	1147322	x184	1	
				Daimler IP FT			
				Datum	Smena	Ukupan broj testir	
1	1-Nov-2022	11898	Jovana Milojević	1-Nov	1	17	16
1	1-Nov-2022	11898	Jovana Milojević	1-Nov	2	22	0
1	1-Nov-2022	11898	Jovana Milojević	2-Nov	1	20	18
1	1-Nov-2022	11898	Jovana Milojević	2-Nov	2	22	21
1	1-Nov-2022	11898	Jovana Milojević	3-Nov	1	28	26
1	1-Nov-2022	11898	Jovana Milojević	4-Nov	1	21	19
1	1-Nov-2022	11898	Jovana Milojević	4-Nov	2	26	24
1	1-Nov-2022	11898	Jovana Milojević	7-Nov	1	17	16
1	1-Nov-2022	11898	Jovana Milojević	7-Nov	2	1	0



DEFISANJE

MERENJE

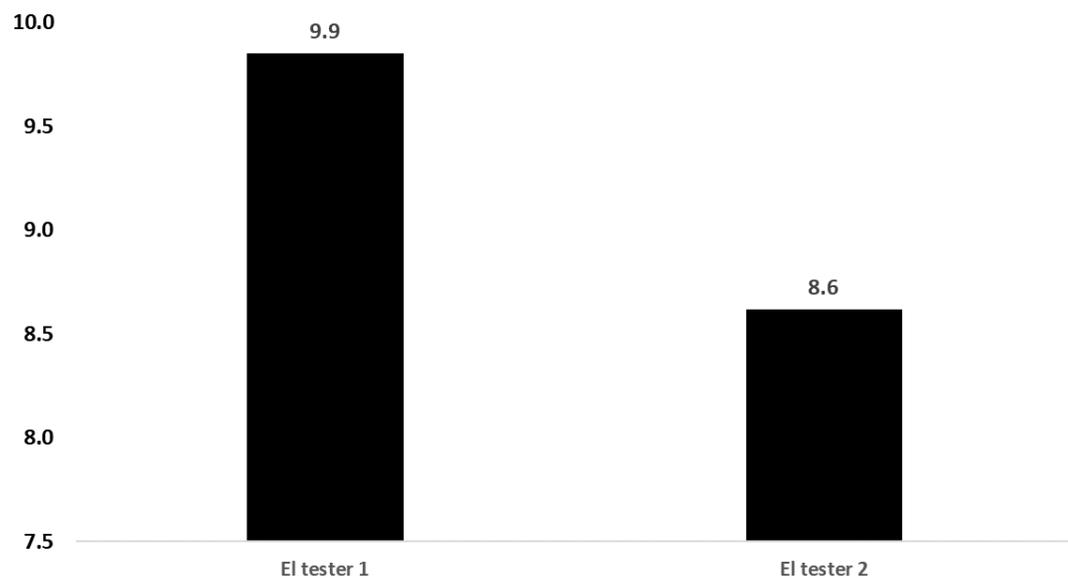
ANALIZA

POBOLJŠANJE

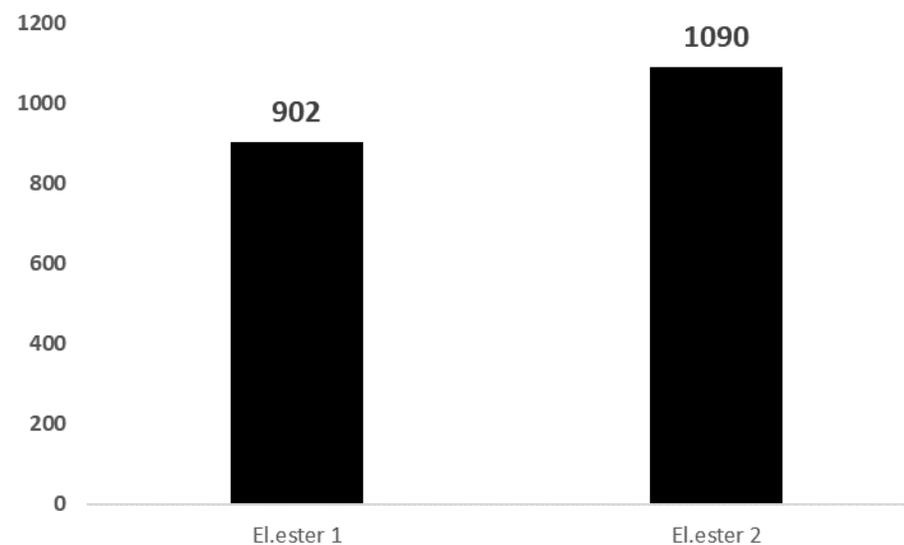
KONTROLA

Measuring results period 1.11 – 30.11.2022 on 1190 tested harnesses

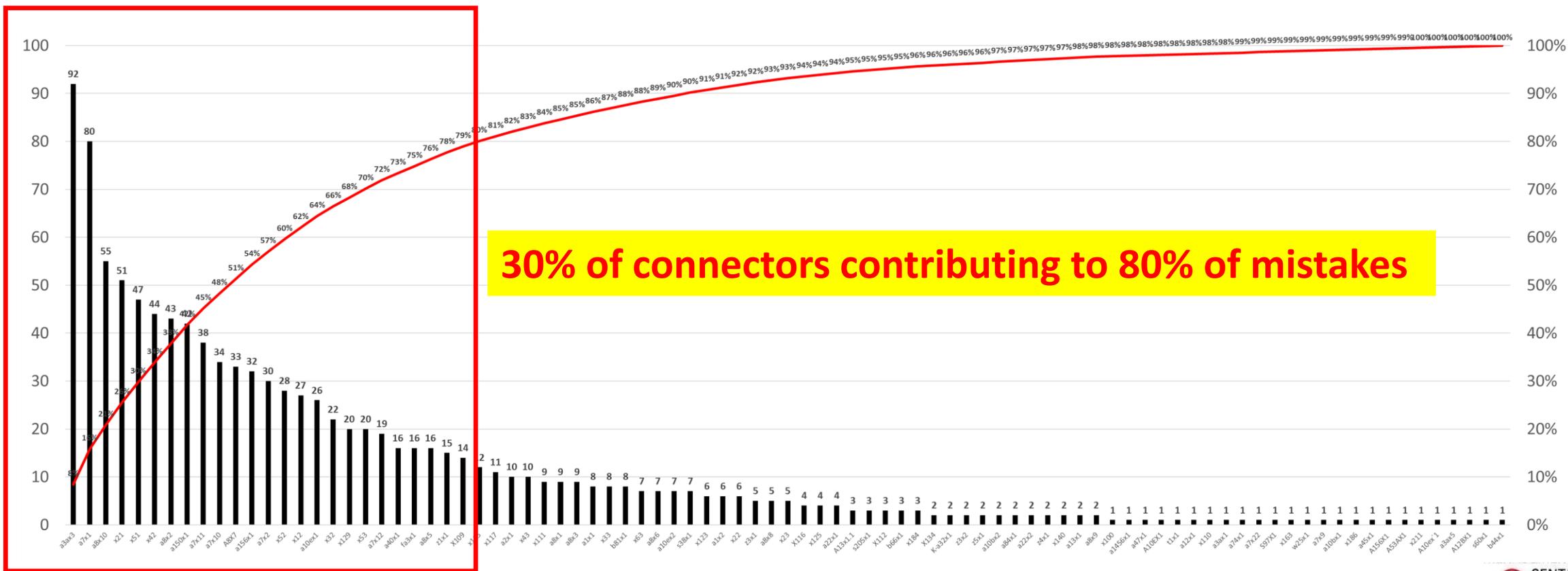
FTT (%)



Number of mistakes



Pareto analysis of Measuring results (all connectors with Cumulative $\leq 80\%$)



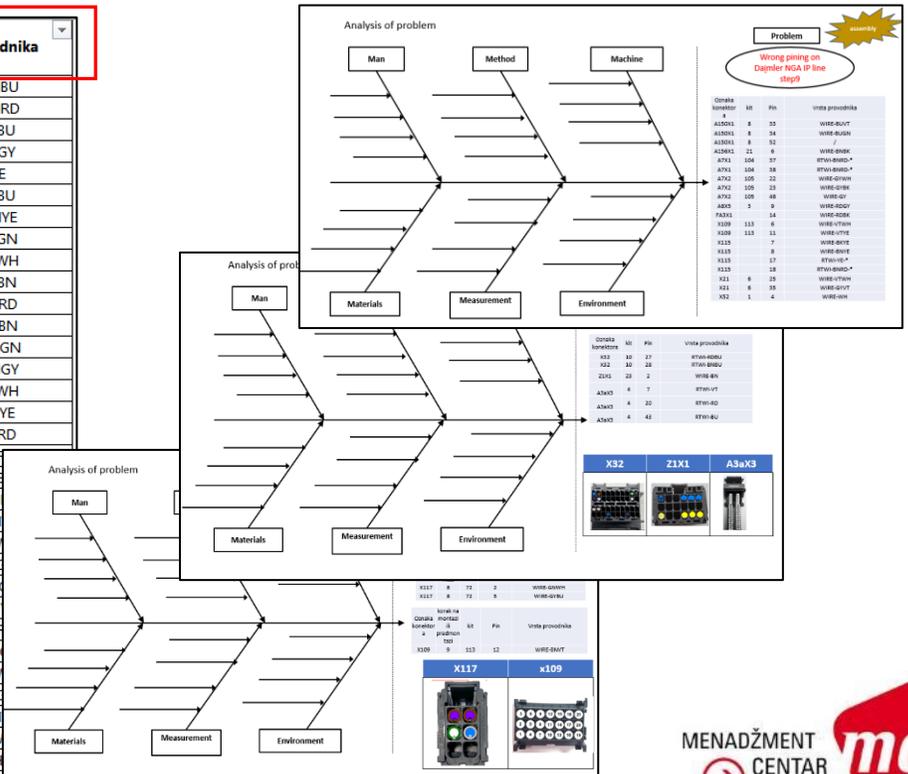
TOP pins with mistakes analyze of connectors

