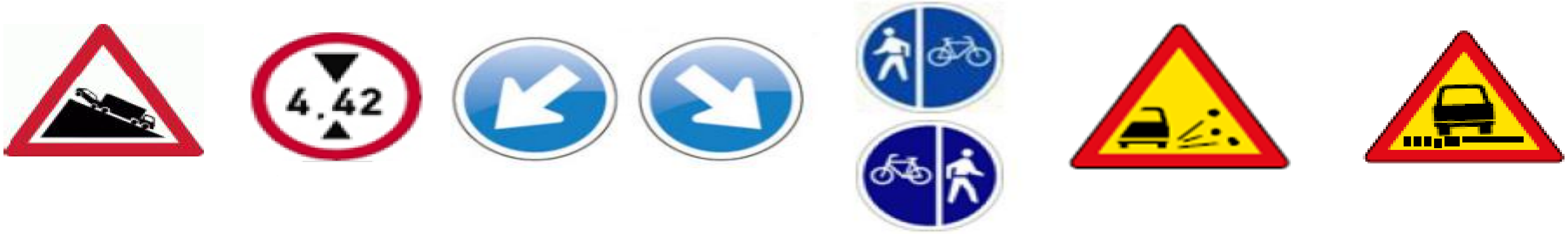
SUGAR PACKING STATION OPTIMIZATION USING OEE

LLOYD MELROSE

SUGAR ILLOVO AFRICA

Safety Moment

Safety Moment



What do these mean?

- ***Lesson***: Passing driver’s license test decades ago doesn’t mean you’re a good driver;
- Re-learning, applying ourselves, staying up to date and not taking safety for granted is a better approach.

