

New AI-Powered System for Postural Ergonomic Evaluation

QCP PRESENTATION

EPK3D-PAD-PED-ISTD-
OMDD-HRD

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"Through this Table of Contents, our QCP group's vision takes shape, guiding all QCP board of jury on an enlightening journey of our cross-function improvement."

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QCP Team Introduction

"Coming together is a beginning; keeping together is progress; working together is success."

- Henry Ford



Observation

The **method** that our group will change and transform thru our improvement.

Green (Sustainable)

Able to maintain and support the established system over the long-term period.

Ergonomic

The **key word** and **object** that our group will optimize to creating the enjoyable workplace, minimizing the risk of injury, while also enhancing productivity.

Blue (Digital Transformation)

Symbolizes **innovation** and **forward-thinking**, which are essential for TMMIN embracing technological change



NASI PECEL

New AI-Powered System for Postural
Ergonomic Evaluation

Project Area



Head Office

Export Destination:
>80 Countries



Manufacturing Plants:

Sunter 1 & 2



Karawang 1&2



Karawang 3



QCP Project Area

Products:



1TR



2TR



Fortuner



Innova Zenix



Yaris Cross



Sienta



Veloz



Yaris



2NR



2NR-VEX

Our Great Team!



Oktavian Heru B.
EPKD

QCP Owner



Daud Nurrendra
EPKD

Manager Facilitator



Yosafat Marcellinus
EPKD

QCP project leader



Widodo Budi Kartika
PAD

Safety Expert



Rizki Muhammad P.
PED

Safety Expert



Eka Prita Yuliatin
EPKD

3 Pillars Management expert



Ari Wibowo
EPKD

Production Leader and
TPS Key Person



Yuniar Aditya Pramono
ISTD

IT Expert



Muhammad Fariz F.
OMDD

TPS Expert



Aisyah Andini Eka Satriani
HRD

Company Doctor



Project Background

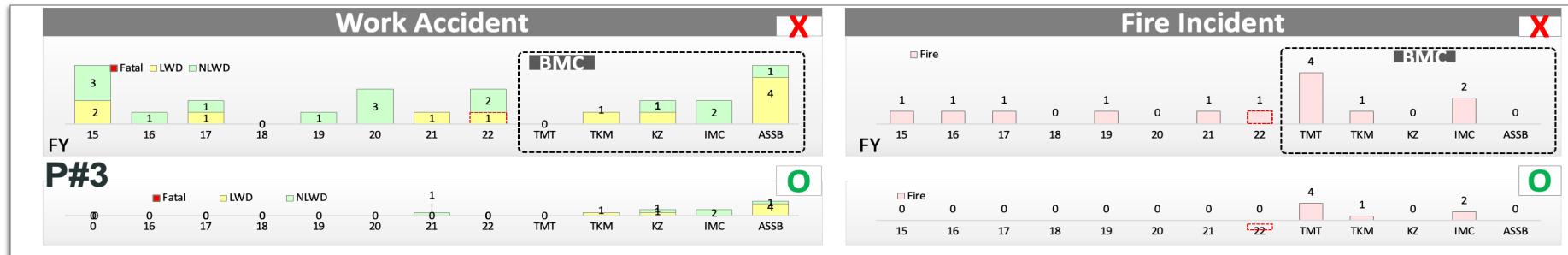


EPK3D-PAD-PED-ISTD-
OMDD-HRD

SAFETY KPI AND DIVISION HOSHIN



❖ TMMIN SAFETY KPI



Sub KPI		HUMAN		MACHINE		WORKSITE						
Regular Activities:	Item	Target	Apr '22 – Mar' 23		Item	Target	Apr '22 – Mar' 23		Item	Target	Apr '22 – Mar' 23	
			Act	Eva			Act	Eva			Act	Eva
	a. 5 KPI Walking	> 95%	Ave 98%	○	a. Certification	100% comply	810/810	○	a. OSHMS (Process KPI)	Level 3	Level 4	○
	b. KY Ability	100% Lvl 3	100% Lvl 3 (7092 MP)	○	b. Facility Risk Audit	Critical : 0 High Risk : 0	Critical : 0 High Risk : 0	○	b. Yokoten	Yarikiri: 100%	Yarikiri : 100%	○
	c. Safety Mindset (KYT +Invisible hazard)	1x/Month	1x/Month	○	c. Safety Device	100% Checked & OK	100% Checked	○	c. Contractor	0 LWD&Rank A	0 LWD & Rank A	○
	d. HYT	Min. 1 mp/month	1,312 MP/month	○	d. External M/C Audit	Zero Level 5 (Cri risk)	Zero Level 5 (Fatal risk)	○	d. Remote Area	Zero Uncontrolled	0 Uncontrolled Area	○
New KPI	e. High Risk Job License (Outhouse)	100%	-	-	e. Internal MC Audit by Inspector*	Zero Level 4 (High Risk)	-	-	e. MSD (Ergo)	Zero LWD	-	-

Focus to prevent ergonomic injury (as priority in division hoshin)

Div.Hoshin

1.1.1 Continuous massive rank down activity through:
a. Easy work & enjoyable activity (massive activity)

“0” accident & incident
Zero MSD case

Additional New Safety KPI Category Related to Musculoskeletal Disorders (MSD) Ergonomic

PROJECT MILESTONE AND STRATEGY



❖ MILESTONE ACTIVITY

BEST NR COMPETITIVENESS

FY 2021-2022

Level up valuable work by
temotoka

[Massive Bottom-up]

REAL WORLD
COMPETITIVENESS

FY 2022- 2023

Shortening part movement by
one touch activity

Massive Activity
from **TOP-DOWN**

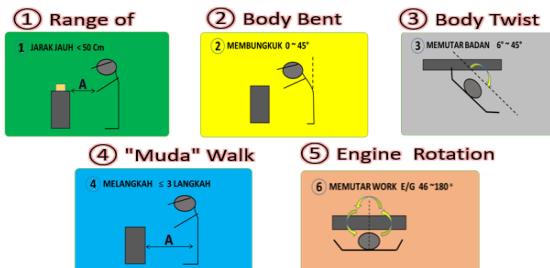
FY 2023-2024

Easy & Enjoyable work

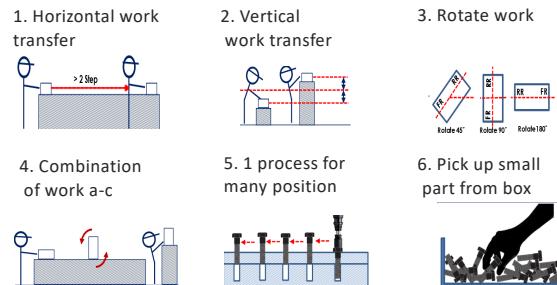
by eliminate unergonomic motion

Collaboration with
Expertise as Proactive

Manual observation & Judgement



Observation by OTRS & Manual Judgement



Create an Easy & Enjoyable Work By Eliminate Unergemonic Motion Through **COLLABORATION WITH EXPERT**



TPS KP
Work observation & muda mura muri elimination



SHE
Ergonomic evaluation standard



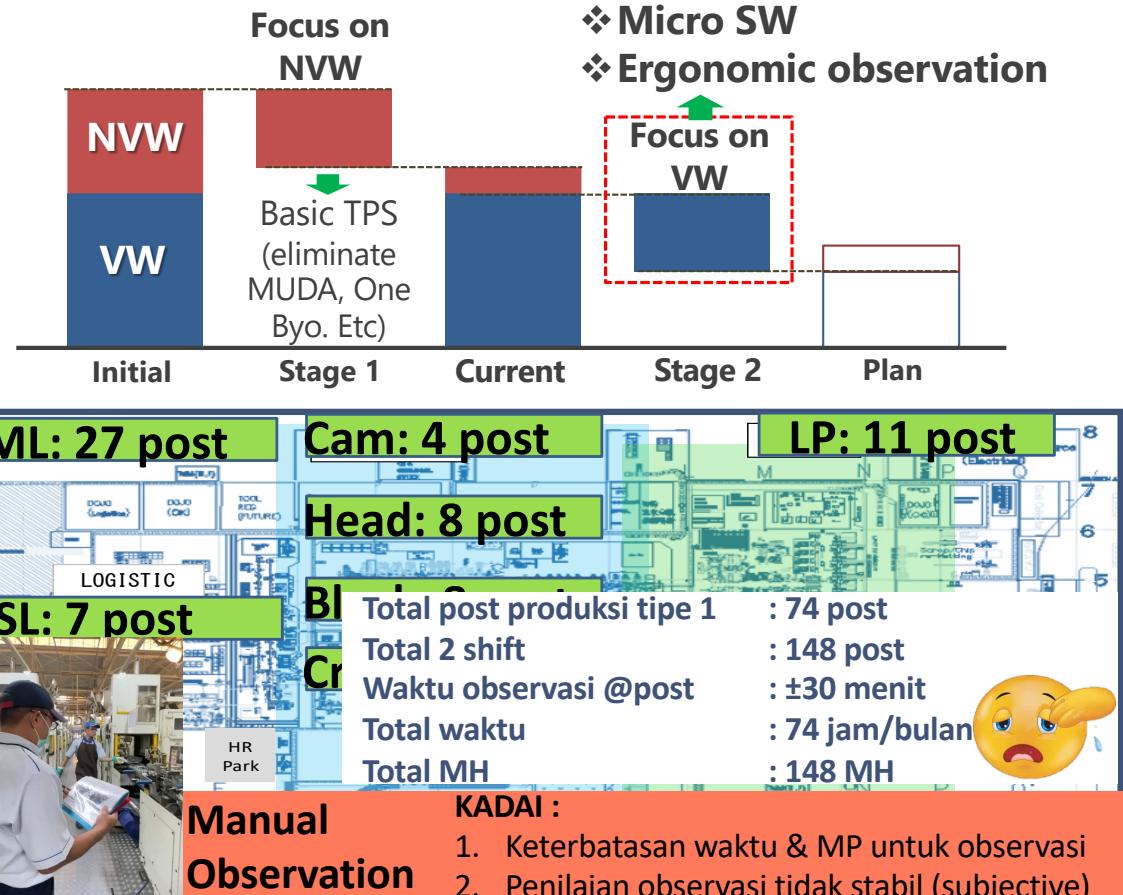
Company Doctor
Employee health

SUSTAINING MFG
COMPETITIVENESS
(RESILIENCE)