Pivot analysis and preparing inputs for Ishikawa analysis

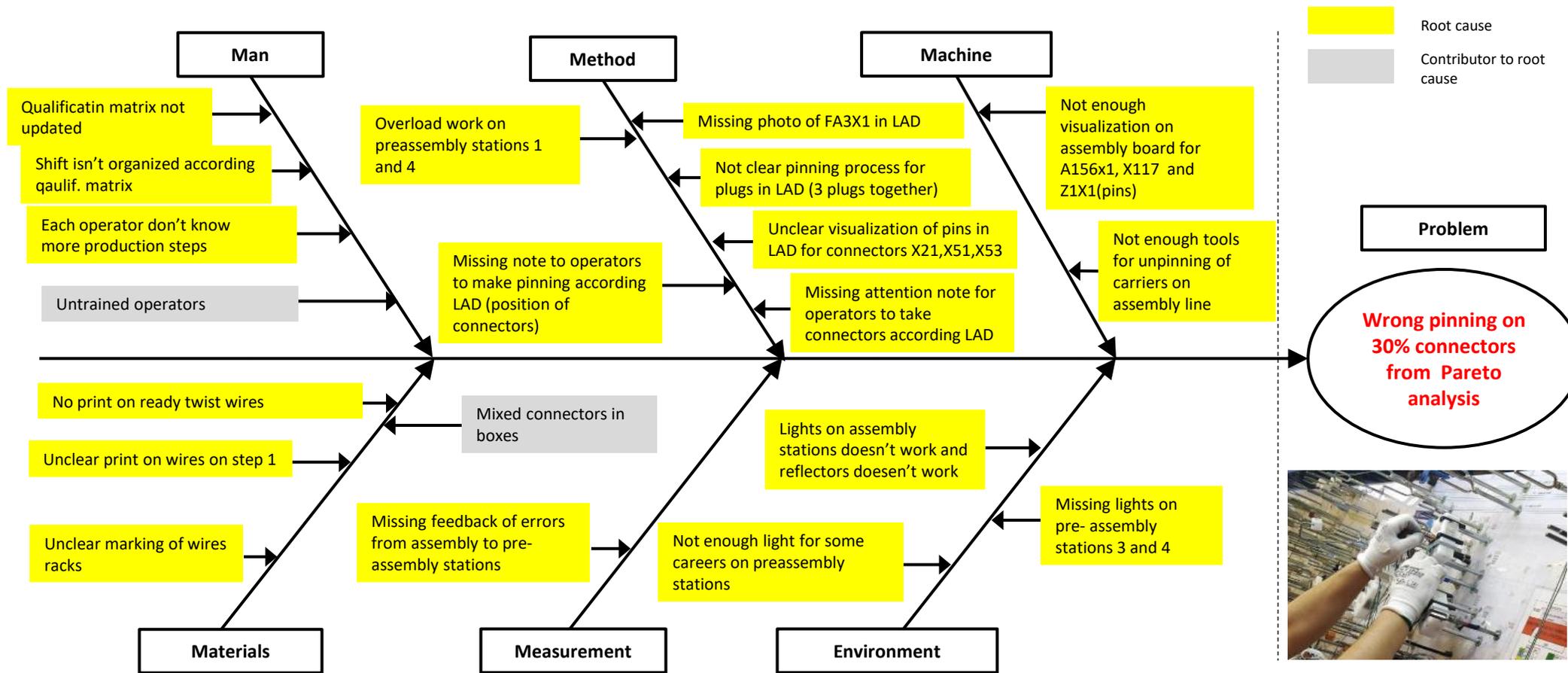
Konektor	Sum of Količina	Cumulative
a3ax3	92	8.45%
a7x1	80	15.79%
a8x10	55	20.84%
x21	51	25.53%
x51	47	29.84%
x42	44	33.88%
a8x2	43	37.83%
a150x1	42	41.69%
a7x11	38	45.18%
a7x10	34	48.30%
A8x7	33	51.33%
a156x1	32	54.27%
a7x2	30	57.02%
x52	28	59.60%
x12	27	62.08%
a10ex1	26	64.46%
x32	22	66.48%
x129	20	68.32%
x53	20	70.16%
a7x12	19	71.90%
a40x1	16	73.37%
fa3x1	16	74.84%
a8x5	16	76.31%
z1x1	15	77.69%
X109	14	78.97%
x115	12	80.07%

Kućište	Sum of Količina
a3ax3	17
7-20	17
20-7	17
40-41	9
43-42	4
40-41	9
1-14	4
29-48	4
14-1	3
48-29	3
33-34	2
6-9	2
14-40	2
20-48	2
13-26	2
1124	2
11-10	2
47-29	2
25-26	2
24-23	2