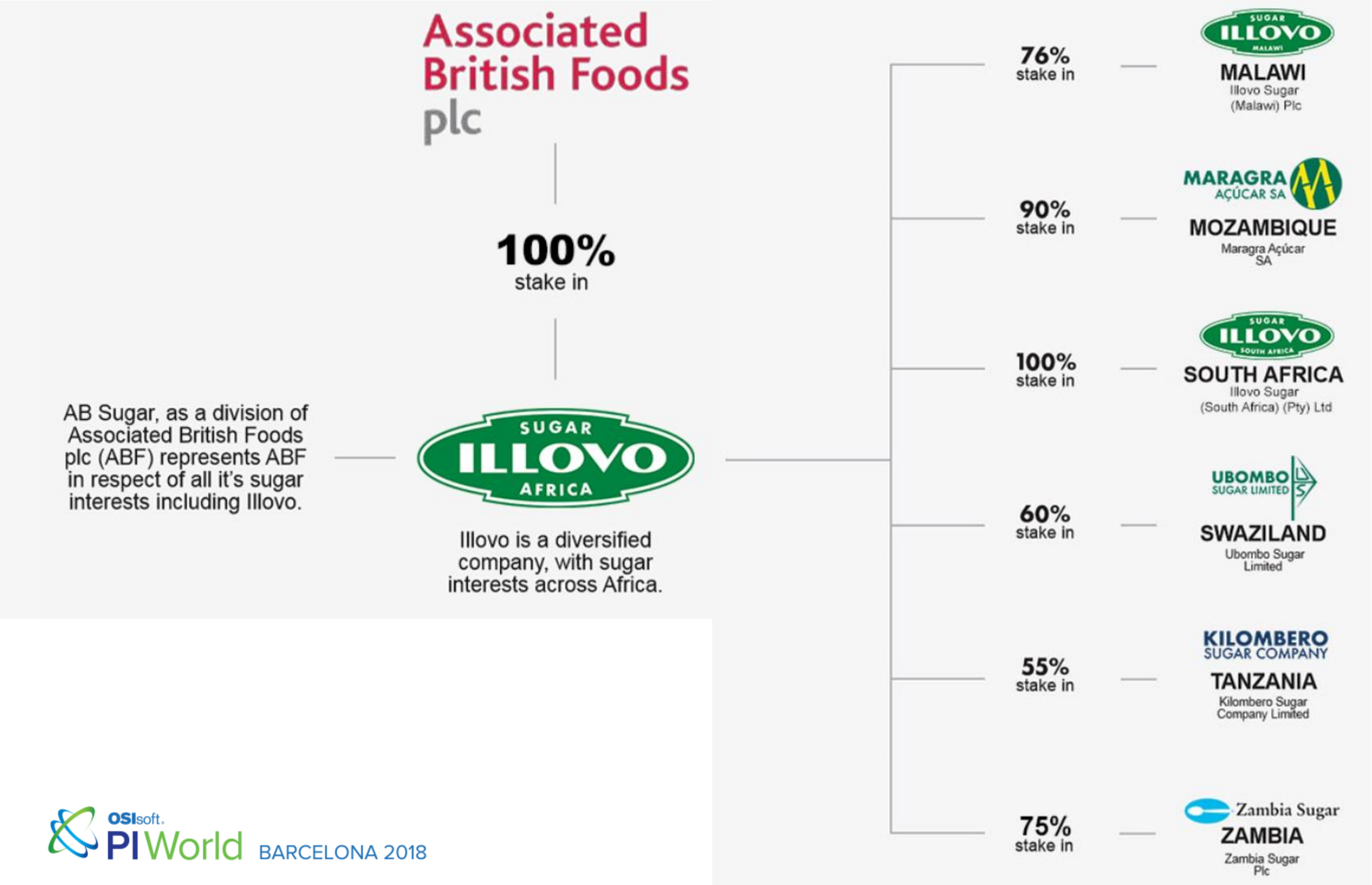
Contents

Contents

- Illovo Sugar Africa (Pty) Ltd Overview;
- Business Need;
- Project Charter;
- Implementation;
- Reporting;
- Results;
- Conclusion.