ERGONOMIC AS MICRO SW IN TPS



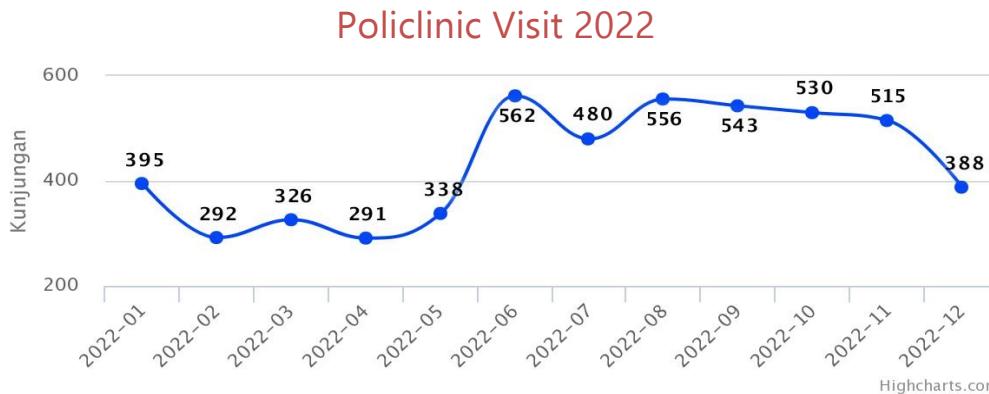
Collaborate 3 Pillars & TPS activity as Basic Foundation



To Improve Valuable Work, Ergonomic Observation Become **Micro SW** in 3 Pillars and TPS Activity



ERGONOMIC FROM MEDICAL POINT OF VIEW



Top Disease 2022 at Polyclinic	Suspect Ergonomic Related Diagnosis	Total Patients
Top 3	Myalgia (muscle pain)	252 (5.6%)
Top 13	Low Back Pain	91 (2.1%)

Hospitalization 2022	Dignosis	Total Patients
	Low Back Pain	38



Muscle Pain due To UNERGONOMIC WORK BECOME TOP 3 DISEASE and In Long-Term will be impacted to Employee's Well-Being

COY SAFETY KPI AND NEW ERGONOMIC ASSESSMENT METHOD



❖ COMPANY ERGO KPI

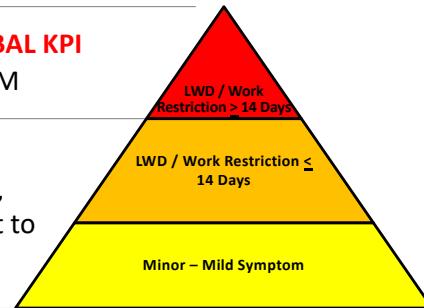
Count as **GLOBAL KPI**

Report to TDEM

Count as

INTERNAL KPI,

Internal report to
Management



Definition of Work Restriction

Work restriction type	Definition
Full Work restriction	the member is <u>not able</u> to work on any of their normally routine process
Partial Work restriction	the member is <u>able to work on some process</u> of their normally routine process

TMMIN KPI Target FY 2022/2023 :

- Zero Lost Day \geq 14 Days or MSD Work Restriction

❖ STRATEGY

1. Ergo Task Force (Ergo Expert)



Rizki M. P.
(Coy Wide)



dr. Aisyah A.
(Coy Doctor)



Sudiardi Robert O.
(Vehicle Plant)



Bambang Eka P.
(Unit Plant)

2. Socialize Ergo Mindset & Online Survey



Online Survey

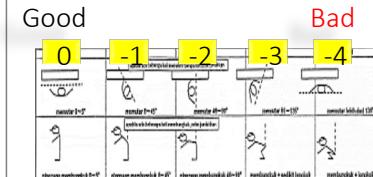


3. Improve Assessment method & develop pilot line

BEFORE

Assessment method :

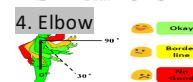
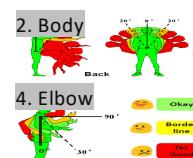
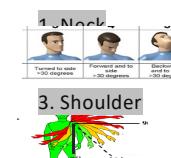
- Vehicle Plant : by WRA, Yasusa, RULA, REBA
- Unit Plant : Temotoka



AFTER

Assessment method :

- TEBA : Production Process Assess STW identify burden
- MEBA : Logistic Process Assess repetitive lifting identify burden



Achieve COY's Ergo KPI Through Ergo Task Force Team and **Level Up Assessment Method by TEBA & MEBA**



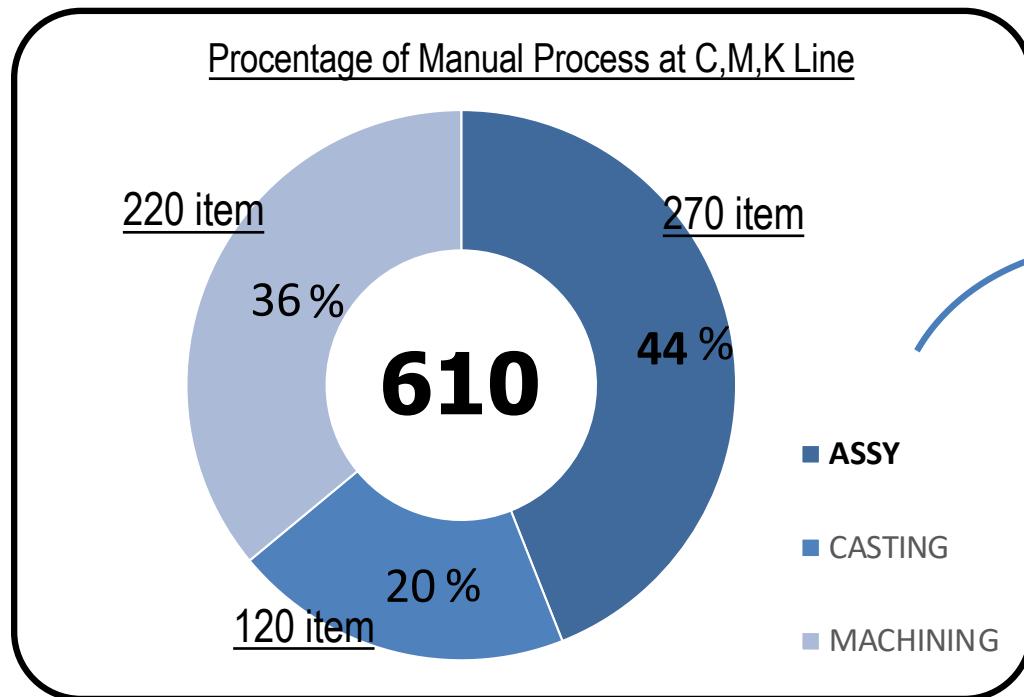
KADAI & CHALLENGES

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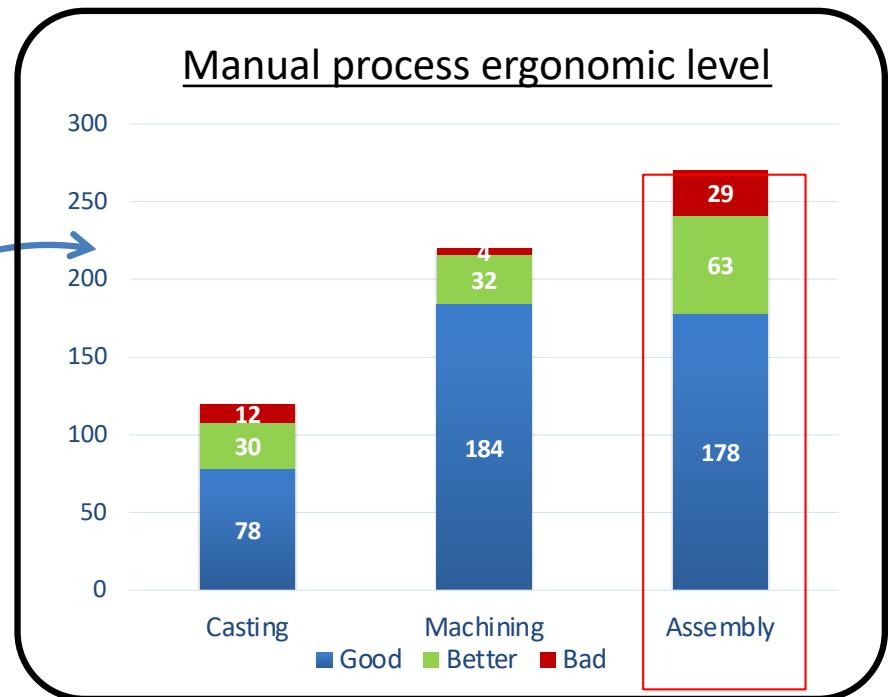
KADAI: ADDITIONAL REQUIREMENTS + TOO MANY POST



