

Digital Transformation with PI System in Food Industry

Emilio Anglés Isern

November 5th, 2020

Agenda

- About Kellogg Company.
- About Kellogg Manufacturing Valls (Spain).
- Valls Plant PI System Architecture.
- Using PI Notifications and PI Vision for silos inventory control.
- Using PI System data for Energy Saving projects.
- Improving Operations Efficiency with PI AF and PI Analysis.

About Kellogg Company



Kelloggs

“We are a company of dedicated people making quality products for a healthier world”

W K Kellogg



Kellogg's



**POWERED
BY KELLOGG IT**

100+ Year Heritage, Progressive Growth



W.W. Kellogg

1906 - Kellogg Company founded



Overseas expansion into UK, Australia



Canadian expansion

1950s – Latin America, Mexico entry

1960s – Asia, Japan entry

Expands into select Frozen Food products in U.S. and bars



Enters biscuits, cookies, crackers with Keebler acquisition



Acquired Pringles



Wilmar International joint venture



Acquired Mass Food Group, leading Egyptian cereal company



Acquired RXBAR, fastest-growing US nutrition bar brand



1906 1920 1940 1960 1980 2000 2012 2013 2014 2015 2016 2017 2018

Numerous iconic foods launched from the 1930s to the 1980s



Acquired Kashi and MorningStar Farms soy-based vegetarian foods

\$14.6 billion in sales



Acquired Bisco Misr, Egyptian biscuits company



Acquired Parati, leading Brazilian biscuits, pasta and powder beverage company



Acquired Verival Austrian Bio Organic food company



About
**KELLOGG
COMPANY**

2019 SALES:
~ \$13.6B
(IN USD)

OVER
1,000 FOODS
MARKETED IN
180
COUNTRIES



32.000
employees
worldwide

**WORLD'S
LEADING
CEREAL
COMPANY**

**WORLD'S
2ND LARGEST
SAVORY
SNACK
COMPANY**

**A LEADING
GLOBAL
PLANT-BASED
FOODS
COMPANY**

**LEADING
NORTH
AMERICAN
FROZEN FOODS
COMPANY**

GLOBAL OPERATIONS ACROSS 4 REGIONS:

NORTH AMERICA
(including Canada & United States)

EUROPE
(including Russia)

LATIN AMERICA
(including Mexico, Central
America & South America)

AMEA
(including Asia, Middle East,
Africa & Turkey)



About Kellogg Manufacturing Valls (Spain)



Kellogg's

Kellogg Manufacturing Valls

47.060m²

24H 7DAYS

**+ 300
EMPLOYEES**

CAPACITY 120M KG



What do we produce?



AREA 1 Sp K : Classic + Variants
Smacks
2 packing lines



AREA 2 Corn / Rice
2 packing lines
CK/RK/CF/EF

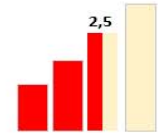


AREA 3 Coex/Dx
2 packing lines
MP/TRESOR/CH/CB/CRR/LS/HL/ROULETTE





Digital journey Valls Manufacturing Plant



**SIEMENS
Schneider
Electric**
INICIO AUTOMATIZACIÓN
PROCESO PRODUCTIVO

COMUNICACIÓN PLC'S
Modbus

PLANT FLOOR DATA COLLECTION SYSTEM
SIEMENS SIMATIC

IMPLANTACIÓN ERP
SAP

ACCESO REMOTO AL PROCESO PRODUCTIVO
ROBOTS ABB PALETIZADO
ABB

RED FIBRA OPTICA + NETWORKING
CISCO

WEOL: VIRTUALIZACIÓN
vmware

MODELO ISA 95 MEDIANTE OPC
Keplware

PROYECTO WMS RAW MATERIAL
amazon web services
SAP

SAP MII
Manufacturing Integration and Intelligence



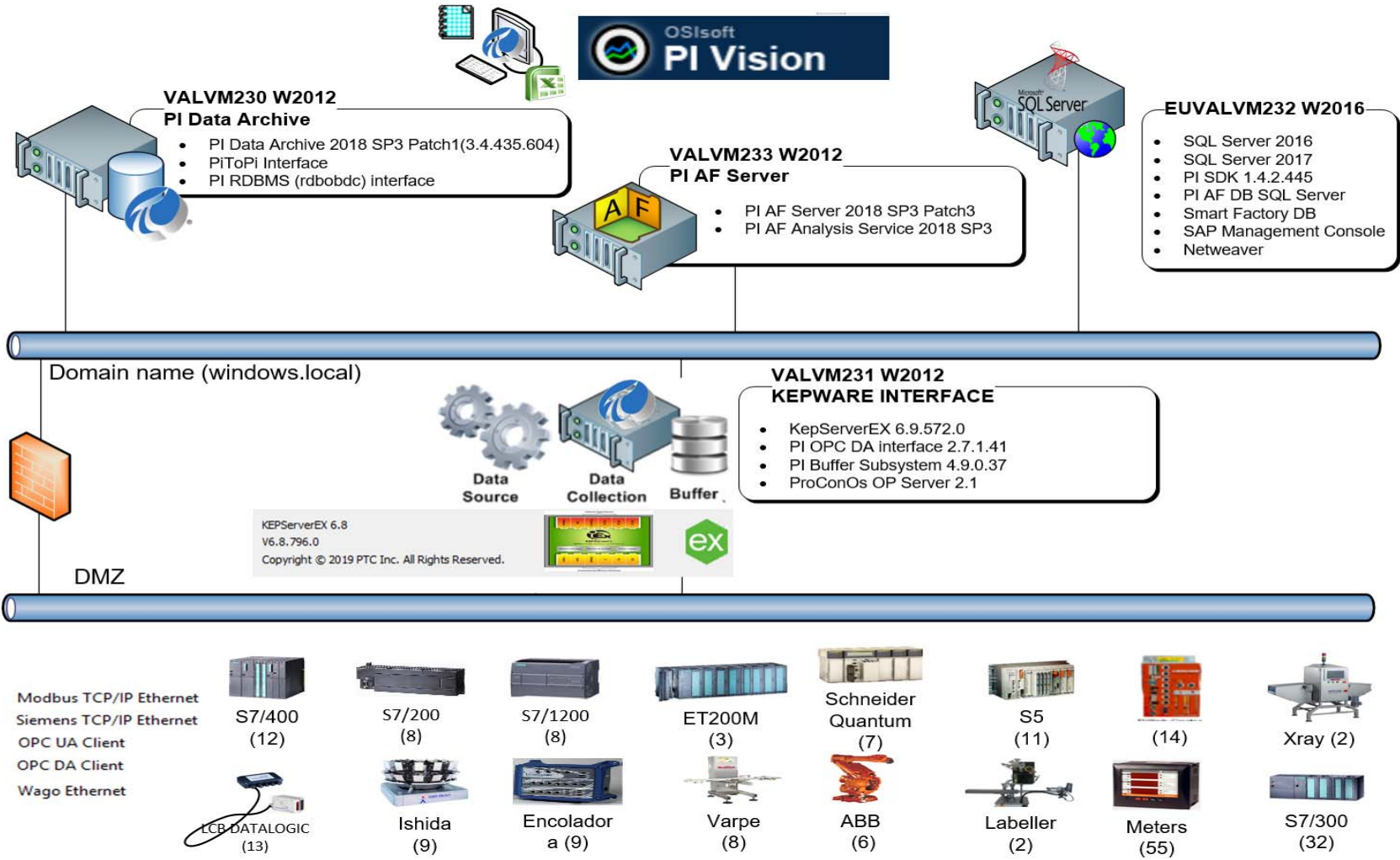
1980 1981 1991 1998 2003 2005 2008 2009 2012 2013 2015 2016 2018 2020



- ACCESO AL PROCESO: MES 4.0
- ROBOTS COLABORATIVOS
- VISION ARTIFICIAL
- IMPRESIÓN 3D/ADITIVA
- REALIDAD AUMENTADA
- MACHINE LEARNIG
- REALIDAD VIRTUAL