Illovo Sugar Africa (Pty) Ltd Overview

Illovo Sugar Africa (Pty) Ltd Overview



Associated British Foods plc

100% stake in

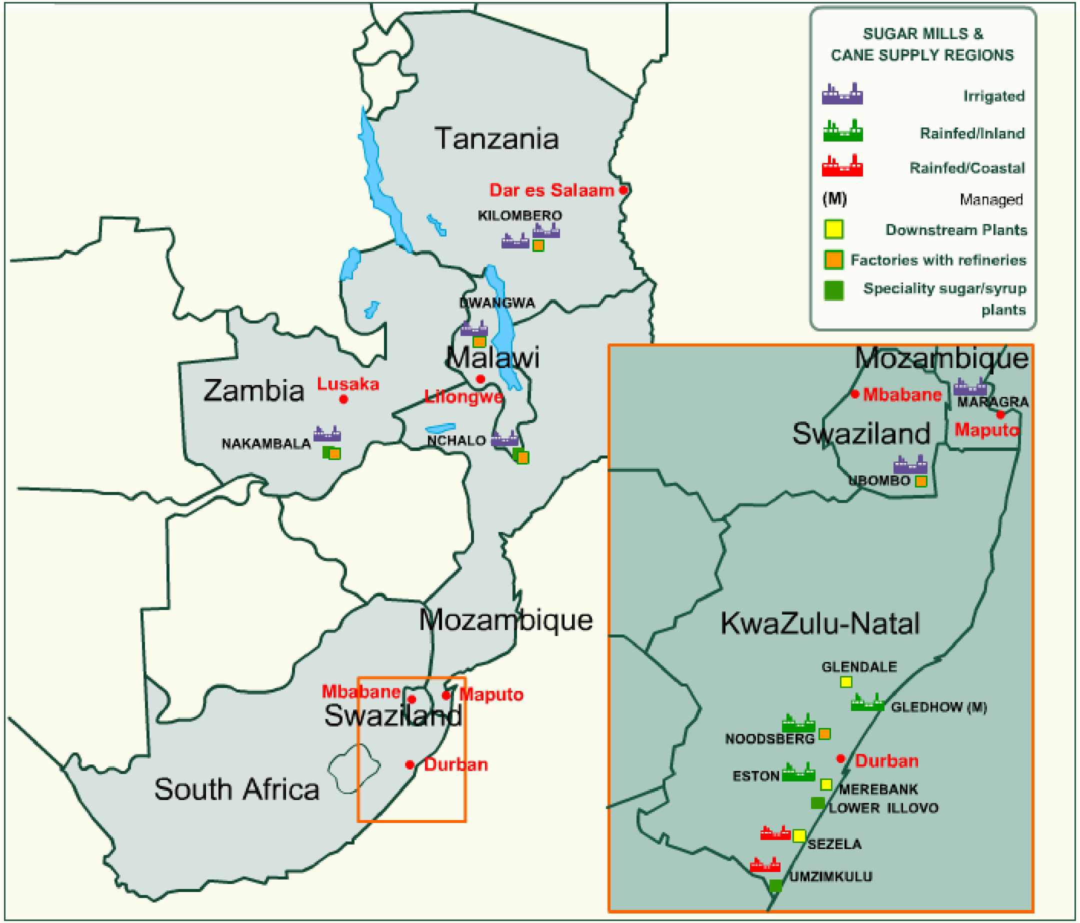
SUGAR ILLOVO AFRICA

AB Sugar, as a division of Associated British Foods plc (ABF) represents ABF in respect of all it's sugar interests including Illovo.

Illovo is a diversified company, with sugar interests across Africa.

76% stake in	SUGAR ILLOVO MALAWI **MALAWI** Illovo Sugar (Malawi) Plc
90% stake in	MARAGRA AÇÚCAR SA **MOZAMBIQUE** Maragra Açúcar SA
100% stake in	SUGAR ILLOVO SOUTH AFRICA **SOUTH AFRICA** Illovo Sugar (South Africa) (Pty) Ltd
60% stake in	UBOMBO SUGAR LIMITED **SWAZILAND** Ubombo Sugar Limited
55% stake in	KILOMBERO SUGAR COMPANY **TANZANIA** Kilombero Sugar Company Limited
75% stake in	Zambia Sugar **ZAMBIA** Zambia Sugar Plc

Illovo Sugar Africa (Pty) Ltd Overview


SUGAR MILLS & CANE SUPPLY REGIONS
Irrigated
Rainfed/Inland
Rainfed/Coastal
(M) Managed
Downstream Plants
Factories with refineries
Speciality sugar/syrup plants
Tanzania
Dar es Salaam
KILOMBERO
DWANGWA
Malawi
Zambia
Lusaka
Lilongwe
NAKAMBALA
NCHALO
Mozambique
Mbabane
Maputo
Swaziland
Durban
South Africa
Mozambique
Mbabane
MARAGRA
Swaziland
Maputo
UBOMBO
KwaZulu-Natal
GLENDALE
GLEDHOW (M)
NOODSBERG
Durban
ESTON
MEREBANK
LOWER ILLOVO
SEZELA
UMZIMKULU

- Leading African low-cost sugar and downstream product producer;
- 16 Operations across 6 African countries;
- Strong domestic, regional & preferential sugar markets;
- Downstream - good local and strong export markets;
- Greater than 12 000 people are permanent employees while approximately 18 000 people are employed at peak periods.

Illovo's Sugar Products Overview

A range of products sold into domestic, preferential, regional and world markets.

Our ***sugar*** offerings include:

- ***Industrial sugar:*** Mainly in refined bulk form, sold primarily to soft drink, confectionery, canning and re-packing customers;
- ***Bulk raw sugar for refining:*** Primarily exported to sugar refineries;
- ***Specialty sugars:*** Sugar with unique flavour, grain size and colour, exported;
- ***Prepack sugar:*** Various pack sizes of refined and brown sugar pre-packed in paper or plastic using Form Fill and Seal Machines (FFS) for direct consumption in domestic markets.