❖ Manual Process Observation at C,M,K Line



❖ Pareto Unergonomic Motion at C,M,K Line

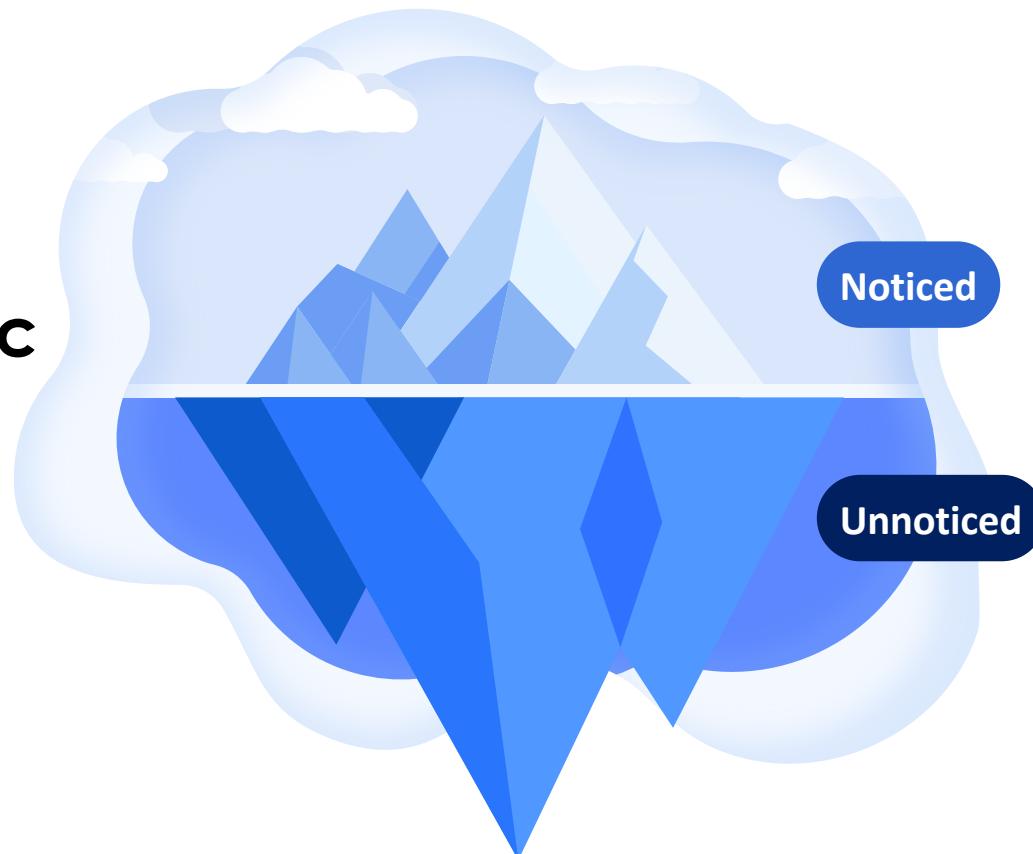


Manual Observation become More Difficult and Need Big Effort Caused by **Too Many Post** and **Additional Ergo Evaluation Requirements** from Experts

HIDDEN UNERGONOMIC JOB



**Hidden
unergonomic
job**



**Noticed thru manual
observation**

Triggered action and
improvement

**Unnoticed for
extended period**

Potential causing long-term
harm to production members

CURRENT EVALUATION METHOD



Manual Observation Weakness:

#01 Subjectivity

Manual assessments are prone to biases and subjective interpretations, leading to inconsistent results.

#02 Time-Consuming

Observing and analyzing every production member's posture is a laborious task, consuming valuable time and resources.

#03 Limited Human Capability

Observers can get fatigued when continuously monitoring members' postures. This may result in missing critical details and potentially unergonomic issues become unnoticed.

#04 Lack of Real-time Insights

Manual assessments provide only retrospective insights, making it challenging to address ergonomic concerns in real-time during production.





IMPROVEMENT IDEATION AND PLAN

EPK3D-PAD-PED-ISTD-
OMDD-HRD

IMPROVEMENT IDEATION



❖ Inspiration Idea:

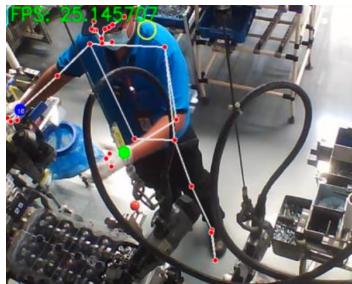
TMC GLOBAL EXHIBITION

TMC showed the utilization of AI system for object tracking and detection.



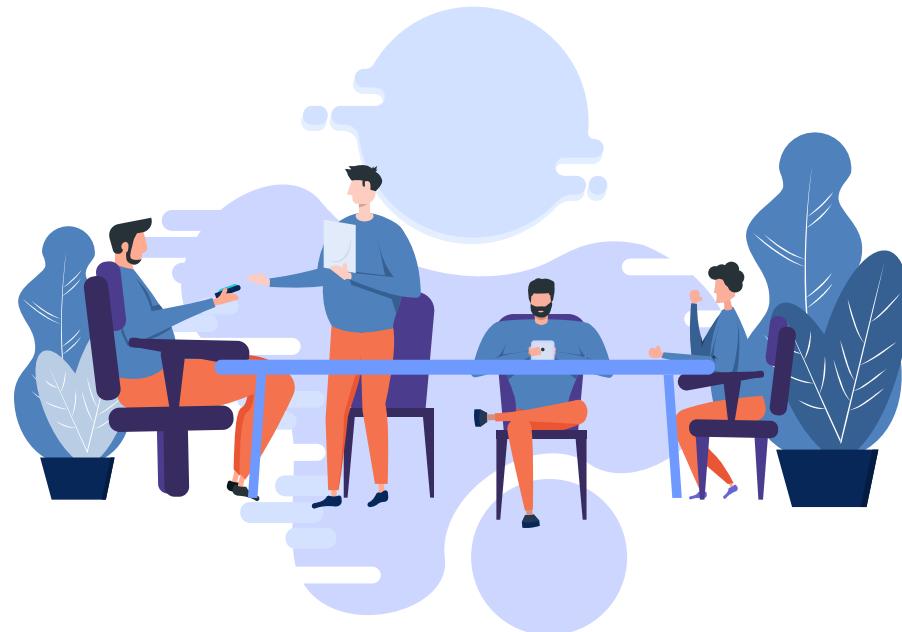
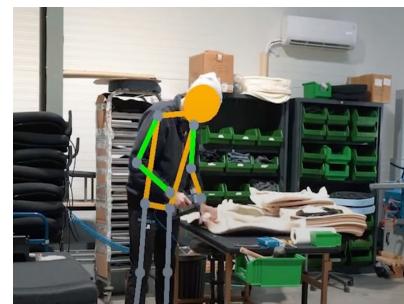
STM's AI System

STM presented the AI-system to monitor member job in production line.



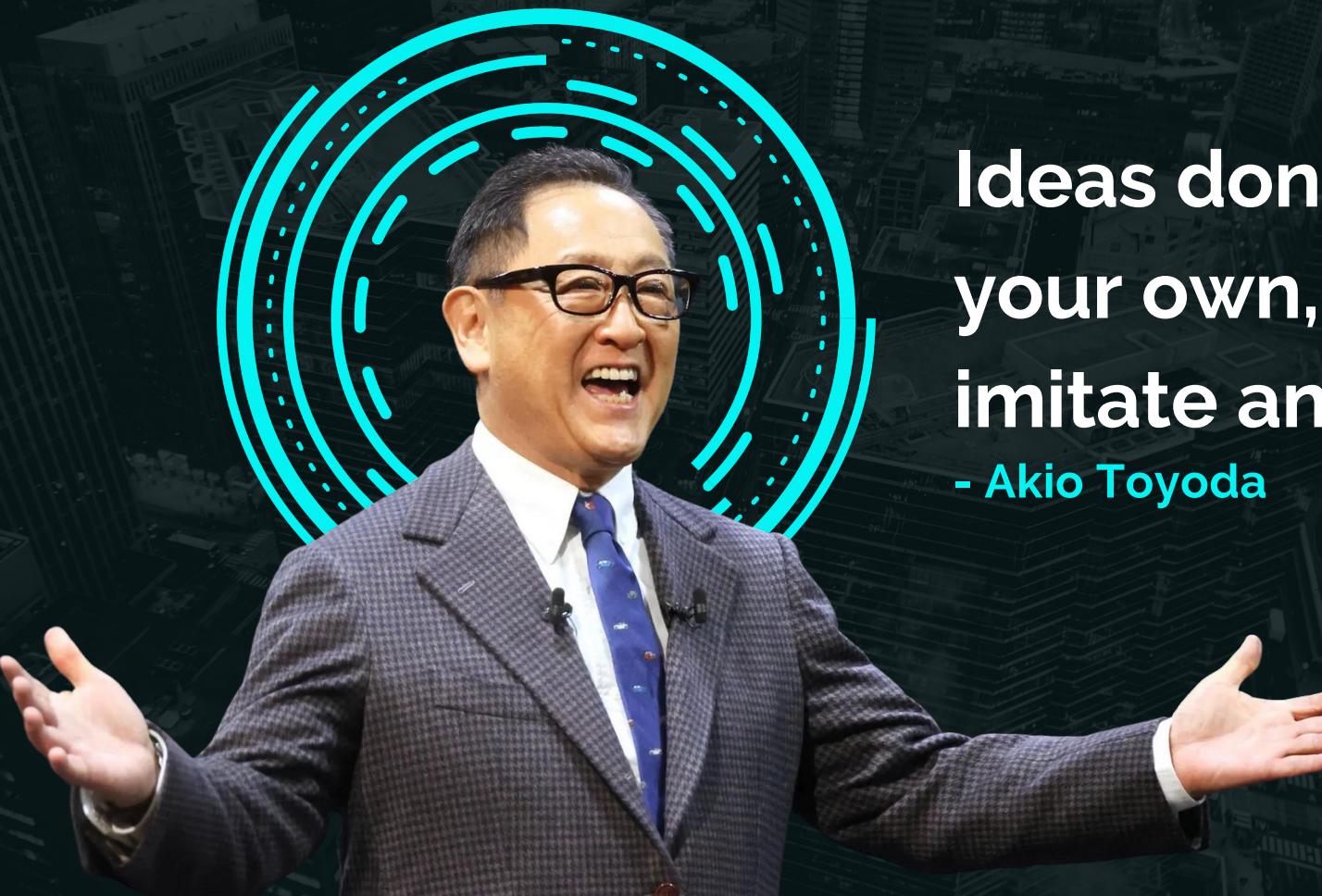
Ready-to-use Software

French startup company build a software (Ergosante LEA) to evaluate worker's ergonomic using AI.