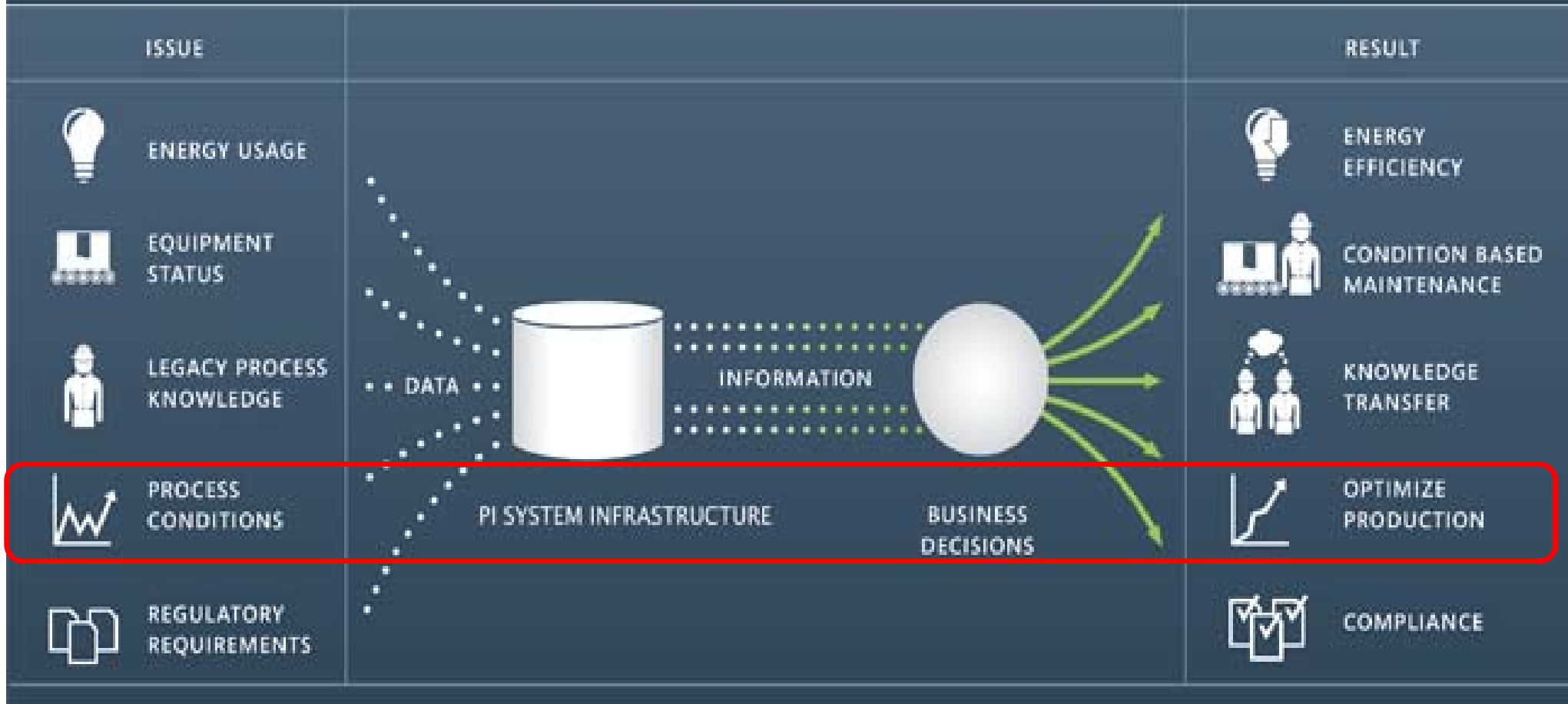


Kellogg's Valls Plant PI System Architecture



Using PI Notifications and PI Vision for silos inventory control

PI SYSTEM TECHNOLOGY ENABLES KEY BUSINESS SOLUTIONS



- Challenge

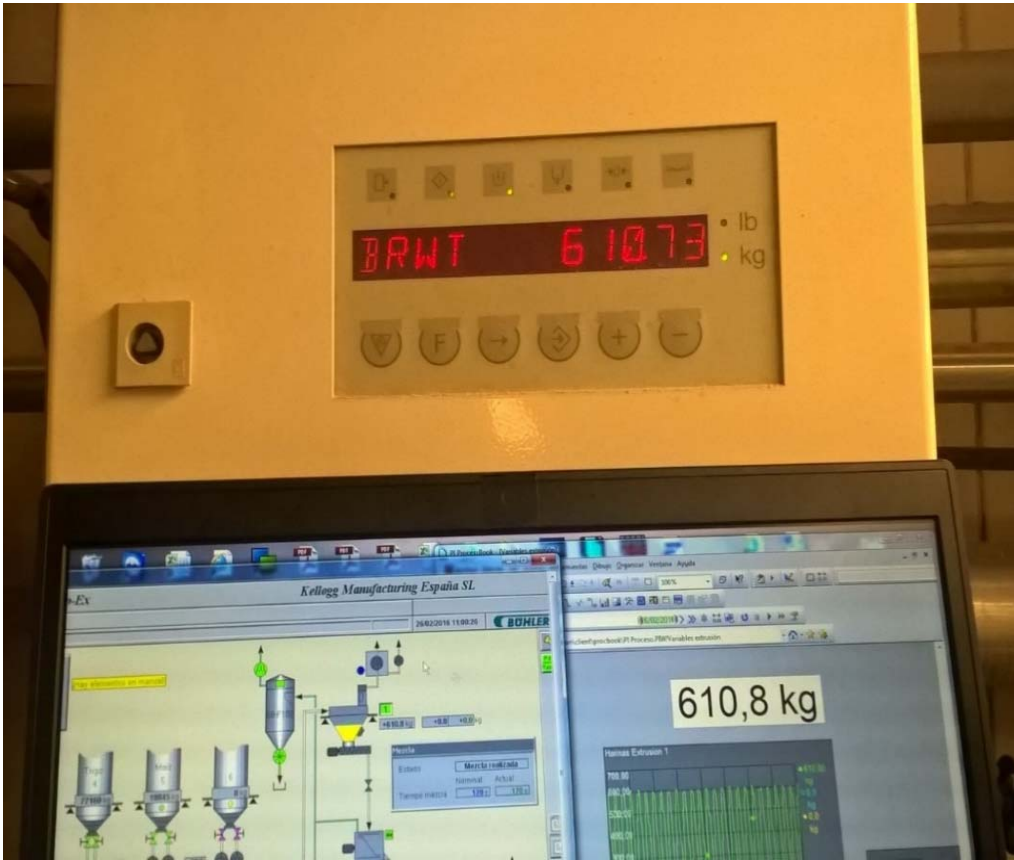
We have to pay an additional cost for having raw material trucks waiting to unload in the Silos, for requesting more raw material than necessary because the silo was still full.



- Challenge

Raw Materials Management

In Co-Extrusion process we had Unplanned plant shutdown due to lack of Chocolate Cream supply.



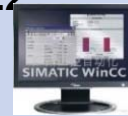
L.4



L.3



L.2



L.1



L.0



Using PI Notifications for silos inventory control



PI Notifications



The screenshot displays the PI Vision interface for 'Silos Materia Prima FAI'. It features a 3D visualization of various silos with their respective inventory levels and status. A red box highlights the 'AVELLANA 1' and 'AVELLANA 2' silos. An email notification from 'Valls.PiNotifications@kellogg.com' is overlaid on the right side of the screen, providing details on silo occupancy.

Silo	Material	Weight (kgs)	Status
5	POLENTA	80	En espera
2	HARINA T550	73.700	En espera
3	HARINA ARROZ	73.470	En espera
4	SEMOLINA	46.360	En espera
1	AZUCAR	51.450	Cargando
7	SILO 7 TRIGO	77.460	
6	TRIGO DURO	61 %	
2	AZUCAR 2	24.570	En espera
2	CAAO LICOR	2.562	En espera
1	AZUCAR 1	54.330	En espera
2	AVELLANA 2	2.340	En espera
1	AVELLANA 1	16.845	En espera
2	CAAO LECHE	22.770	En espera
2	GLUCOSA 2	18.850	En espera
1	GLUCOSA 1	24.945	Cargando

BARRY CALLEBAUT

Occupacion Silos Crema Kellogg Manufacturing Valls - Mensaje (HTML)

ve 02/10/2020 4:00

Valls.PiNotifications@kellogg.com
Occupacion Silos Crema Kellogg Manufacturing Valls

Para: Angles, Email

Este es un mail Automatico NO RESPONDER.

- Occupación Silo Crema Avellana1: 22785 Kg
- Occupación Silo Crema Avellana2: 2340 Kg
- Occupación Silo Crema Chocolate con Leche: 18140 Kg

Kellogg Manufacturing España, S.L.

02/10/2020 4:04:37

Using PI Notifications for silos inventory control



Challenge

- Reduce unplanned plant shutdown due to lack of raw material supply.
- Avoid the extra costs for having raw material trucks waiting for discharge in the Silos.



Solution

Deployed the latest OSIsoft PI technology including PI AF & Analytics and PI Vision plus email PI Notifications.