Oznaka konektora	Predmontaza ili Montaza	korak na montazi predmontazi	kit	Pin	Vrsta provodnika
A10eX1	pred - montaza 2	3	31	1	TWIS-WHBU
A10eX1	pred - montaza 2	3	31	2	TWIS-WHRD
A10eX1	pred - montaza 2	3	31	3	WIRE-YEBU
A10eX1	pred - montaza 2	3	31	4	WIRE-YEGY
A10eX1	pred - montaza 2	3	31	5	WIRE-YE
A10eX1	pred - montaza 2	3	31	10	TWIS-BKBU
A10eX1	pred - montaza 2	3	31	11	TWIS-WHYE
A10eX1	pred - montaza 2	3	31	12	WIRE-YEGN
A10eX1	pred - montaza 2	3	31	13	WIRE-YEWH
A10eX1	pred - montaza 2	3	31	14	WIRE-YEBN
A10eX1	pred - montaza 2	3	31	15	WIRE-BURD
A10eX1	pred - montaza 2	3	31	16	WIRE-BUBN
A10eX1	pred - montaza 2	3	31	19	TWIS-WHGN
A10eX1	pred - montaza 2	3	31	20	TWIS-WHGY
A10eX1	pred - montaza 2	3	31	21	WIRE-VTWH
A10eX1	pred - montaza 2	3	31	22	WIRE-GYYE
A10eX1	pred - montaza 2	3	31	23	WIRE-YERD
A10eX1	pred - montaza 2	3	31	24	WIRE-YE
A10eX1	pred - montaza 2	3	31	25	WIRE-YE
A10eX1	pred - montaza 2	3	31	28	TWIS-WH
A10eX1	pred - montaza 2	3	31	29	TWIS-WH
A10eX1	pred - montaza 2	3	31	30	WIRE-YE
A10eX1	pred - montaza 2	3	31	31	WIRE-BKC
A10eX1	pred - montaza 2	3	31	32	WIRE-BK
A10eX1	pred - montaza 2	3	31	33	WIRE-RD
A10eX1	pred - montaza 2	3	31	34	WIRE-VTF
A10eX1	pred - montaza 2	3	31	36	WIRE-WH
X53	pred - montaza 2	4	46	2	WIRE-YE
X53	pred - montaza 2	4	46	4	WIRE-BKC
X53	pred - montaza 2	4	46	7	WIRE-GN
X53	pred - montaza 2	4	46	12	WIRE-RD
X53	pred - montaza 2	4	46	13	WIRE-WH



Ishikawa diagram



Cost Benefit analysis

+		<ul style="list-style-type: none"> • Balance of preassembly steps 1 and 4 • Print on all ready twisted wires • Order more unpinning tools for “carriers” • Additional Lights on preassembly stations • Neon lights on preassembly stations
-	<ul style="list-style-type: none"> • Training of all operators according LAD (connector orientation) on all production steps • Sorting of all connectors on all preassembly stations 	<ul style="list-style-type: none"> • Attention for operators in LAD for proper orientation of connectors • Fix print on wires on pre-assembly stations on step 1 • Fix lights on assembly line and order of lights for reflectors • Feedback regarding pinning mistakes from assembly operators to pre-assembly operators • Renew marking on wire KNBs (positions) • Improve pin visualization in LAD for connectors • Split plugs in LAD • Update qualification matrix • Organize shift according qualification matrix • Increase knowledge of production operators for more production steps • Pin visualization of contra parts on assembly board for some connectors • Photos of brackets in LAD
		+
		Benefit



Action list

WHAT?



WHO?



WHEN?



No.	Root cause	Activity	Resp.	Open date	Due date	Closing date	Status
1		Napraviti formu za praćenje grešaka pinovanja na elektro testerima / <i>Make form/document for wrong pinning error tracking</i>	B.Žujović / A.Jovičić	20.10.2022	1.11.2022	1.11.2022	
2		Obuka za formu / <i>Training for form</i>	Nina / B.Žujović	20.10.2022	1.11.2022	1.11.2022	
3		Prikupljanje podataka / <i>Collecting data from el. Tester</i>	B.Žujović / A.Jovičić	20.10.2022	2.11.2022	2.11.2022	
4		Poslati popunjene formulare / <i>Send filled formulars</i>	B.Žujović	20.10.2022	3.11.2022	3.11.2022	
5		Excel analiza dobijenih podataka / <i>Excel analyse of data</i>	Nemanja	20.10.2022	4.11.2022	8.12.2022	
6		Kontaktirati lokalni menadžment za podršku na projektu kako bi odobrili članove tima / <i>Contact local Management for support</i>	B.Žujović	4.11.2022	18/11/22	18/11/22	
7		Napraviti spisak ucesnika u timu za projekat / <i>Make a list of team members</i>	B.Žujović	4.11.2022	18/11/22	18/11/22	
8		Organizovati inicijalni sastanak tima / <i>Initial team meeting</i>	B.Žujović	20.10.2022	21/11/22	21/11/22	***Sastanak tima
9		Prikupljanje podataka za ceo mesec Novembar / <i>Collecting and consolidaiton of data for November</i>	B.Žujović	02.12.2022	02.12.2022	02.12.2022	
10		Ažurirati prezentaciju projekta sa rezultatima praćenje grešaka / <i>Update project presentation with measuring result tracking</i>	B.Žujović	06.12.2022	13.12.2022	12/12/22	
11		Poslati spisak pinova prema radnim koracima / <i>Make list of</i>	B.Raković	8.12.2022	8.12.2022	8.12.2022	