Inspired to Change The Current Observation Method

“



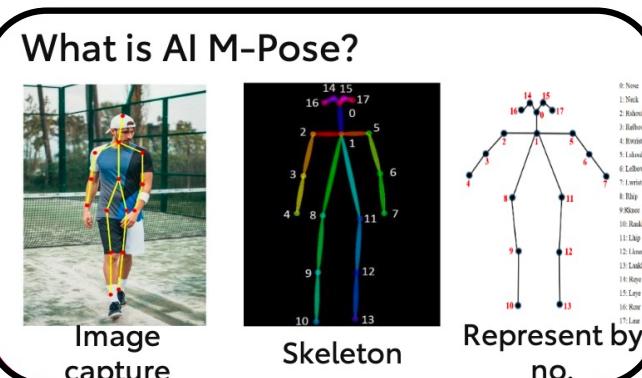
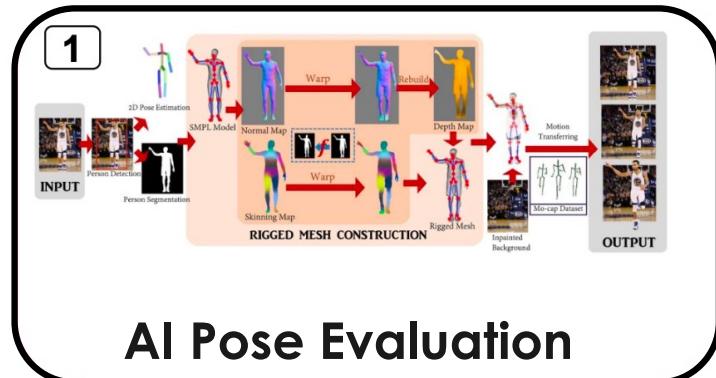
Ideas don't have to be
your own, but observe,
imitate and modify.

- Akio Toyoda

IMPROVEMENT IDEATION



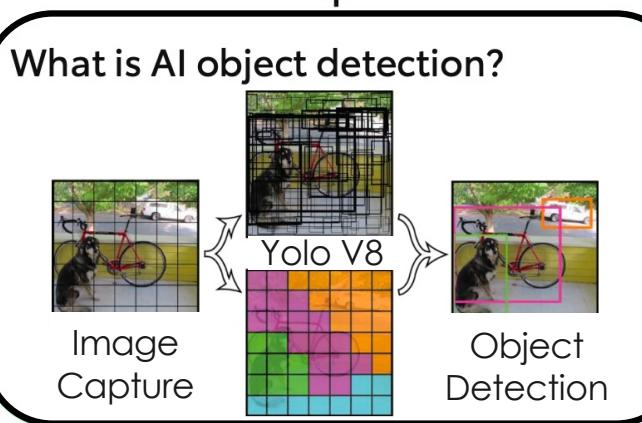
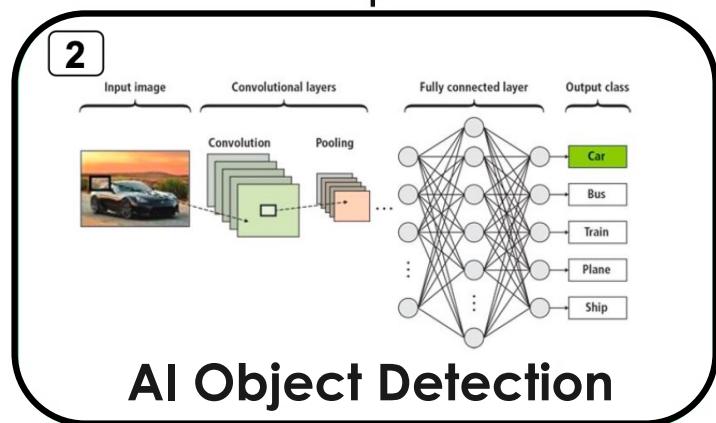
❖ General AI Technology



How it works

Pose estimation is the task of using an AI model to estimate the pose of a person from an image or a video by estimating

AI pose Confirm movement



How it works

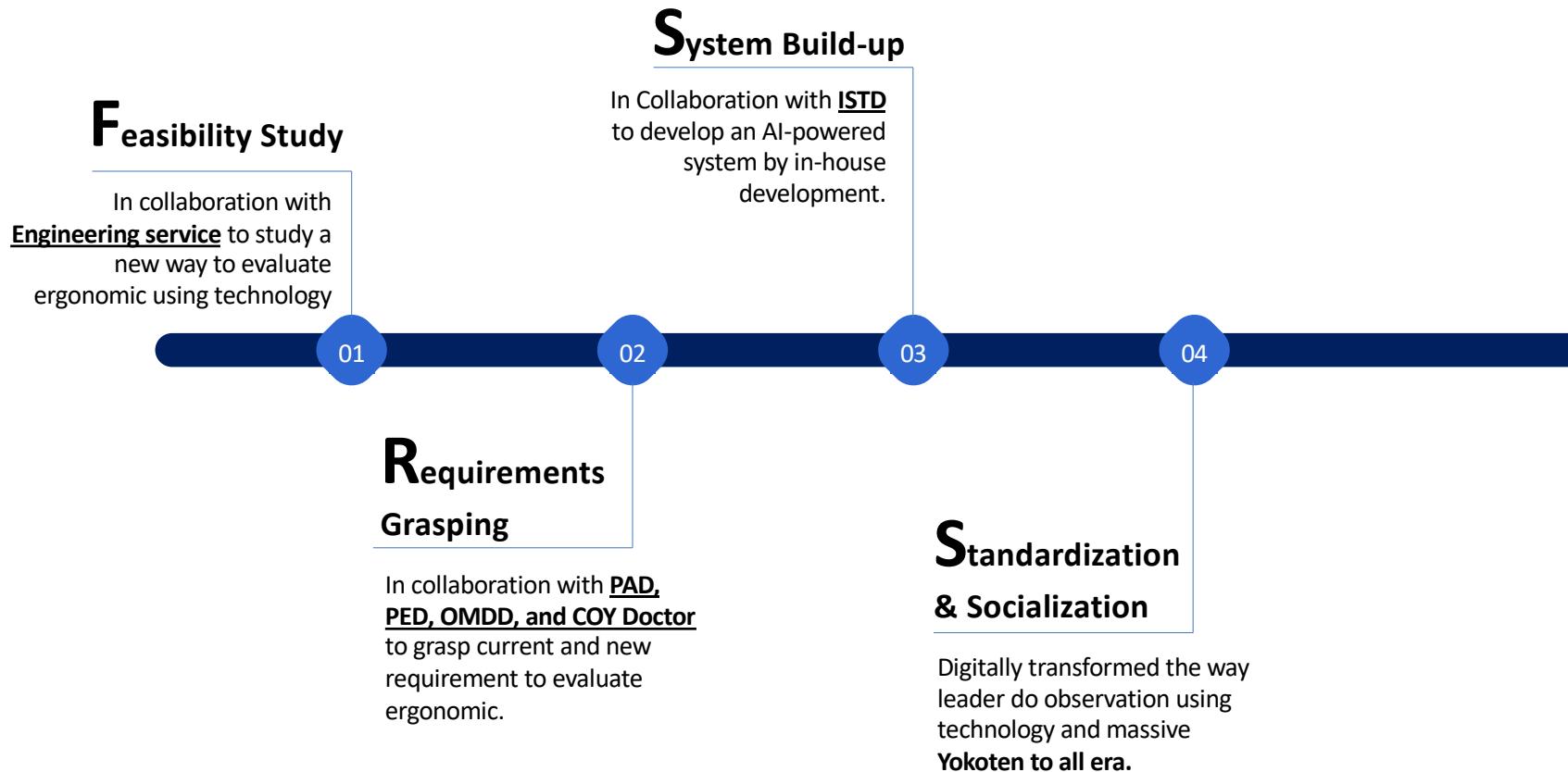
YOLO or You Only Look Once is a Realtime Object Detection Model that high accuracy and very fast to detection