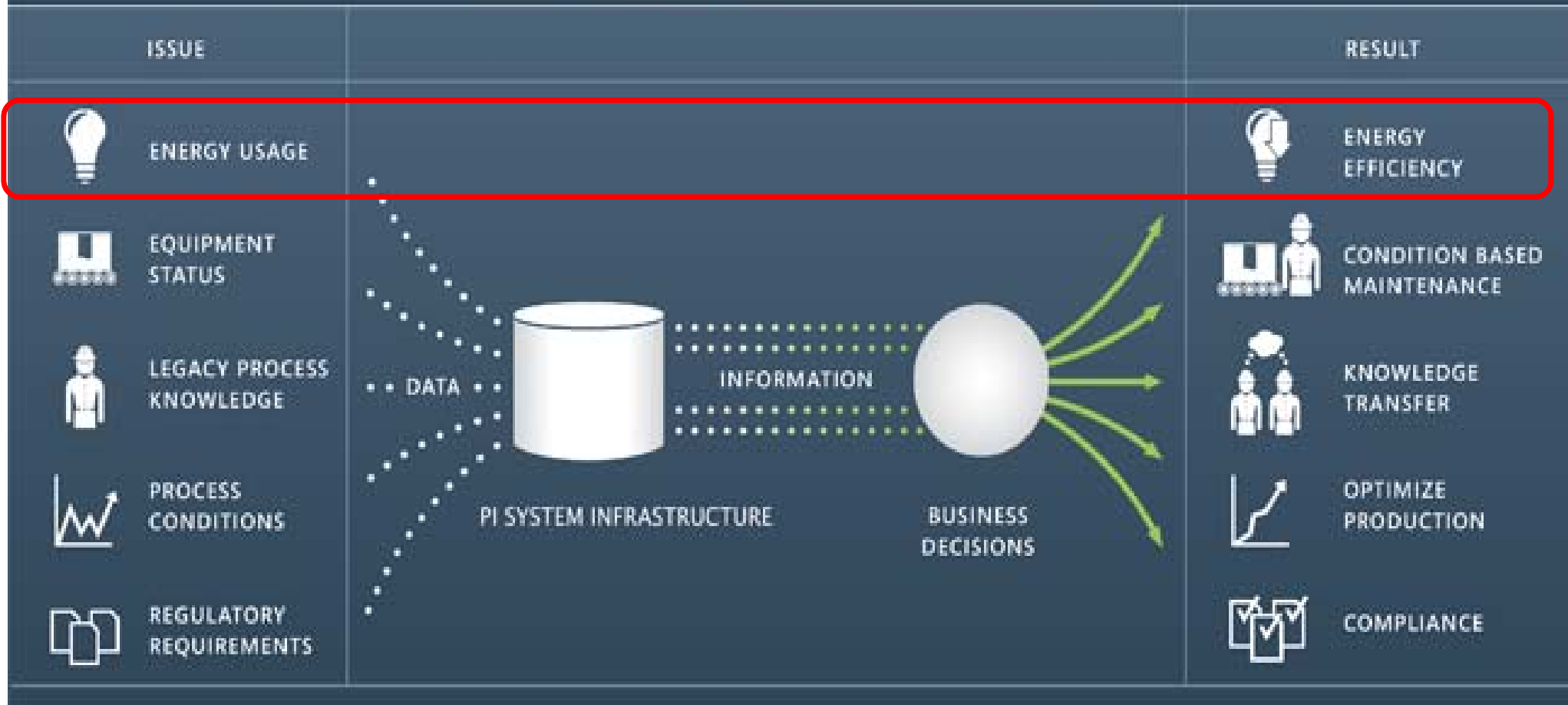


Benefits

- Increased production and operational efficiency, eliminating the unplanned plant shutdowns for run out of chocolate cream in Coex process..
- We reduce the waiting cost for discharge by 100%.

Using PI System data for Energy
Saving projects.

PI SYSTEM TECHNOLOGY ENABLES KEY BUSINESS SOLUTIONS



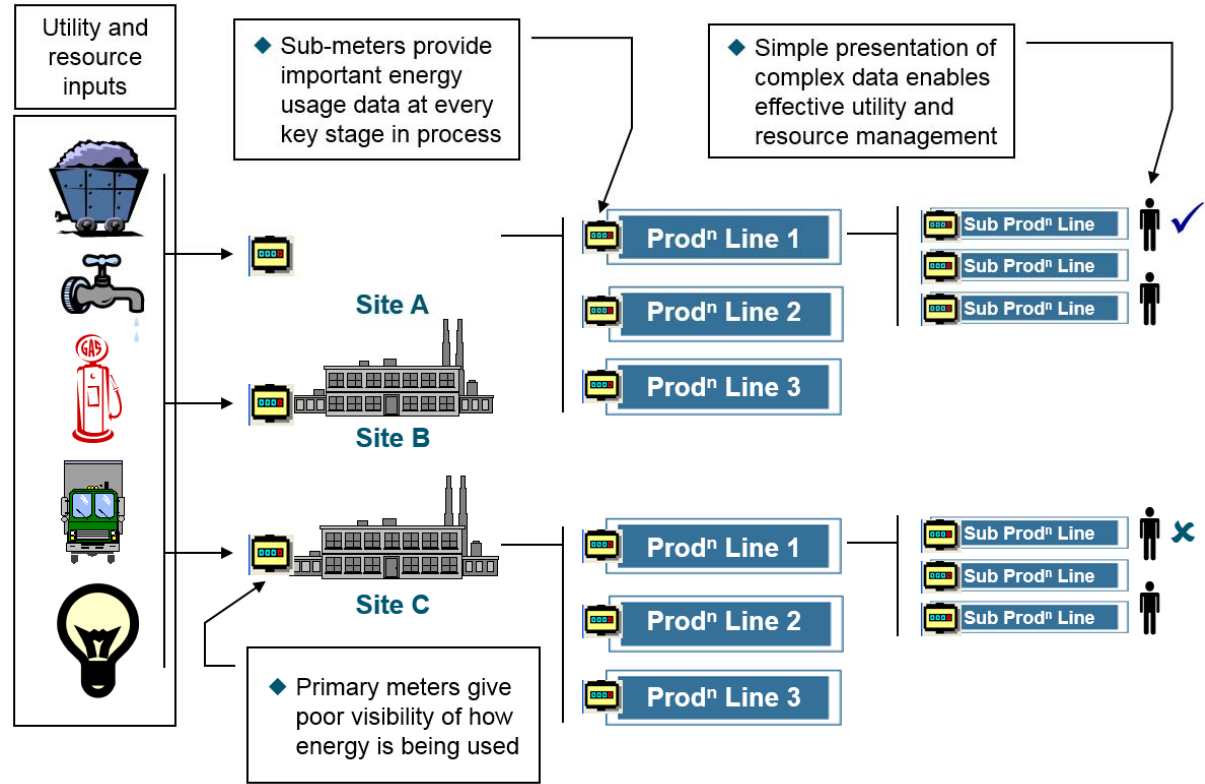
- Challenge

In 2005 Kellogg's Company had a challenge to reduce 20% Energy usage (Kw/Ton) in 15 years in all Kellogg Manufacturing Plants worldwide