Action list status



LAD instruction improvement

Root cause : Unclear visualization of pins in LAD for connectors X21,X51,X53

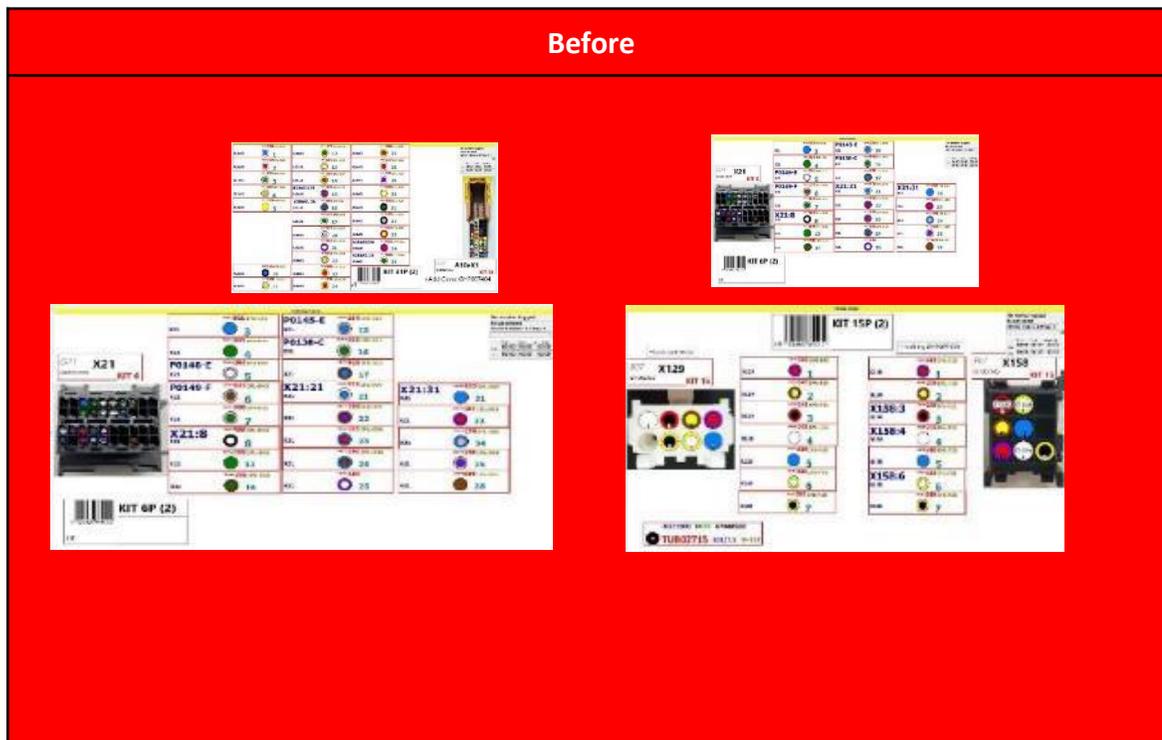
Before

After

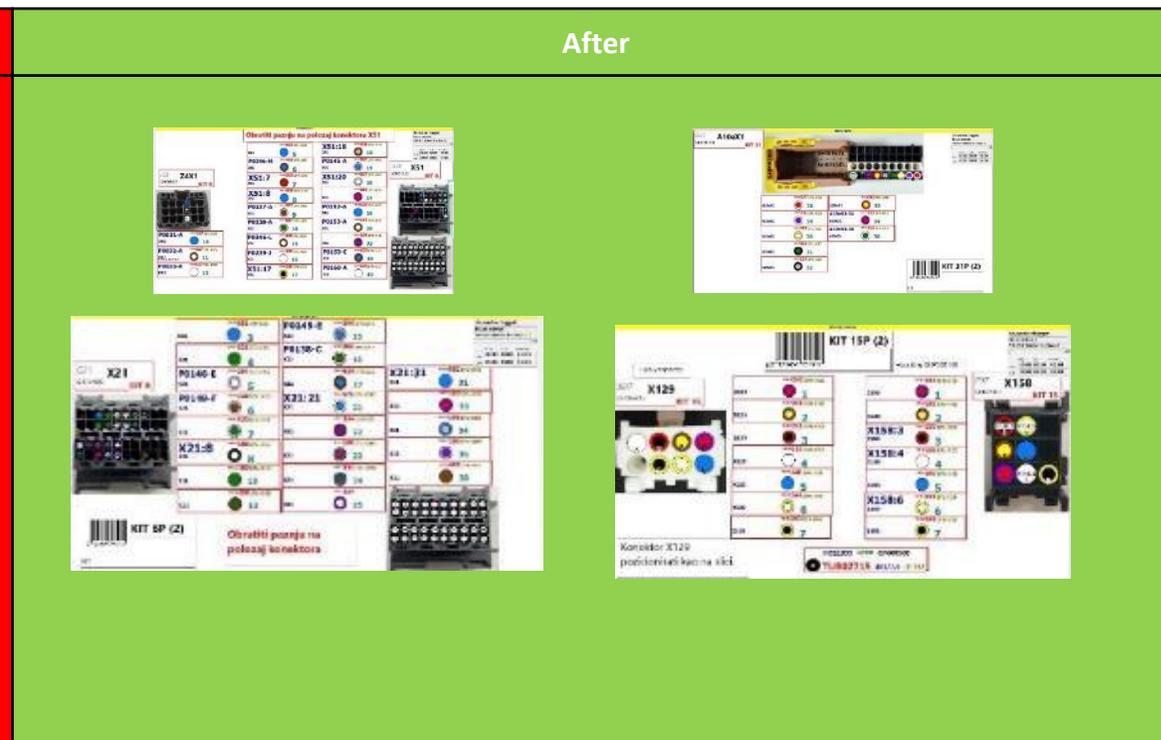
LAD instruction improvement

Root causes : Unclear visualization of pins in LAD for connectors X21,X51,X53

Before



After



Assembly board pin visualization on contra parts

Root cause : Not enough visualization on assembly board for A156x1, X117 and Z1X1 (pins)