AI Object detection Confirm object

PROJECT PLANNING AND ACTIVITY SCHEDULE



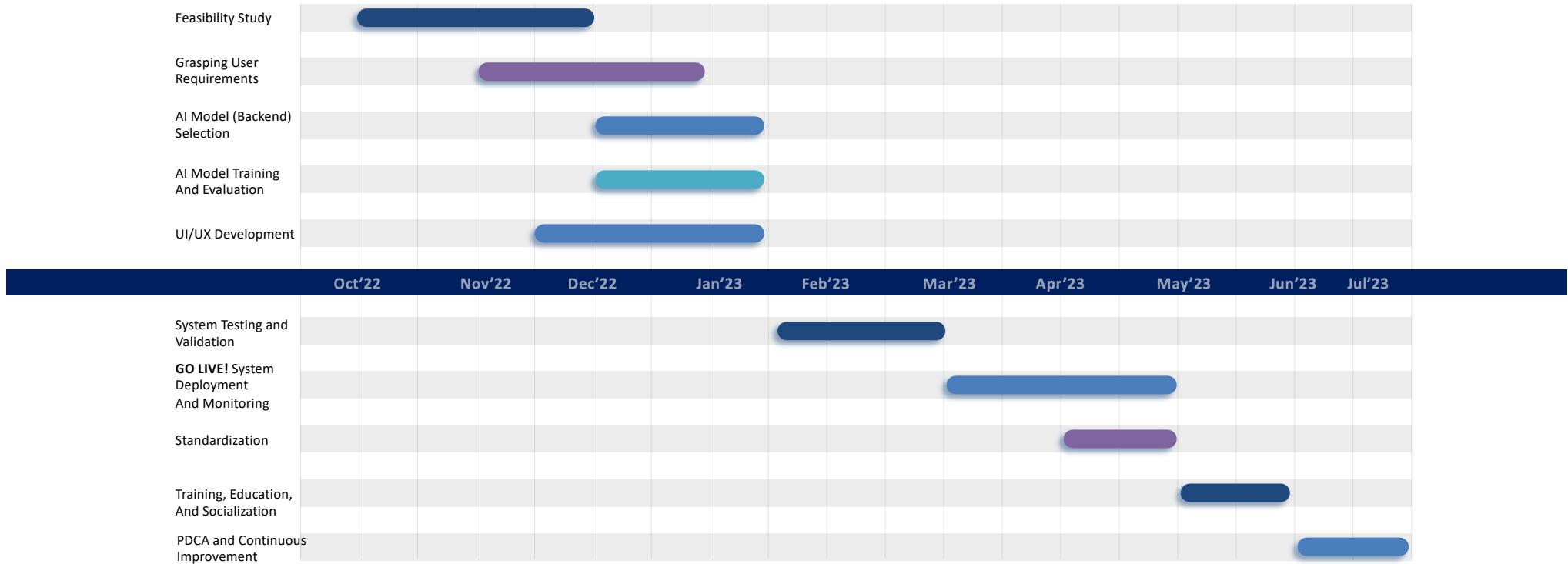
❖ Cross-function Collaboration Strategy



PROJECT PLANNING AND ACTIVITY SCHEDULE



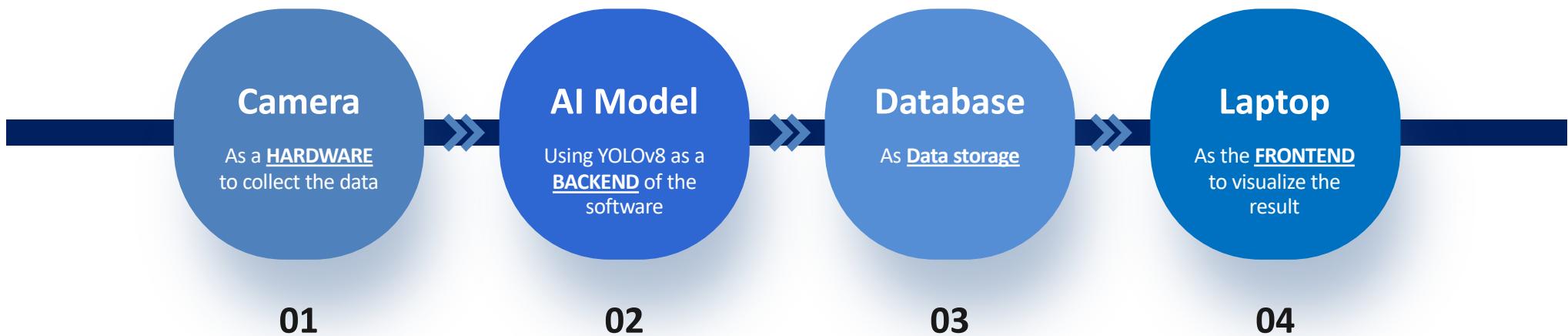
❖ Master Schedule



SYSTEM INFRASTRUCTURE



❖ How it works?



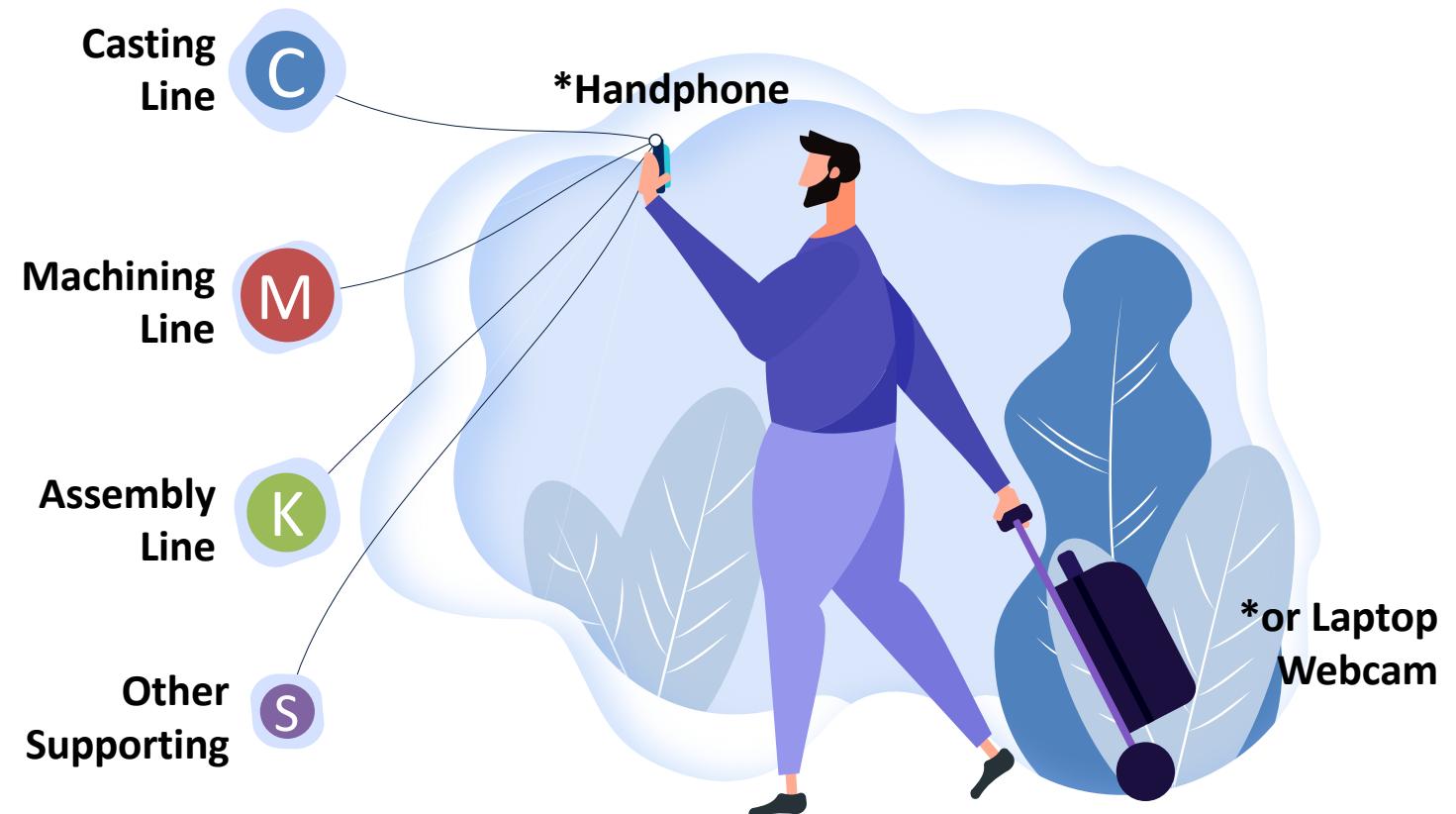
SYSTEM INFRASTRUCTURE



❖ Data Collection

Leader

Observation



SYSTEM INFRASTRUCTURE



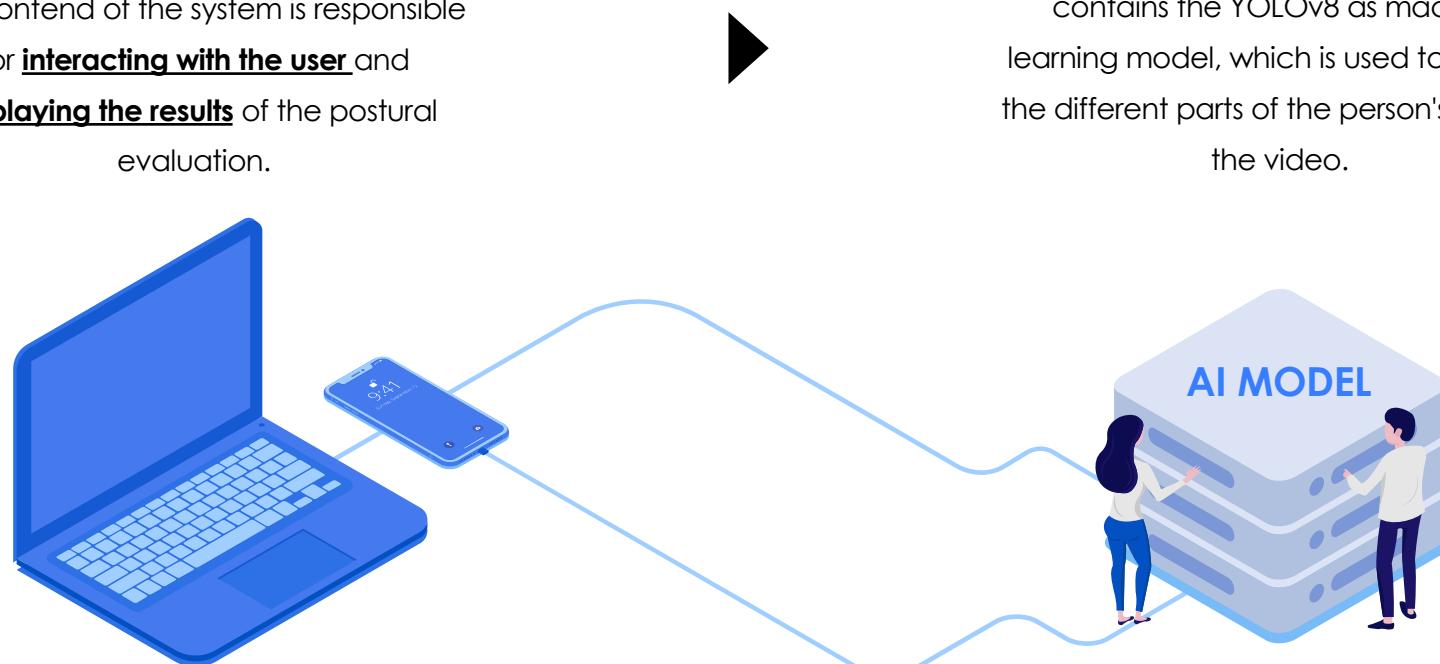
❖ Data Processing

Frontend [JAVASCRIPT]

The frontend of the system is responsible for interacting with the user and displaying the results of the postural evaluation.