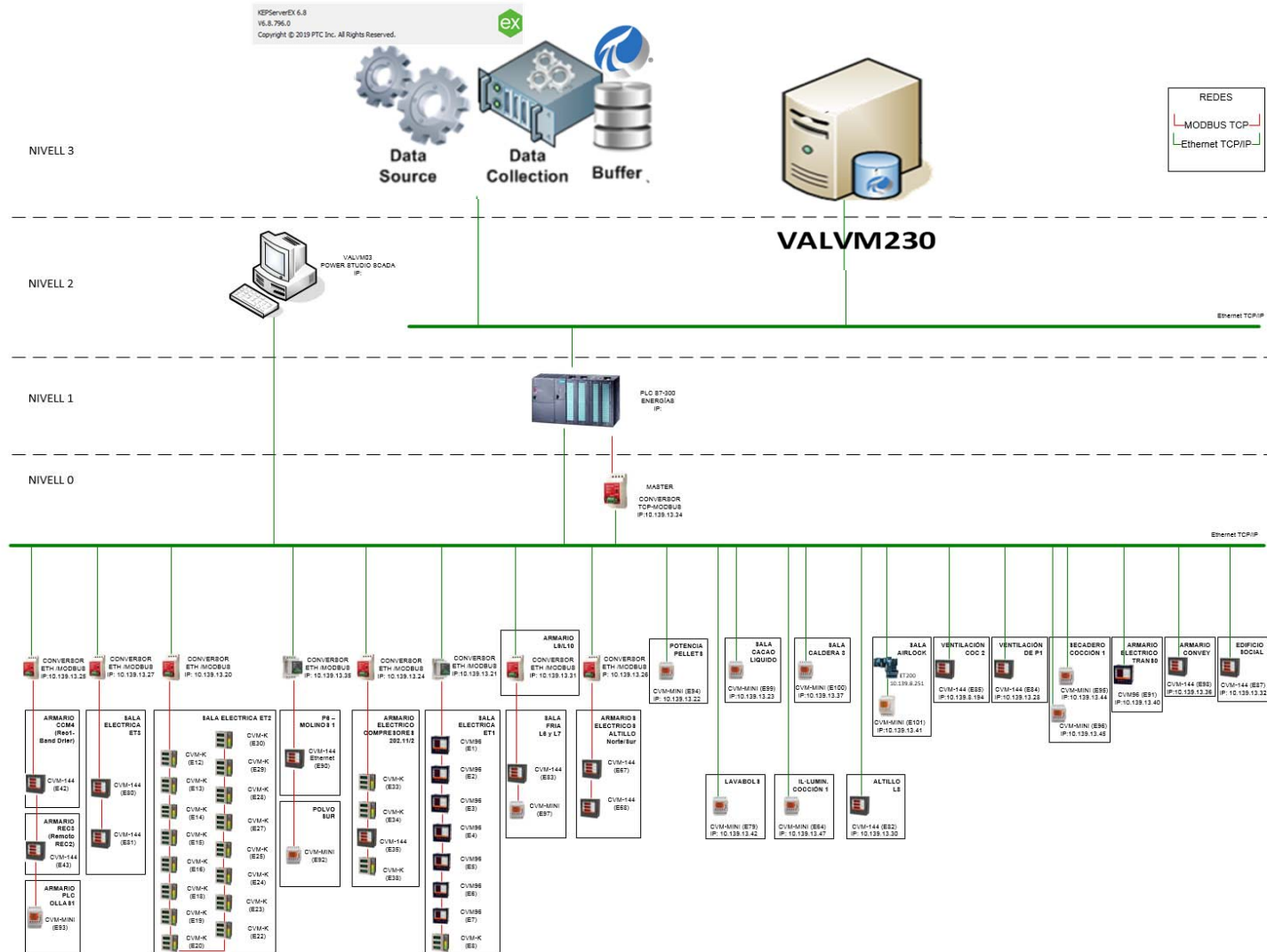


Energy Management

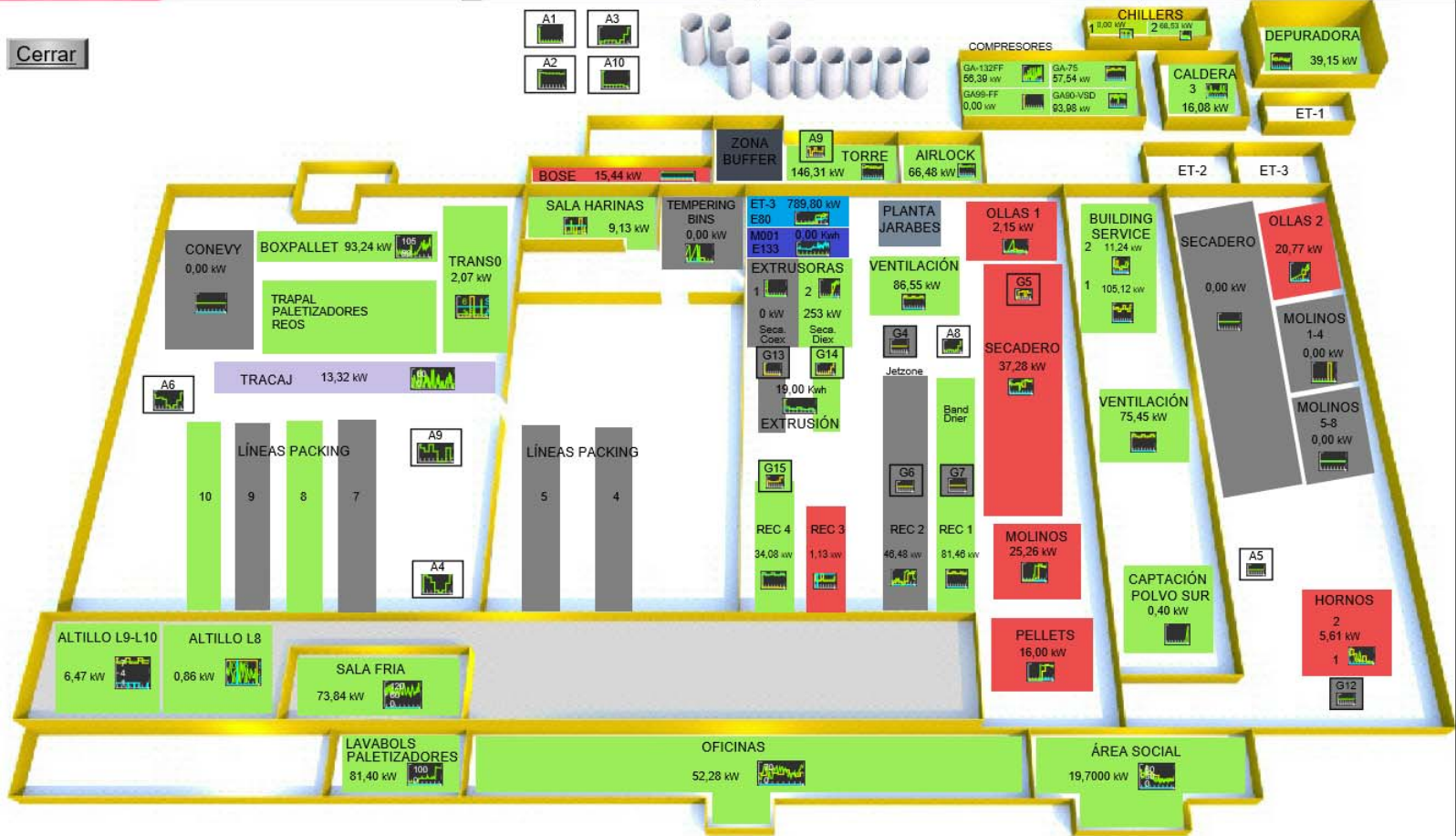
Making the invisible, visible!



Energy Management Architecture



Cerrar





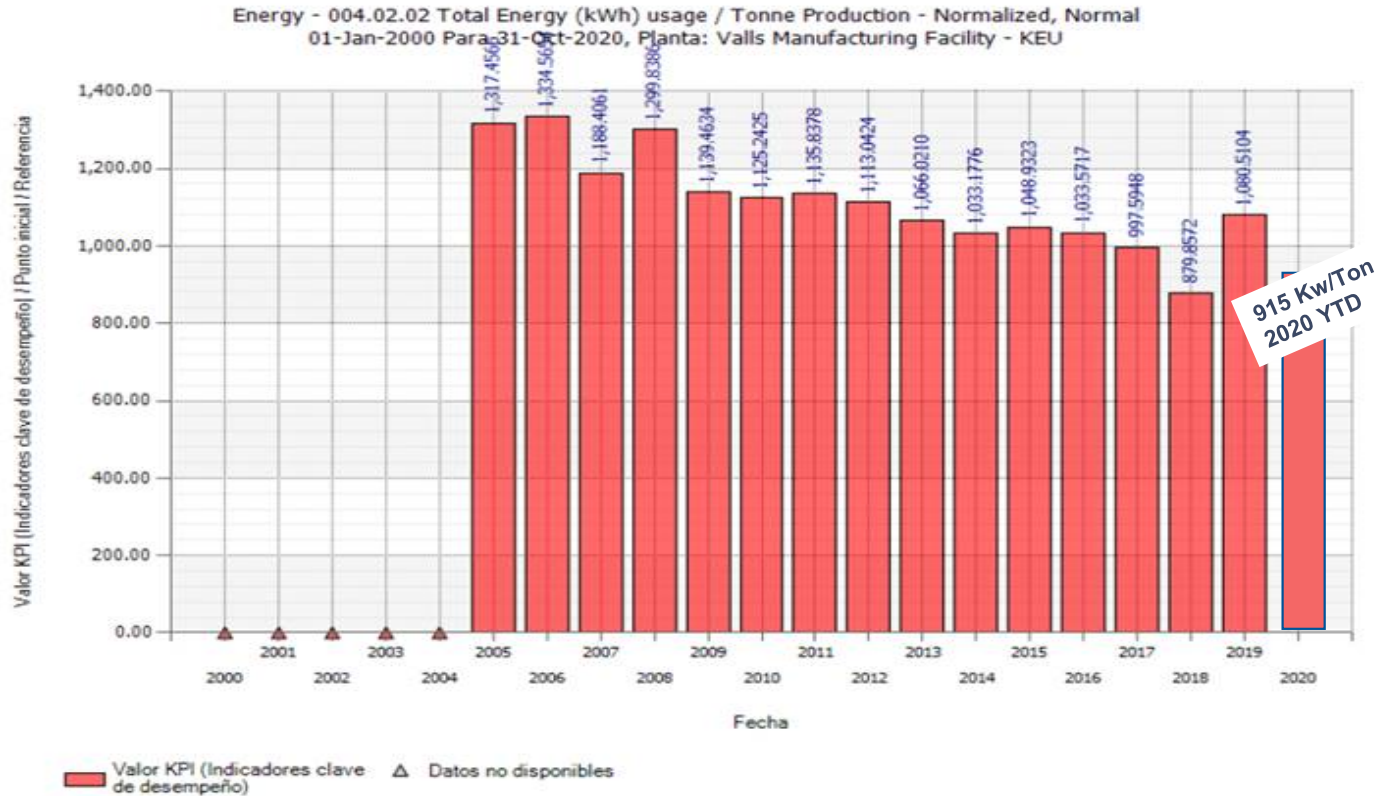


We have reduced the kW / Ton consumption by 30% in the last 15 years



Informes KPI Valls Manufacturing Facility - KEU

Mostrar valores de KPI Drill-down type: By Interval By Site



Using PI System data for Energy Saving



Challenge

20% Energy usage (Kw/Ton) in 15 years in all Kellogg Manufacturing Plants



Solution

Deployed the latest OSIsoft PI technology including PI AF and PI Vision along with energy meters, (Electricity, Gas Compress Air and Water) for Monitoring energy consumption in real and use the data for defining Energy Saving Engineering projects



Benefits

- 30% energy consumption reduction in 2020 YTD compared with 2005.
- The information in real time enables to take actions at shift basis