Before



After



Assembly board pin visualization on contra parts for connectors X117 i Z1X1

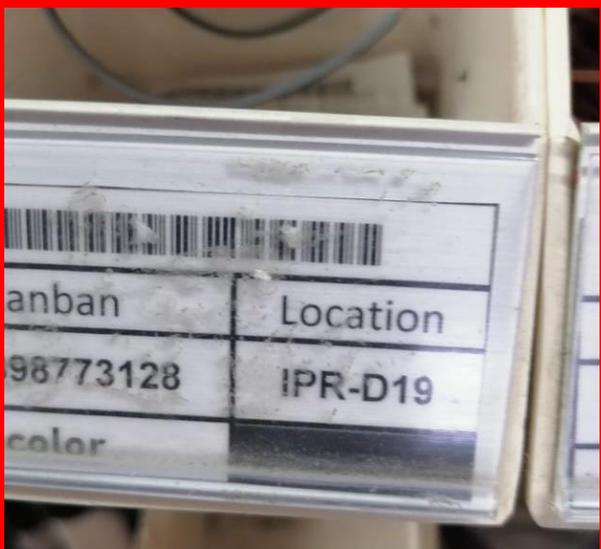


Root cause: Not enough visualization on assembly board for A156x1, X117 and Z1X1 (pins)

Visualization of labels on wires rack

Root cause: Unclear marking of wires racks

Before



KNB98711264;KNB98693198;

After



KNB98711264;KNB98693198;

Visualization of hooks for KITs

Root cause: Unclear marking of wires racks

Before



After



Rearrange of double crimp wires position on step1

Overload work on preassembly stations 1 and 4

Before



After



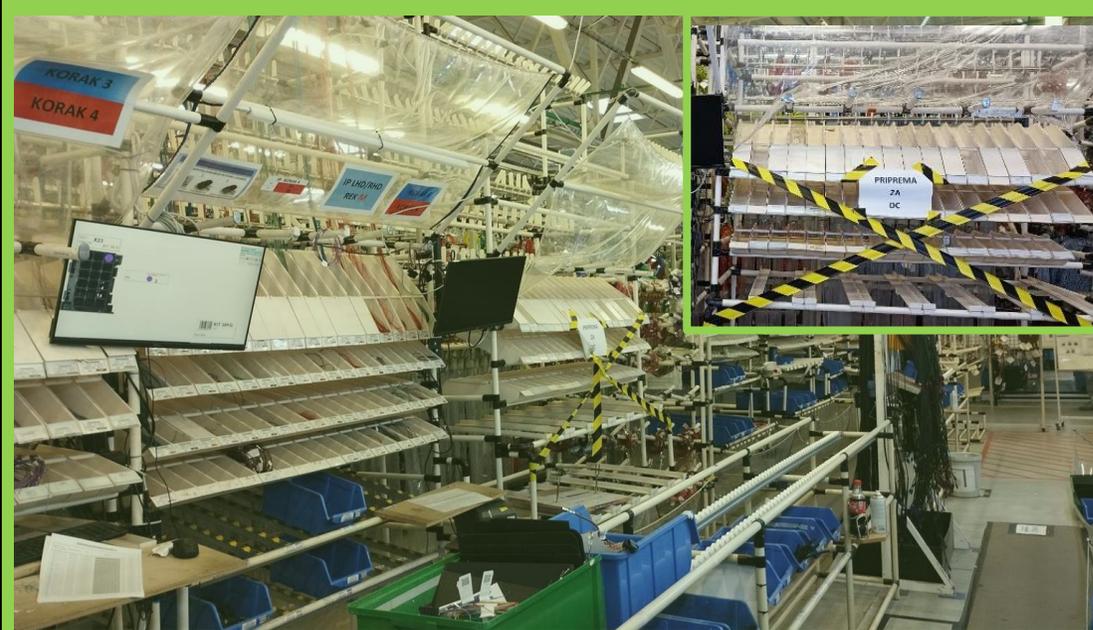
Rearrange of double crimp wires position on step4