Backend [PHYTON]

contains the YOLOv8 as machine learning model, which is used to identify the different parts of the person's body in the video.



SYSTEM INFRASTRUCTURE



❖ Data Storage



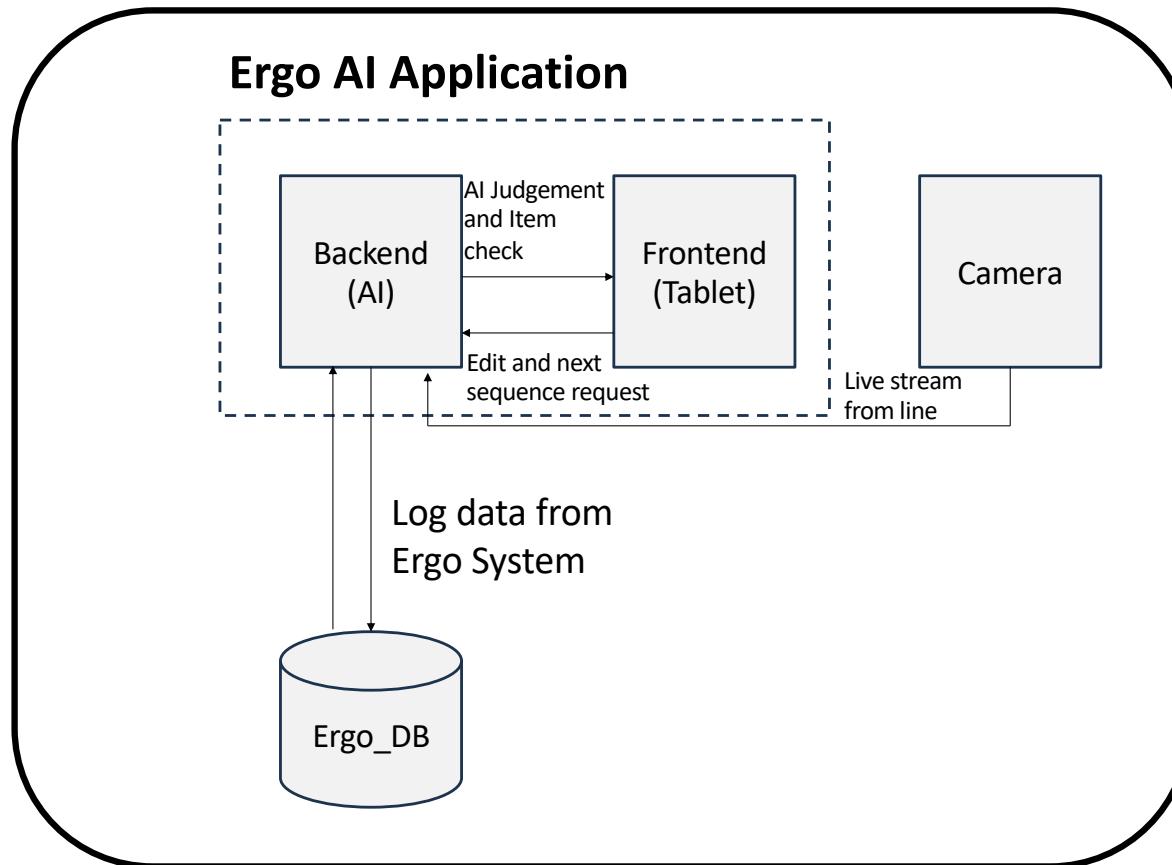
Database

The database will store a large amount of data, such as the angles between different parts of body, the judgment results, and recommendations for production leader or observer.

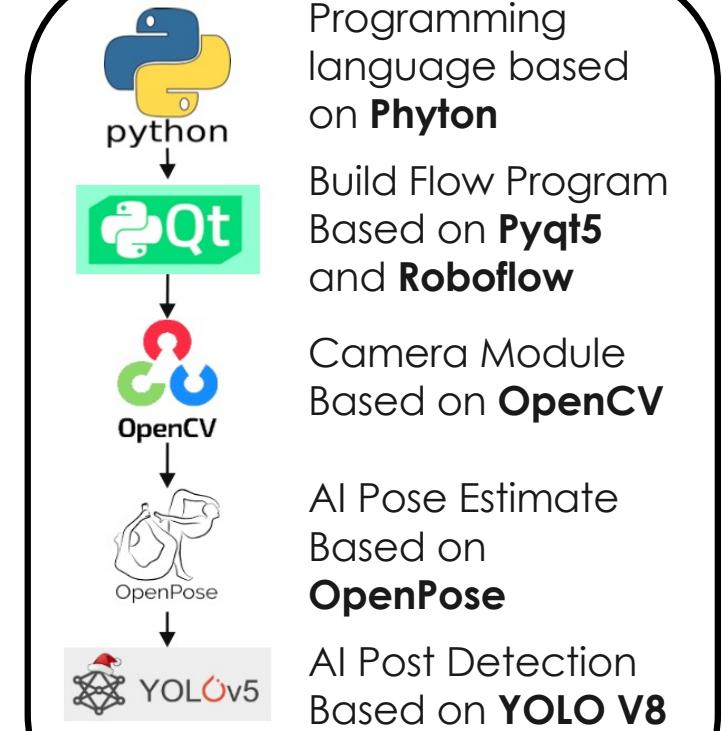
SYSTEM INFRASTRUCTURE



❖ Overview System Topology



❖ Software



SOFTWARE TESTING RESULT



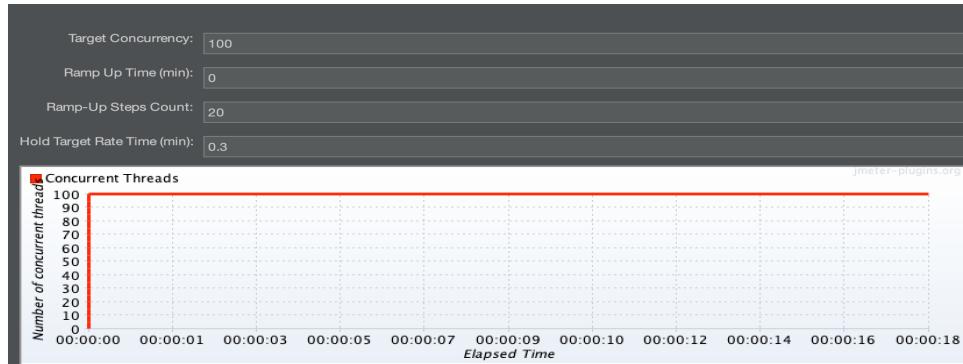
- Trial focus on server performance to **measure response time from internal network access.**
- **Target response average <= 3 secs** using JMeter

a. Ergo Development Test Criteria

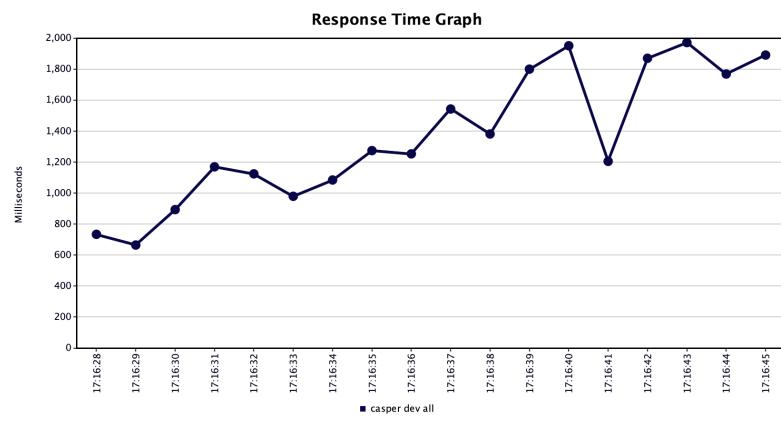
Parameter test :

- User : **100** user
- Method : **Concurrent** access (load test)
- Activity : **20x** activities per request)
- Server : Development

b. Configuration using Apache JMeter



c. Performance Test Result



Total response from Apps server with TMMIN internal connection are :