Improving Operations Efficiency with PI Asset Framework and PI Analysis

PI SYSTEM TECHNOLOGY ENABLES KEY BUSINESS SOLUTIONS

ISSUE

RESULT



ENERGY USAGE



ENERGY EFFICIENCY



EQUIPMENT STATUS



CONDITION BASED MAINTENANCE



LEGACY PROCESS KNOWLEDGE



KNOWLEDGE TRANSFER



PROCESS CONDITIONS



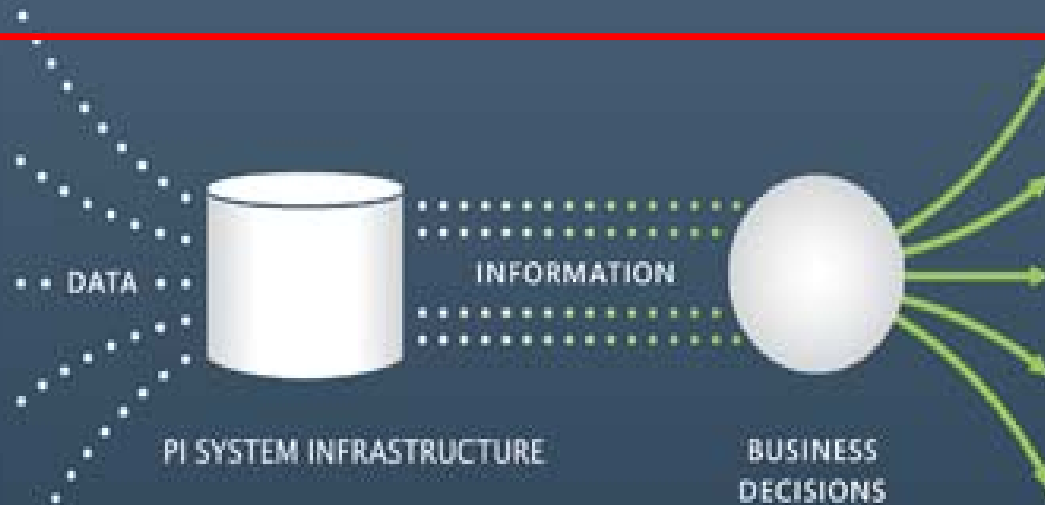
OPTIMIZE PRODUCTION



REGULATORY REQUIREMENTS



COMPLIANCE



Challenge: Be in the best in Class Consumer Product Goods Industry = 80% OEE
In 2017 the packing lines OEE was 68%

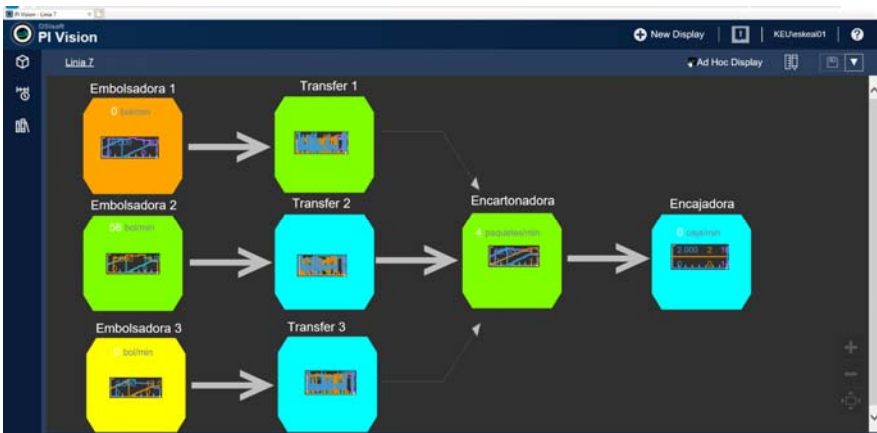


Context

Operations TEAM needs data in order to:



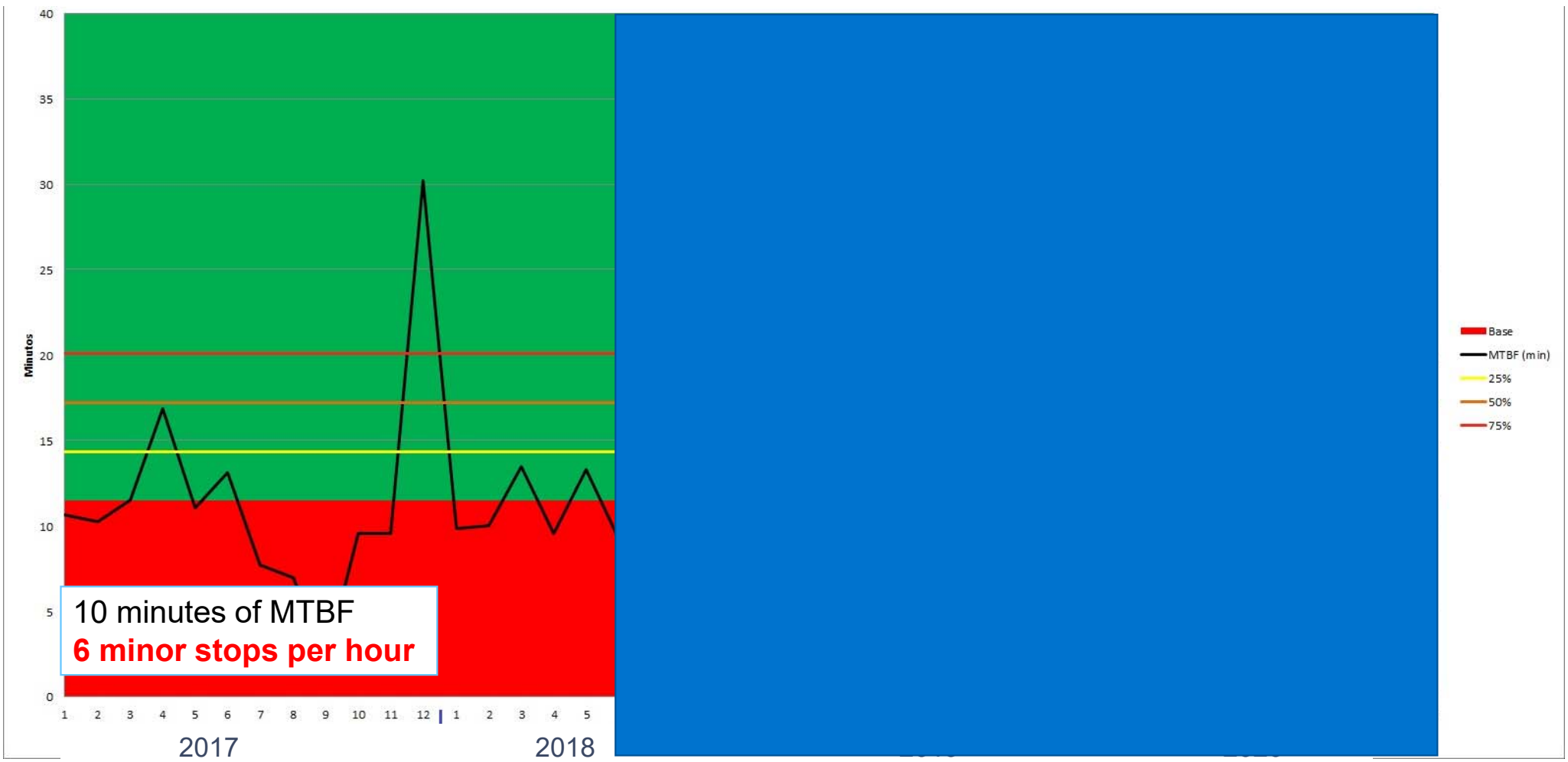
- Measure the improvement after the periodic "Pit Stops" where maintenance and cleaning task are executed.



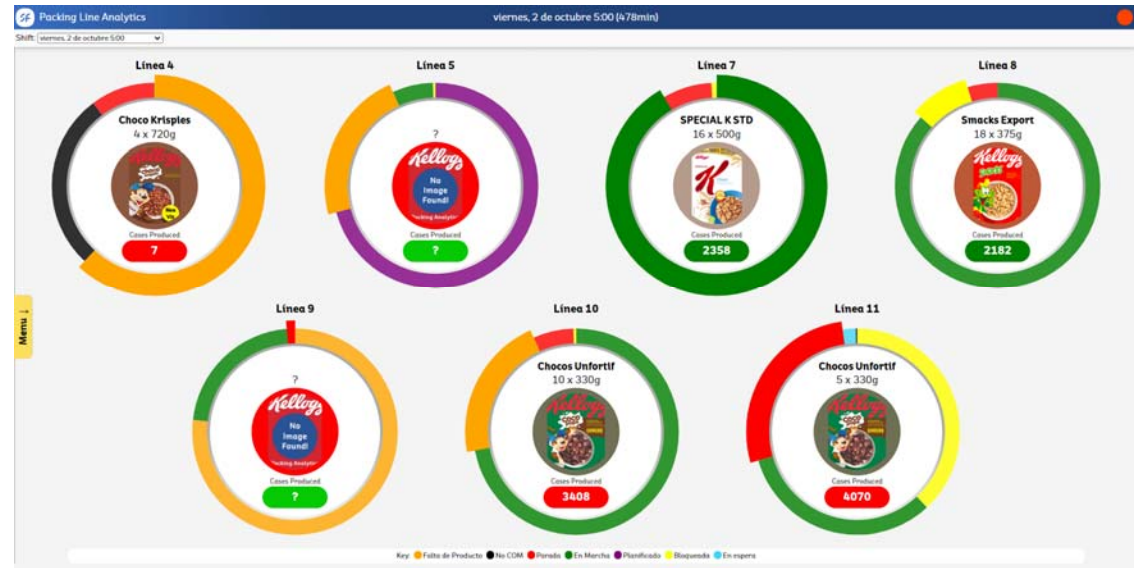
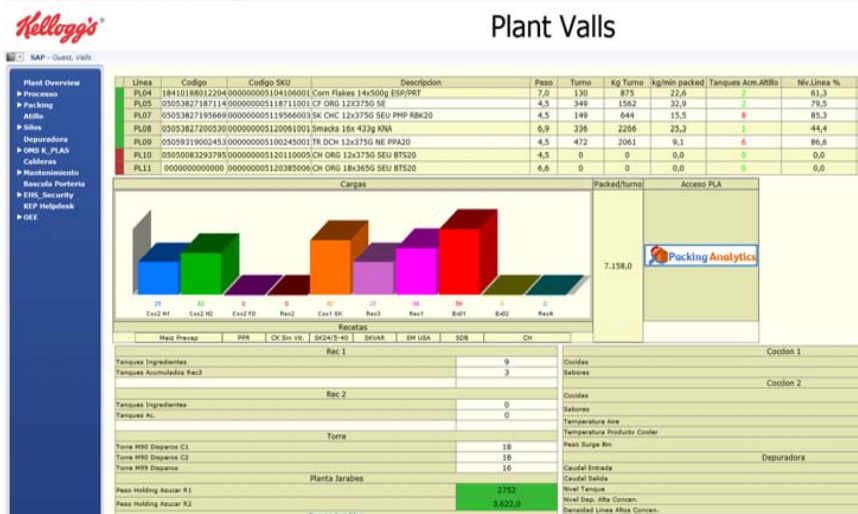
- Eliminate the historical fights between Maintenance and Production