Overload work on preassembly stations 1 and 4

Before



After



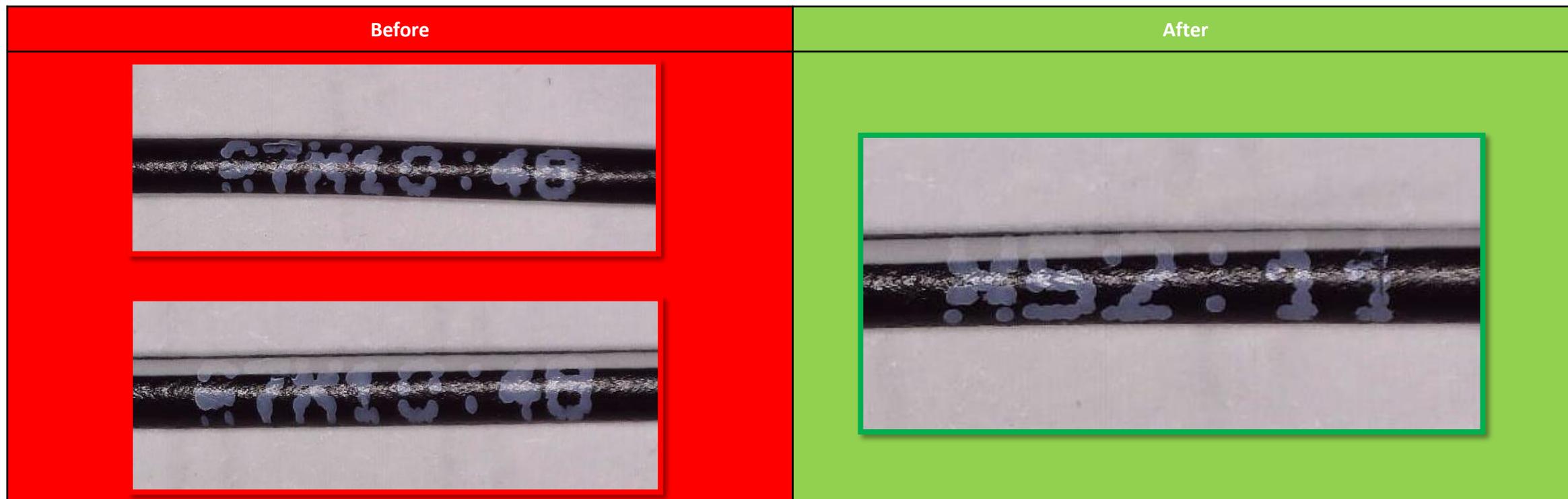
Add photo of FA3X1 in LAD

Root cause: Missing photo of FA3X1 in LAD



Visualization of proper print on wires

Unclear print on wires on step 1



Discussion regarding pinning mistakes on start 5 meetings

Missing feedback of errors from assembly to pre-assembly stations

Before	After
N/A	

Fixing lights in assembly line

Lights on assembly stations doesn't work and reflectors doesn't work

Before



After



Fixing lights (reflector) above assembly line

Lights on assembly stations doesn't work and reflectors doesn't work

Before



After



Additional qualification matrix according production steps

Shift isn't organized according qaulif. matrix

Before

N/A

After

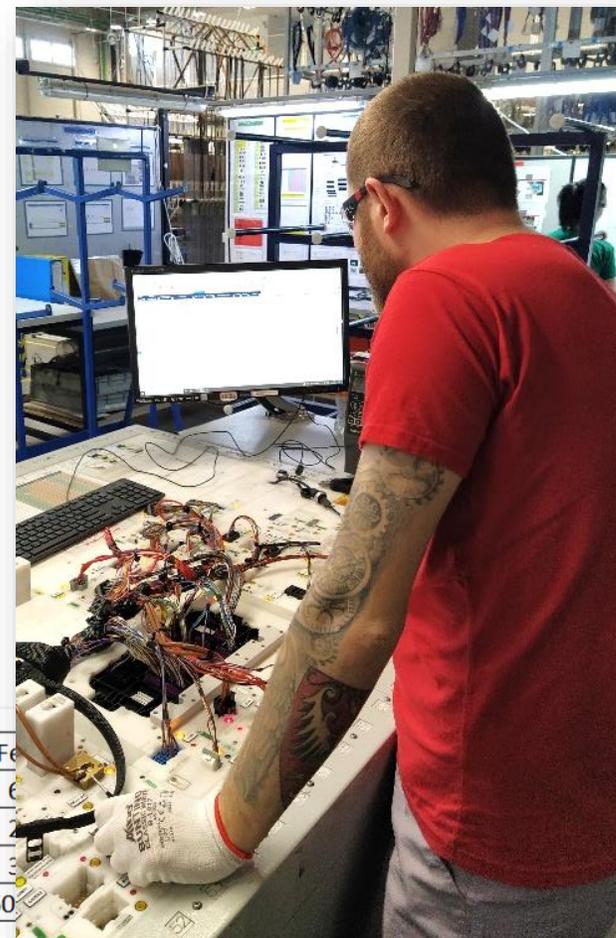
			MATRICA KVALIFIKACIJA											
ID broj	Datum zaposlenja	Ime i prezime	Kit preassembly											
			Korak 1	Korak 2	Korak 3	Korak 4	Korak 5	Korak 6	Korak 7	Korak 8	Korak 9			
15963	26.06.2022	Aleksa Zivojinovic												
12756	01.09.2020	Sanja Tadic												
11996	28.03.2019	Andrijana Krstic												
11340	16.07.2016	Snezana Kostic						x	x					
13624	12.02.2021	Andjela Cirkovic												
11757	21.07.2017	Nikola Brankovic												
13947	26.03.2021	Aleksandar Nikolic												
13880	24.03.2021	Ibrahim Agusi												
13809	12.03.2021	Suzana Savic												
11030	01.12.2015	Daliborka Ilic												
11898	28.02.2018	Jovana Milojevic							x	x				
14238	21.4.2021	Danijela Zdravkovic												
14099	07.04.2021	Mihaela Zivojinovic	x	x	x	x	x	x	x	x	x	x	x	x
13800	12.03.2021	Radica Stefanovic					x	x						
14304	28.04.2021	Brigita Perica	x	x	x	x	x	x	x	x	x	x	x	x
14305	28.04.2021	Lela Backic	x	x	x	x	x	x	x	x	x	x	x	x
14314	28.04.2021	Natasa Vljakovic												
13070	04.11.2020.	Jasmina Stojanovic						x	x					
16141	15.07.2022.	Svetlana Petrovic												
12749	01.09.2020.	Jovana Jovanovic												
16501	26.08.2022.	Zorica Vojinovic												
16502	26.08.2022.	Ivanka Zivkovic												
16489	26.08.2022.	Sasa Komaromi												
16495	26.08.2022.	Aleksandra Feschete												