- Fastest : 0.62 sec
- Slowest : 1.98 sec
- **Average : 1.35 sec**

and already **meet the target <= 3 sec**

label	Samples	Average
Ergo apps	2830	1335
Total	2830	1335

System Performance Already Matched with Target <= 3 Seconds

AFTER IMPROVEMENT

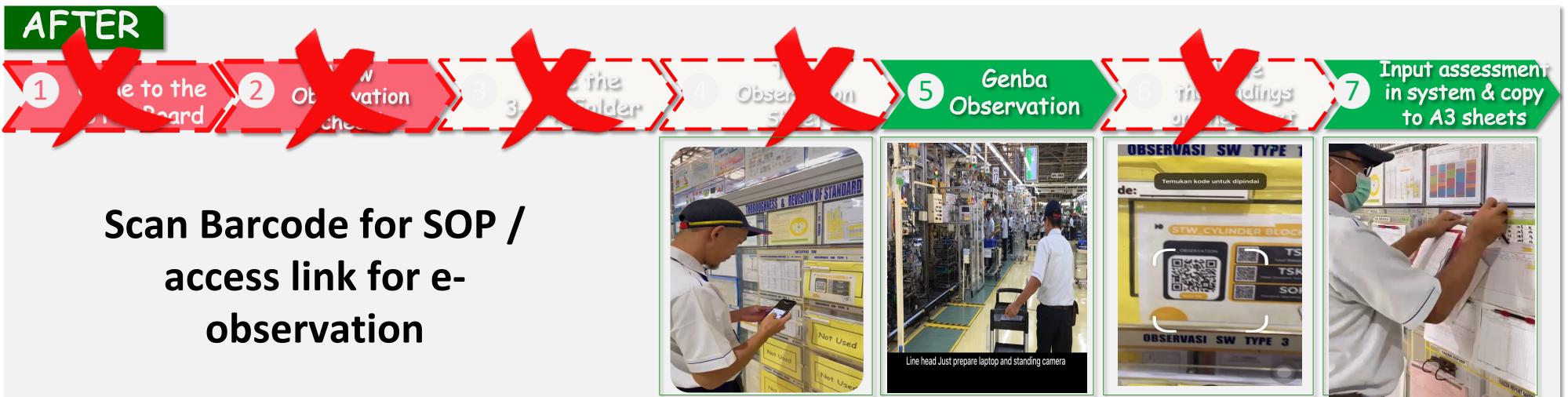
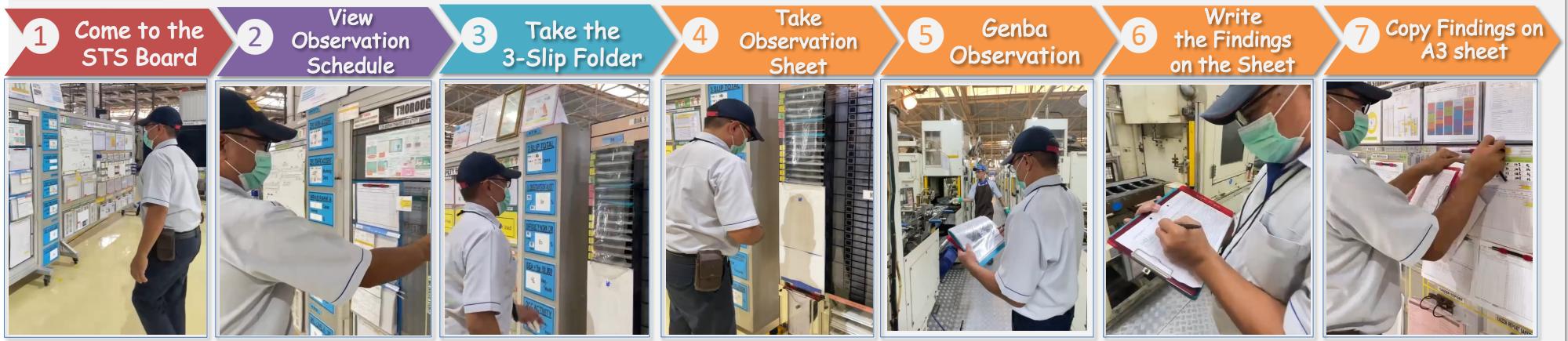


EPK3D-PAD-PED-ISTD-
OMDD-HRD



AFTER IMPROVEMENT

BEFORE



AFTER IMPROVEMENT



Thru AI-Powered Ergonomic Evaluation System:

Real-Time Posture Analysis

Capture and analyze the real-time postures of production members as immediate detection of incorrect postures, reducing the risk of musculoskeletal injuries.

Intelligent Feedback

Immediately notifies leader and about risky postures or fatigue-related signs and empowers them to make necessary improvement.

Objective Assessments

Eliminates the subjectivity associated with human-based assessments and ensures consistent and objective evaluations, providing more reliable data for decision-making.

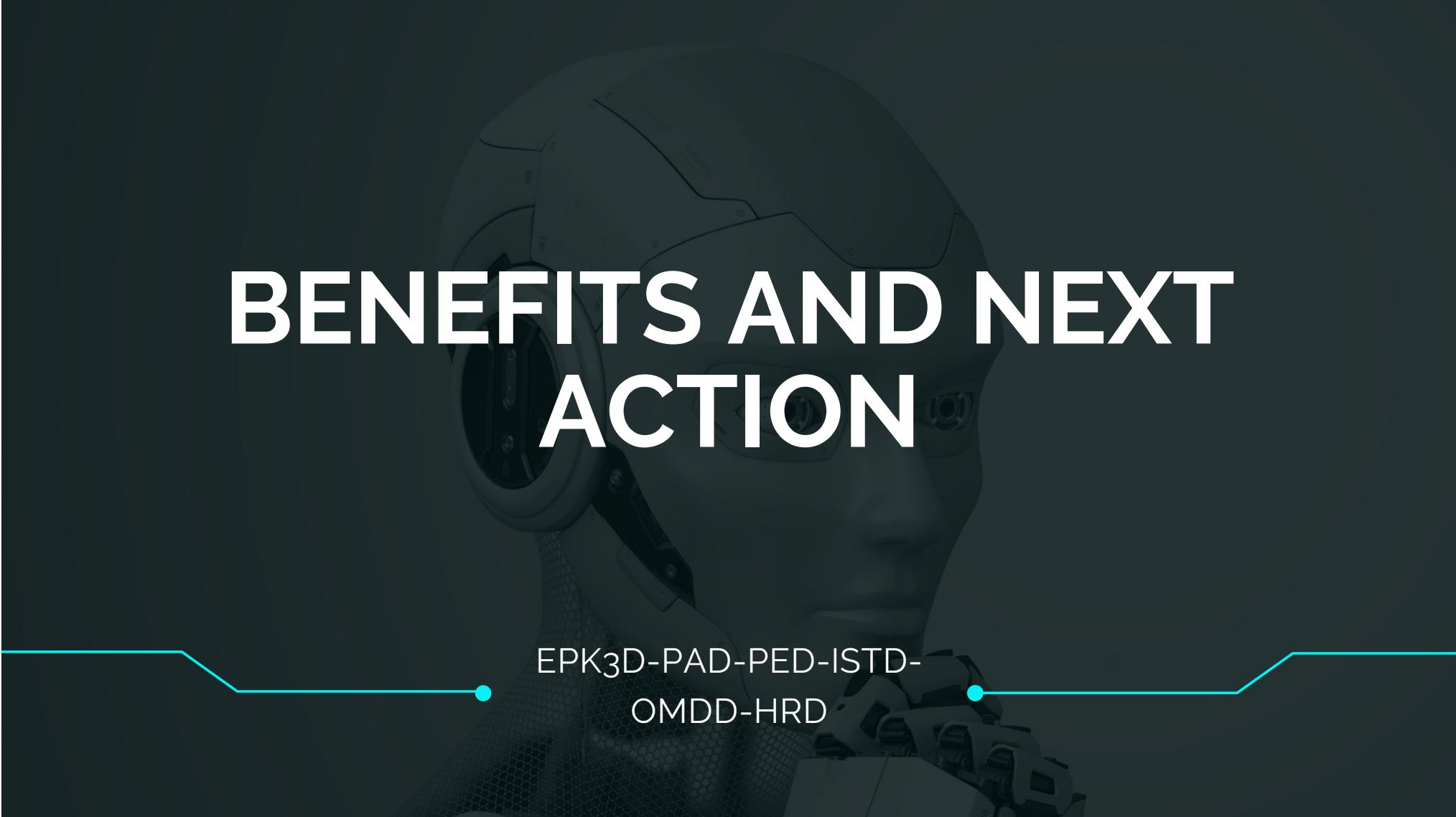
Well-being and Productivity

Comfortable job and less prone to injuries, they tend to be more productive and motivated, leading to better overall efficiency and output.



BEFORE-AFTER IMPROVEMENT VISUALIZATION VIDEO





BENEFITS AND NEXT ACTION

EPK3D-PAD-PED-ISTD-
OMDD-HRD

TANGIBLE AND INTANGIBLE BENEFITS



Safety : Zero accident

Before :

- TSKK
- SOP
- K/Z Report
- Observation sheet
 - A lot of document
 - Potential drop
 - Distract observation & work process
 - Potential problem related safety matter

After :

- TSKK
- SOP
- K/Z Report
- Observation sheet
 - Less document
 - Reduce potential drop

Safety : Zero LWD caused by MSD

	Ergonomic level	
	Good	Better
Before	12	30
After	108	78
Before	184	4
After	213	32
Before	178	29
After	241	63

Casting **Machining** **Assembly**

Morale

EASY & ENJOY WORK

Increase member's motivation through Easy and Enjoyable Workplace

Quality

Succeeding JKK with routine work observation

=

Good Quality Trend

Before **After**

Casting	Quality [Defect Ratio %]	
	target	SR 2
2022	2022	BMC
2023	2023	BMC

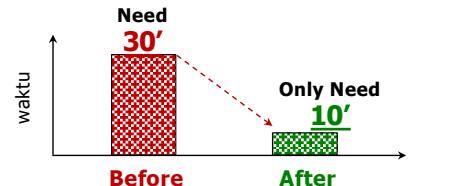
Machining	Quality [Defect Ratio %]	
	target	SR 2
2022	2022	BMC
2023	2023	BMC

Assembly	Quality [Defect Ratio %]	
	target	SR 2
2022	2022	BMC
2023	2023	BMC

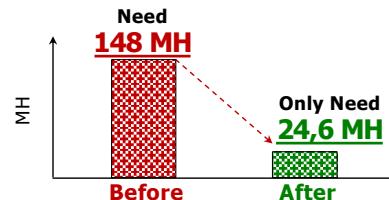
TANGIBLE AND INTANGIBLE BENEFITS



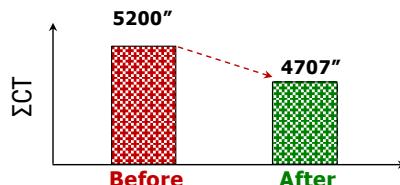
P

roductivity


Menurunkan waktu observasi kerja



Menurunkan MH observasi kerja



Menurunkan ΣCT

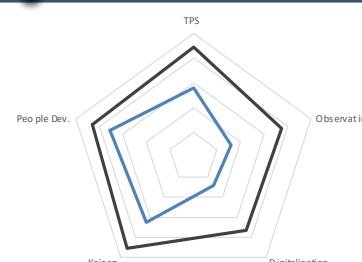
Productivity

Before – High Baratsuki eff

After – Low Baratsuki

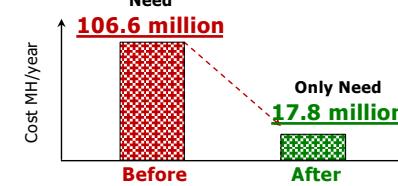
Routine work observation will increase improvement to eliminate muda

Human resource



Meningkatkan Skill Member

Cost

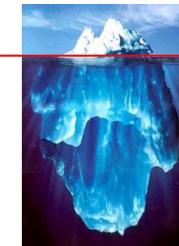


Menurunkan cost MH observasi kerja

Total Saving: Rp 88.800.000
Investment Cost: Rp 35.000.000
Payback Period: 0.39 per year

Cost Penurunan Sigma CT

- Worker's insurance
- Medical expenses



Hidden costs

- LTI (Lost time injury)
- Re-training costs
- Overtime to cover injured worker
- Management time
- Damage to family unit
- Provident fund
- Sick leave
- Investigation costs
- Loss of production
- Fines

Cost Pasca MSD

Total cost = Visible + hidden costs
Hidden costs = 5 TIMES visible cost!