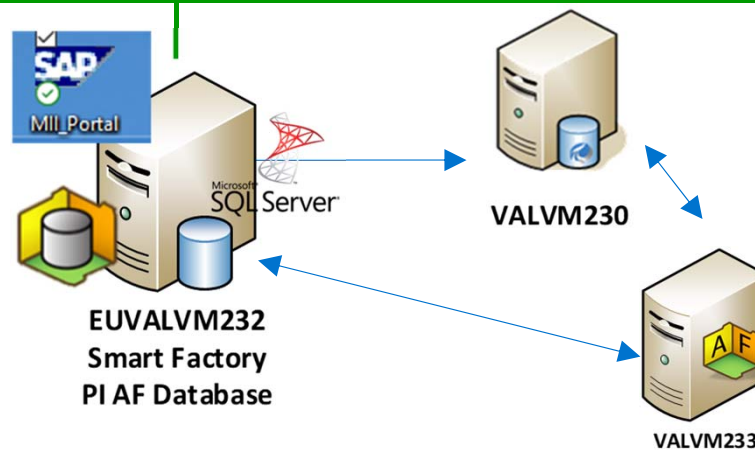
Packing lines MTBF in 2017



Use the PI System data along with SAP xMII



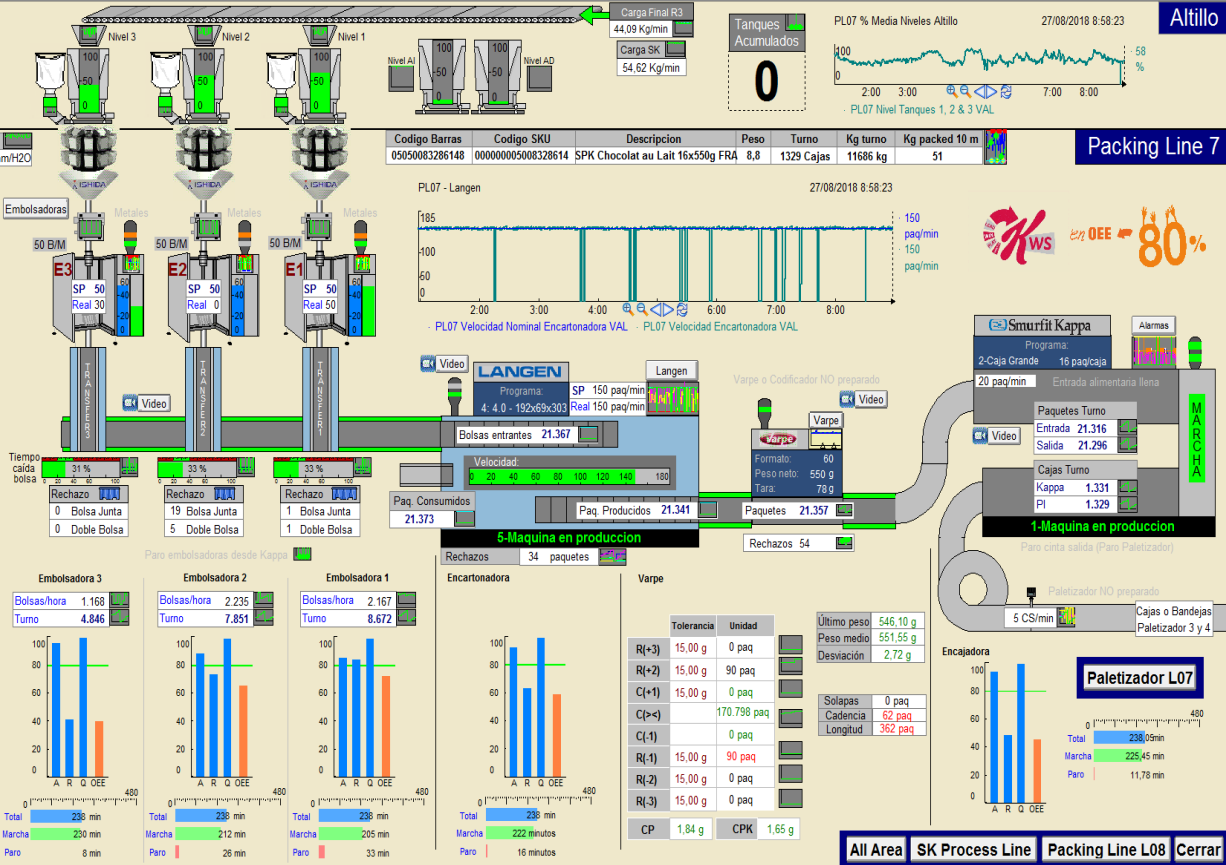
Valls PI System Architecture
2020 for Smart Factory, Packing
Lines Analytics (PLA)



Solution

1. Create a Digital Twin connecting all Packing machines to PI System via PI Interface for OPC DA

Digital Twin



2. Set up PI AF structure and Analytics for calculating line status

The screenshot displays the PI System Explorer interface. On the left, the 'Elements' tree is expanded to show the hierarchy for '0341-PACK', including sub-elements like 'PL04' through 'PL10', 'Embolsadora1-3', 'Encajadora', 'Encartonadora', 'Pesadora1-3', and 'PL11'. A red circle highlights this tree structure.

The main window shows the configuration for 'PL10'. The 'General' tab is active, displaying a table of variables:

Name	Backfilling
f(x) Linea_Estado_Calc	✓
f(x) Stop_Reason_Int_Calc	✓

Below the table, the 'Expression' tab is active, showing the following code:

```
Variable1 //Estado de la linea (para poner un comentario shift+Enter//  
if ('.\Encajadora|Estado_VAL' = "Bloqueada") then 3 else if ('.\Encartonadora|Estado_VAL' = "Parada" or '.\Encartonadora|Estado_VAL' = "Bloqueada" or '.\Encajadora|Estado_VAL' = "Parada") th  
Variable2 if variable1 = 'Linea Estado' then NoOutput() else Variable1
```

The 'Output Attribute' column shows 'Map' for Variable1 and 'Linea_Estado' for Variable2. A red circle highlights the entire configuration area.

At the bottom, the 'Scheduling' section is set to 'Periodic' with a 'Period' of '00h 00m 05s'. A status bar at the bottom right indicates 'Connected to the PI Analysis Service.'

3. We set up Packing line stop reason analyses

The screenshot shows the PI System Explorer interface. On the left, a tree view shows the hierarchy of elements, including '0341-PACK' and 'PL10'. The main window displays the configuration for the 'Stop_Reason_Int_Calc' analysis. The 'Name' field is 'Stop_Reason_Int_Calc', and the 'Description' is 'Calculamos el Stop Reason Int de la linea'. The 'Analysis Type' is set to 'Expression'. The 'Trigger on' field is 'Linea Estado'. The 'Scheduling' is set to 'Event-Triggered'. The 'Advanced...' button is visible. The main configuration area is highlighted with a red circle.