Number of mistakes and FTT tracking

Excel templates standardized

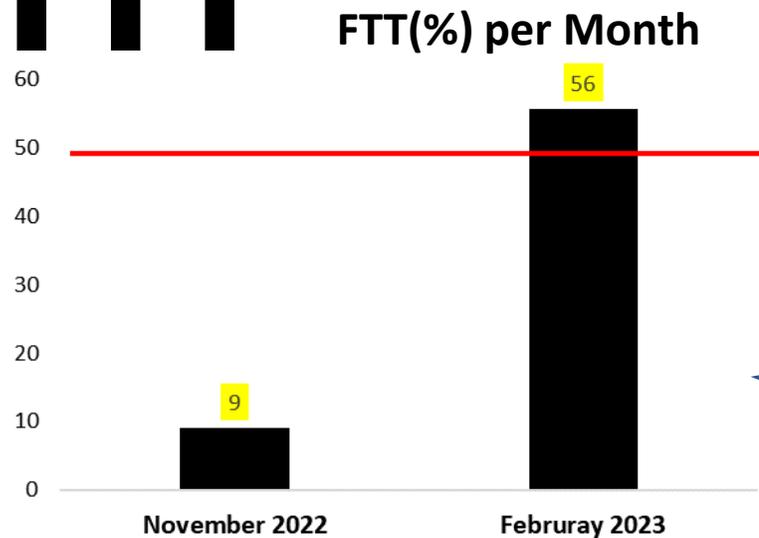
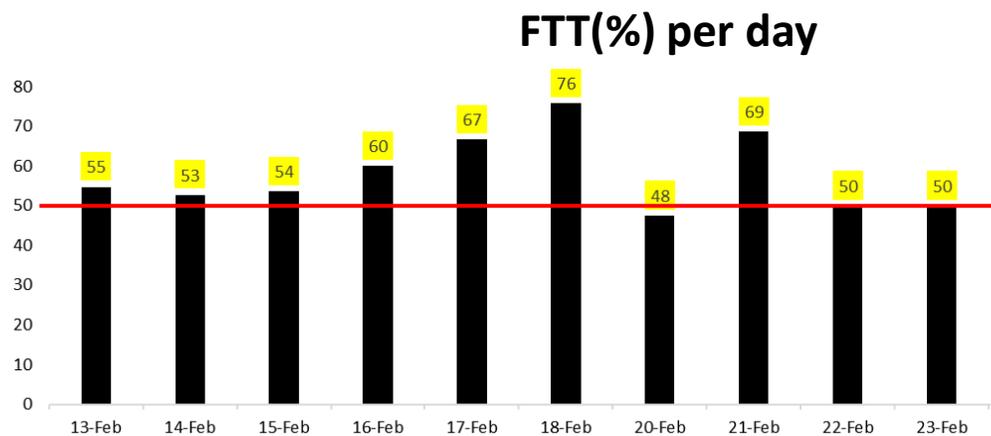
Smena 1/2/3	Datum -> Format mesec/dan /godina	ID Operatera na testeru.	Operater	Broj Kamiona	Kod greške	Opis koda greške	Količina	Kućište	Pinovi
1	14-Feb-2023	11898	Jovana Milojević	1152903	1	Connection error	1	x52	16-18
1	14-Feb-2023	11898	Jovana Milojević	1152640	1	Connection error	1	a7x1	37-38
1	14-Feb-2023	11898	Jovana Milojević	1152640	1	Connection error	1	a7x1	3-13 12-22
1	14-Feb-2023	11898	Jovana Milojević	1152640	1	Connection error	1	a156x1	8-22
1	14-Feb-2023	11898	Jovana Milojević	1152662	1	Connection error	1	x42	23-18
1	14-Feb-2023	11898	Jovana Milojević	1152662	1	Connection error	1	a7x1	37-38
1	14-Feb-2023	11898	Jovana Milojević	1152662	1	Connection error	1	a156x1	22-8
1	14-Feb-2023	11898	Jovana Milojević	1152674	1	Connection error	1	x42	23-18
1	14-Feb-2023	11898	Jovana Milojević	1152674	1	Connection error	1	a7x1	37-38
1	15-Feb-2023	11740	Stefan Stojković	1152652	1	Connection error	1	a156x1	22-8
1	15-Feb-2023	11740	Stefan Stojković	1152941	1	Connection error	1	a156x1	22-8

Tester 1 and Tester 2	13-Feb	14-Feb	15-Feb	16-Feb
Total harnesses	53	55	56	60
Harnesses with pinning mistakes	24	26	26	30
Harnesses without pinning mistakes	29	29	30	30
FTT (%)	54.7	52.7	53.6	60.0



Project results

Measuring results from 13.02 – 28.02.2023



**Average
FTT 56%**

DEFISANJE

MERENJE

ANALIZA

POBOLJŠANJE

KONTROLA

Project savings

Reduction in manpower	Reduction in rework time	Decrease of unnecessary movement	Decrease number of claims for wrong pining
One electrical test operator per shift removed Annual saving : 12 000 €	Annual saving : 560 € per year	Annual saving = 240 €	Annual cost = 1800 €
Total annual saving	14 600 €		

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