Cost

Operasi Saraf Terjepit :

± 50 -90 jt/ orang

Obat-obatan pasca operasi :

± 9.325.000

Pemulihan pasca operasi :

4 minggu LWD

± 5.176.179 (UMK KRW)

Fisioterapi:

54 minggu (3x/minggu)
± 31.200.000

Data kunjungan poliklink untuk keluhan MSD : 343MP

biaya perawatan : 4,65 miliar

Total cost= visible+hidden cost

Hidden cost = 5x visible cost

Potensi biaya perawatan =

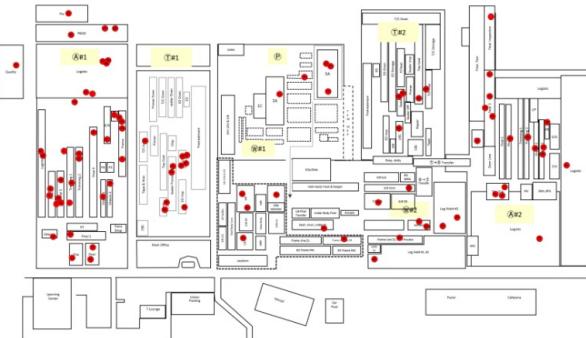
27,9 miliar

Cost Perawatan MSD

NEXT ACTION: ERGONOMIC MANAGEMENT



MAPPING UN ERGONOMIC COND. IN VEHICLE



MENINGKATKAN FUNGSI AI ERGONOMIC EVALUATION TOOL



Finalisasi Fungsi Upload



Compact on Phone



Multi recognize

PENYEDIAAN FASILITAS REHABILITASI & TREATMENT KASUS ERGONOMI

Proses konfirmasi 7 Langkah diagnosis okupasi

Diagnosa ergonomi pada kunjungan klinik

198 kasus

Eliminasi penyebab lain (olahraga, eksternal, degenerative)

38 cases hospitalisasi

6 kasus suspek karena proses kerja

Kroscek dengan hasil input survei ergonomi

3 proses overburden (Assy #2, Weld#2, PBOD)



Konfirmasi dengan genba oleh SHD dan SO dgn AI, TEBA & MEBA

Tatalaksana kasus:

1. Pengobatan & hospitalisasi (jika diperlukan)
2. Fisioterapi di klinik
3. Rekomendasi pekerjaan (RTW – Return to Work)



Improvement :

1. Assy: 16.5 → 4.5 kgf dgn alat bantu
2. Weld: 5.25 → 4.8 kg, Besi → Plastik
3. PBOD: 15.7 → 5.3 kgf dgn raku2



Langkah selanjutnya:

1. Optimalkan ergonomi rehabilitatif & program RTW (return-to-work)
2. Pelatihan staf medis untuk diagnosis dan analisis kasus ergonomi

NEXT ACTION: SYSTEM EXPANSION



Lower Body Posture



Optimum Angle Standardization

Expansion to Other Use Case (Load Sensor, Linkage to TSKK)



Android/iOS App

Scaling and Connected to Mfg. Platform

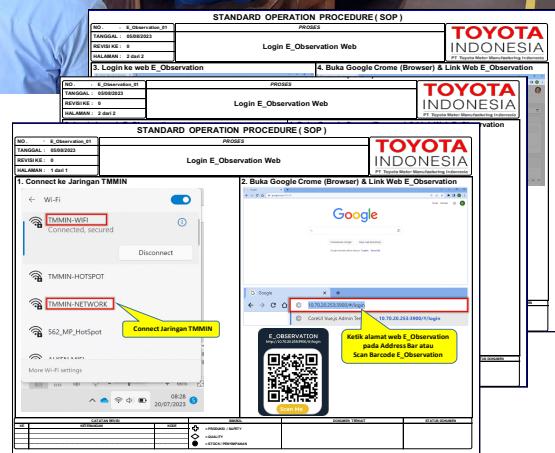


Commercialize

STANDARDIZATION AND SOCIALIZATION



SOSIALISASI SYSTEM INTERNAL PLANT#3



SOSIALISASI TOTAL TMMIN



PENGAJUAN HAK CIPTA



- Pengajuan Hak Paten untuk ide digitalisasi observasi kerja
- Pengajuan Cipta untuk system e observasi dan AI ergonomic evaluation

SHARING AND TESTIMONY



Have explained to others affiliate (TDEM, STM, TMC)

- BEST SAFETY KAIZEN (TMMIN Safety Campaign)
- Toyota Global Safety Awards
- Mol (government)visit
- STM Benchmark activity
- Hapyoukai local supplier
- TPS Master TMC Onoue san
- AP-U Kouryukai
- TMMIN P2K3 Meeting
- and others TMMIN visitor

"Easy-Enjoy activity is great activity with TPS approach. As the result productivity can be increased and member can work more ergonomic and enjoy... please share to others AP"

Mr. Onoue
(TMC TPS Master)



TMMIN P2K3 Meeting



"Perkuat konfirmasi di genba dengan deklarasi kodawari by leader dan gali potensi untuk dikomersialkan"

AP-Unit Kouryukai



" STM also have system to detect abnormality work. But we're very impressed with TMMIN for approaching with heart to create comfort working area

-Virayot -STM President-

Supplier Testimony

PT. AKEBONO



PT. YASUNAGA





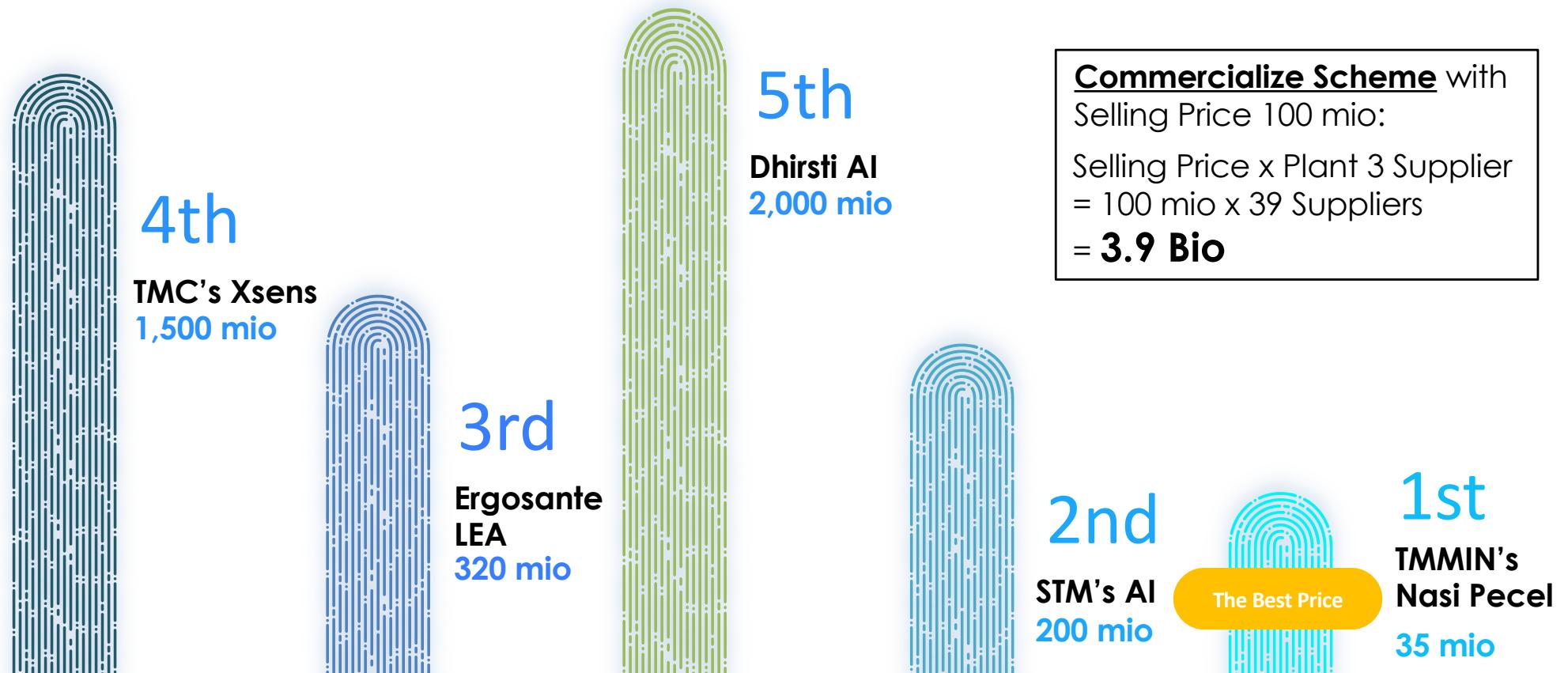
FUTURE BUSINESS OPPORTUNITY

EPK3D-PAD-PED-ISTD-
OMDD-HRD

FUTURE BUSINESS OPPORTUNITY



❖ Price Comparison with other similar system:





Thank You!