Name	Backfilling
Linea_Estado_Calc	✓
Stop_Reason_Int_Calc	✓

```
Variable1 if ('Linea Estado' = "Parada" and ('.\Encajadora|Estado_VAL' = "Parada" or '.\Encajadora|Estado_VAL' = "Bloqueada")) then 40000 + '.\Encajadora|Stop_Reason_Int_VAL' else if ('Linea Estado' = "Bloqueada" and '.\Encajadora|Estado_VAL' = "Bloqueada") then 40156 else if ('Linea Estado' = "Parada" and ('.\Encartonadora|Estado_VAL' = "Parada" and '.\Encartonadora|StopFromOperator'=1)) then 20074 else if ('Linea Estado' = "Parada" and ('.\Encartonadora|Estado_VAL' = "Parada" or '.\Encartonadora|Estado_VAL' = "Bloqueada")) then 20000 + '.\Encartonadora|Stop_Reason_Int_VAL' else if ('Linea Estado' = "Falta producto") then 10000 else if ('Linea Estado' = "No COM") then 30000 else if ('Linea Estado' = "En Espera") then 50000 else 0
```

```
Variable2 if PrevVal('Linea Estado', '-1s') = 'Linea Estado' then NoOutput() else if variable1 = 'Linea Stop Reason' then NoOutput() else Variable1
```

Output Attribute: [Map](#)

Linea Stop Reason

4. We created a packing line equipment structure and analyses in PI AF using Element Templates.

The screenshot displays the PI AF software interface for configuring element templates. The main window is titled "Encartonadora_Rovema" and shows a table of templates. A red arrow points from the table to a detailed view of a template's logic.

Name	Description	Default Value
Estado_VAL		
Estado_VAL2	Performance equation	
FuncionAlarma		0
Stop_Reason_Int_VAL		0

The detailed view shows the logic for the "FuncionAlarma" template:

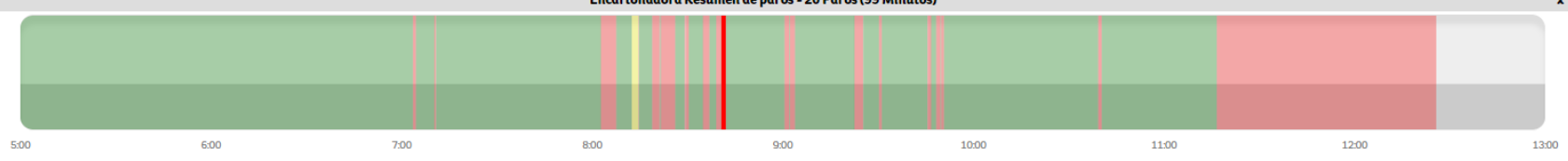
```

Variable: if ('CodigoFuncion_Alarma_PLC_VAL' = "11000-1") then 74 else if ('CodigoFuncion_Alarma_PLC_VAL' = "1803-0")
('CodigoFuncion_Alarma_PLC_VAL' = "2052-10577") then 3 else if ('CodigoFuncion_Alarma_PLC_VAL' = "2200-0")
('CodigoFuncion_Alarma_PLC_VAL' = "3487-0") then 6 else if ('CodigoFuncion_Alarma_PLC_VAL' = "4326-13875")
('CodigoFuncion_Alarma_PLC_VAL' = "4326-23032") then 0 else if ('CodigoFuncion_Alarma_PLC_VAL' = "4326-20070") then 20 else if ('CodigoFuncion_Alarma_PLC_VAL' = "4463-33060") then 23 else if
('CodigoFuncion_Alarma_PLC_VAL' = "5463-19577") then 12 else if ('CodigoFuncion_Alarma_PLC_VAL' = "5463-23876") then 14 else if ('CodigoFuncion_Alarma_PLC_VAL' = "5737-0") then 15 else if
('CodigoFuncion_Alarma_PLC_VAL' = "6232-323") then 16 else if ('CodigoFuncion_Alarma_PLC_VAL' = "6232-423") then 17 else if ('CodigoFuncion_Alarma_PLC_VAL' = "6232-523") then 18 else if
  
```

The background image shows a 3D visualization of the packing line equipment, including three filling stations (Embotelladora 1, 2, and 3), a conveyor system, and a palletizer (Paletizador L07). The interface also displays various data points, charts, and status indicators for the equipment.

5131538003 CP ORG 16x600G FBX
 5129379002
 5110452001
 5110420002

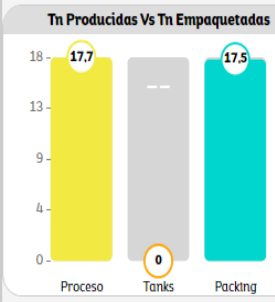
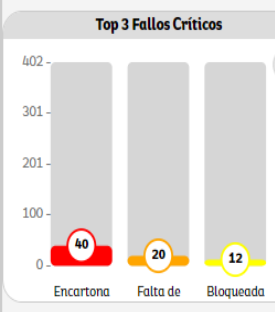
Línea 10 - viernes, 2 de octubre (Mañana)
 Encartonadora Resumen de paros - 20 Paros (99 Minutos)



Evento	Duración	Paros
Encartonadora - PARO POR OPERADOR	69.1 mins	1 Paros
Encajadora - ENTRADA ALIMENTARIA LLENA	13.8 mins	7 Paros
Encajadora - B1021 DETECTOR IZQ PARA LENGTA ABIERT	4.5 mins	1 Paros
Encajadora - No Planificado - Operaciones - Encajadora - Fallos ambiguos - Ajustes en marcha	3.5 mins	3 Paros
Encartonadora - Transporte de salida no disponible	3.1 mins	3 Paros
Encajadora - US FALLA MECÁNIC D EMPUJ A VOLT	2.0 mins	1 Paros
Encartonadora - Vigilar empujador fuera de recorrido	1.4 mins	1 Paros
Otros Microparos (menos de 1 minuto)	2 Segundos	3 Paros
Total	99.4 Minutos	20 Paros

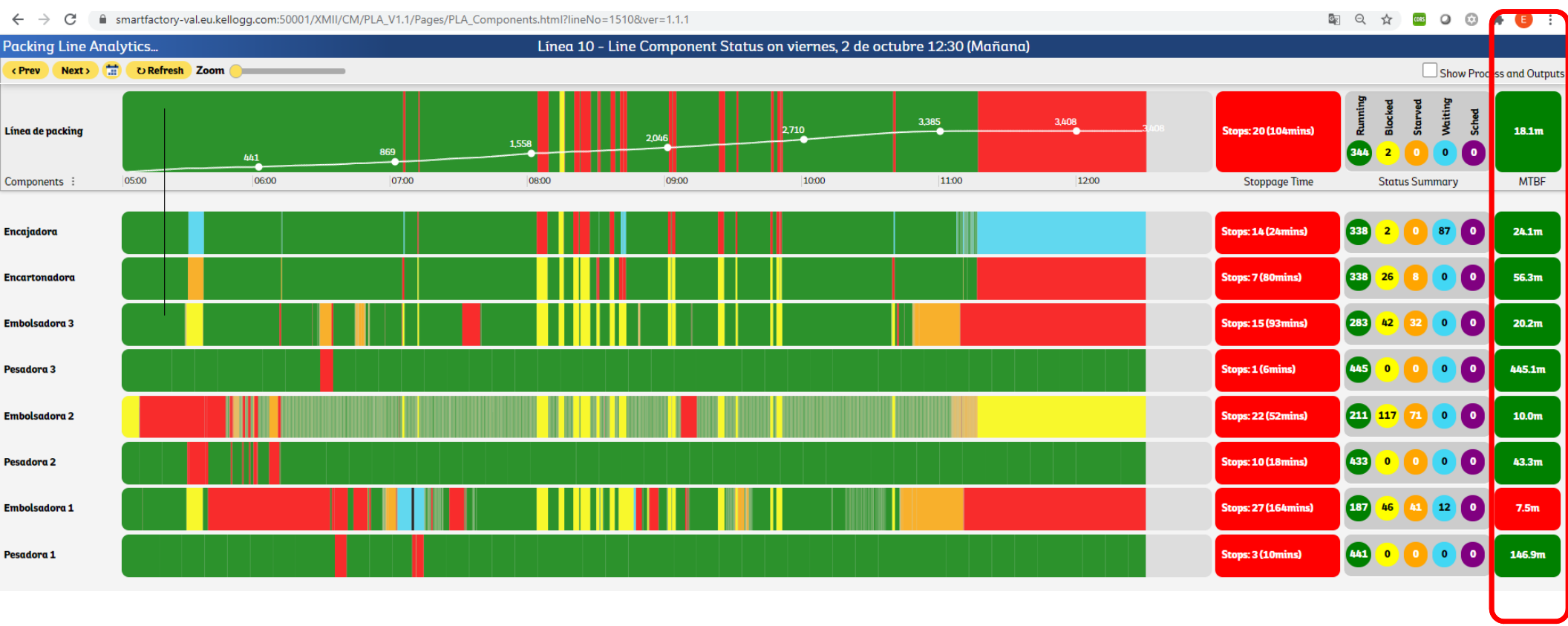
Shift Notes

5131538003
 Hora Puesta en Marcha
 08 Oct 18:30

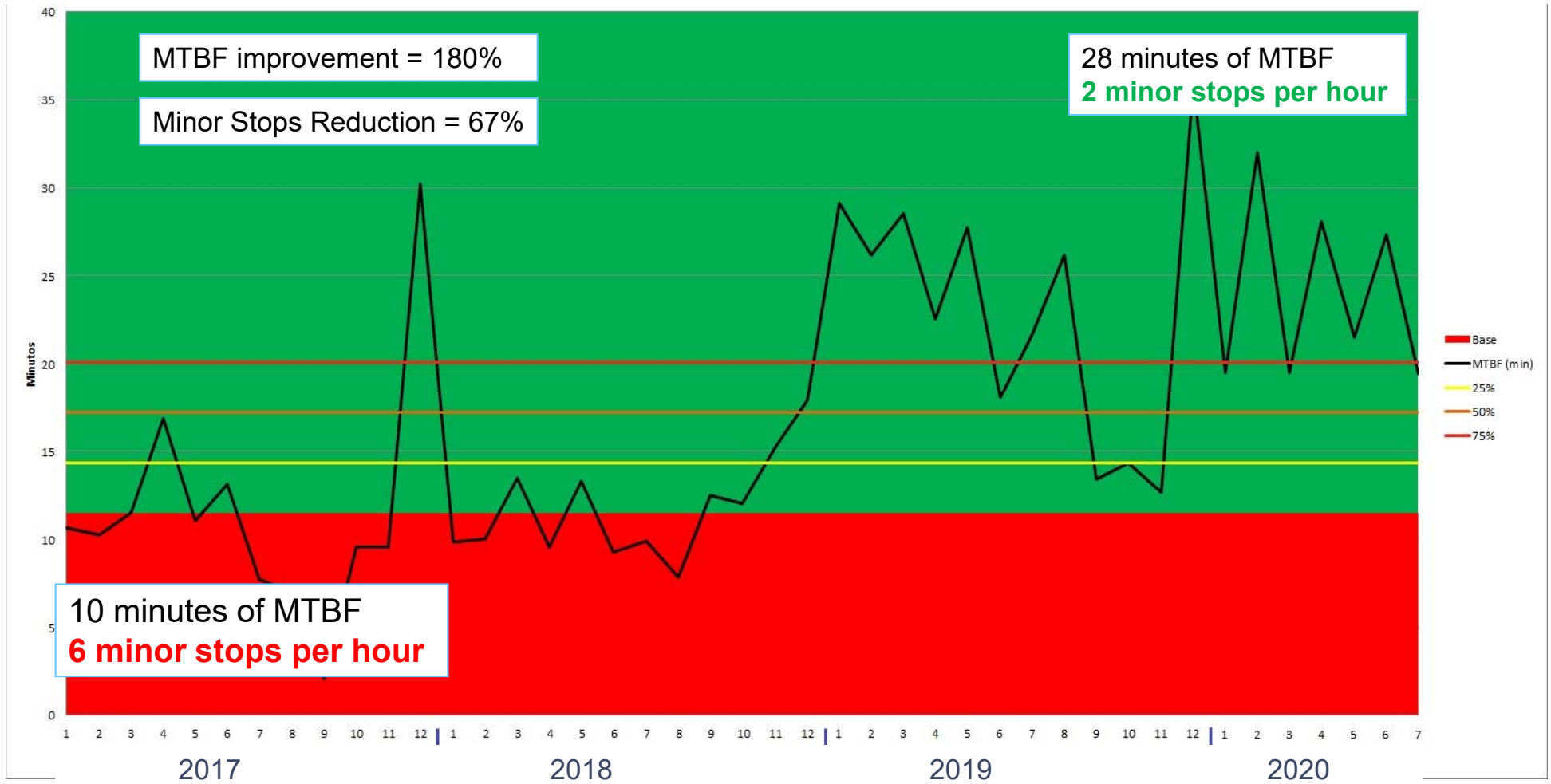


REG19
 2.6%
 7.2%
 6.3%
 Línea

Packing Line equipment status and MTBF



Results 2020 YTD





**Smart Factory
Digital Workstation Paperless Plant**



Using PI Notifications and PI Vision for silos inventory control



Challenge

- 68% Valls Plant packing lines OEE 2015

Reduce line minor stops, 6 per hour in 2015.

Improve the 10 minutes MTBF that we had in 2015.

No automatic data capture for Root Cause Analysis



Solution

Deployed the latest OSIsoft PI technology including PI AF & Advanced Analytics and connect to SAP xMII in order to monitor the packing line status and stop reason in real time



Benefits

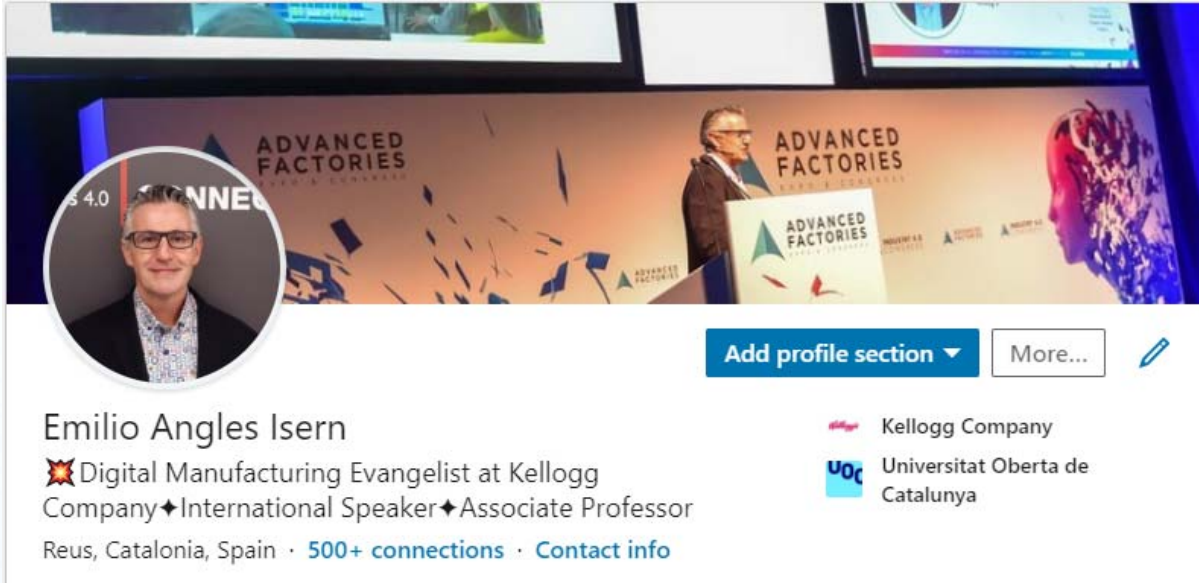
- 76% OEE in packing lines

- 67% less of minor stops per hour.

- MTBF increased from 10 minutes to 28 minutes. (180%).

- We have eliminated paper in the packing lines.

- The information in real time enables to take actions at shift basis




The image shows a LinkedIn profile for Emilio Angles Isern. The profile picture is a circular portrait of a man with glasses and a dark jacket. The background of the profile banner features a presentation slide titled "ADVANCED FACTORIES" with a speaker at a podium. The slide also includes the text "ADVANCED FACTORIES" and "4.0". Below the profile picture, the name "Emilio Angles Isern" is displayed, followed by his title: "Digital Manufacturing Evangelist at Kellogg Company ♦ International Speaker ♦ Associate Professor". His location is listed as "Reus, Catalonia, Spain" and he has "500+ connections". There are buttons for "Add profile section" and "More...". To the right, two affiliations are listed: "Kellogg Company" and "Universitat Oberta de Catalunya".


Emilio Angles Isern

🔥 Digital Manufacturing Evangelist at Kellogg Company ♦ International Speaker ♦ Associate Professor

Reus, Catalonia, Spain · 500+ connections · [Contact info](#)

[Add profile section](#) [More...](#)

 Kellogg Company

 Universitat Oberta de Catalunya

Thank you



謝謝
 DZIĘKUJĘ CI
 NGIYABONGA
 TEŞEKKÜR EDERİM
 DANKIE
 TERIMA KASIH
 SPASIBO
 ПАСИБО
 GRAZIE
 ПAKMET CИЗГЕ
 GO RAIBH MAITH AGAT
 БЛАГОДАРЯ
 GRACIAS
 ТИ БЛАГОДАРАМ
 TAK DANKE
 RAHMAT
 HATUR NUHUN
 CẢM ƠN BẠN
 WAZVIITA
 TAPADH LEIBH
 KEA LEBOHA
 БАЯРЛАЛАА
 MISAOTRA ANAO
 WHAKAWHETAI KOE
 DANKON TANK TAPADH LEAT
 MATUR NUWUN
 ХВАЛА ВАМ
 MULȚUMESC
 GRAZIE
 고맙습니다
 SHUKRA
 HVALA
 FAAFETAI
 ESKERRIK ASKO
 HVALA
 TEŞEKKÜR EDERİM
 OBRIGADO
 DANKJE
 EΥΧΑΡΙΣΤΩ
 GRATIAS TIBI
 AČIŮ
 SALAMAT
 MAHALO IĀ 'ŌE
 TAKK SKALDU HA
 ДЗЯКУЙ
 MERCI
 DI OU MÈSI
 ĎAKUJEM
 GRAZZI
 PAKKA PÉR
 ありがとうございます
 SIPAS JI WERE
 TERIMA KASIH
 UA TSAUG RAU KOJ
 TI БЛАГОДАРАМ
 СИПОС
 KÖSZÖNÖM
 GRACIES
 SALAMAT
 MAHADSANID
 FALEMINDERIT