PI System Infrastructure Overview

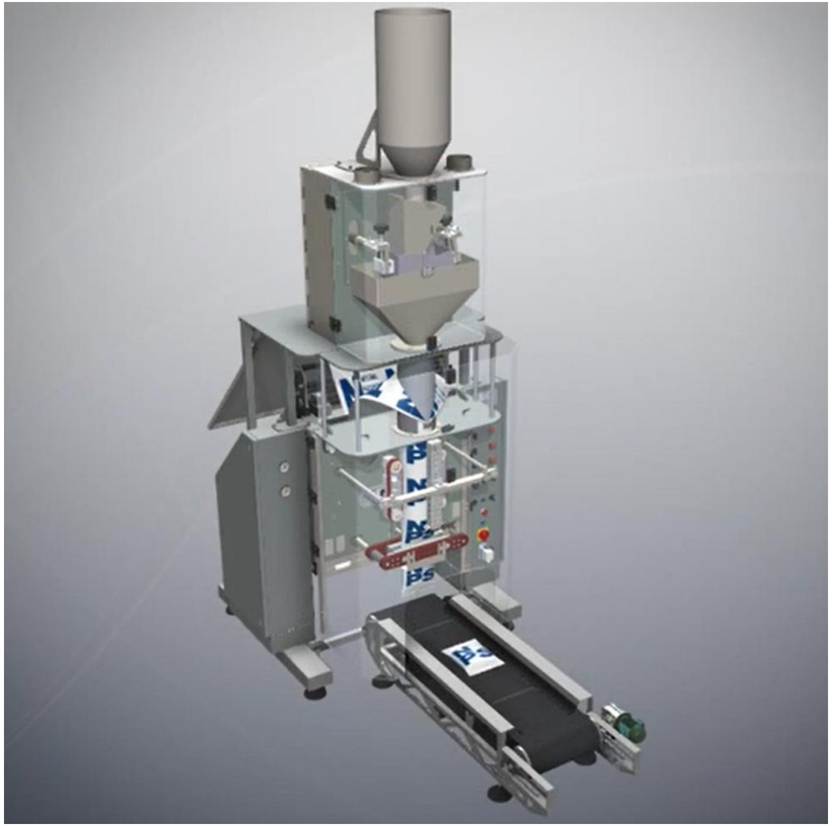
- 13 PI and 13 AF Servers – 12 sites and 1 roll-up;
- Hyper-V virtualized Server standard;
- Physical Interface Node Server standard;
- Predominantly PI Process Book and PI Datalink visualization tools;
- PI RDBMS, PI OPC, PI UFL and PI to PI interfaces;
- PI Manual Logger and Excel (PIPutVal) for data entry;
- Increasing PI Vision adoption;
- Increasing PI Asset Framework (AF) adoption.

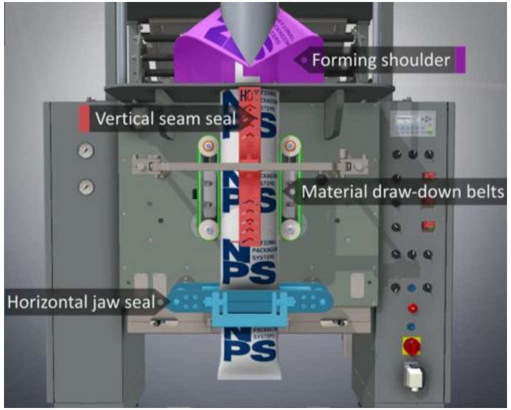
Business Need

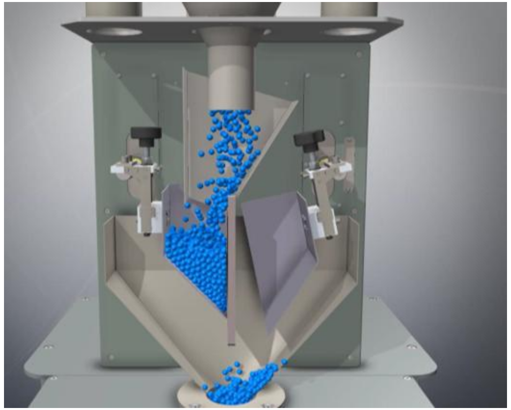
Business Need

- One of the business strategies was to shift from bulk product to smaller Stock Keeping Units (SKU) and to increase this customer base;
- Need to improve quality, throughput and SKU diversification;
- Need to improve performance from the Form Fill and Seal (FFS) Pre-pack Packing Machines;
- Measure, analyze, improve and control.

Form Fill and Seal (FFS) Packing Machine




Forming shoulder
Vertical seam seal
Material draw-down belts
Horizontal jaw seal



Project Charter

Problem Statement

- Reliance on shift log sheets in terms of capacity utilization on the FFS packing machines to provide insight into the performance and availability of these machines;

- Minimal repeatable, reliable data available to confirm that the machines are operating at optimum levels or to highlight controllable constraints for optimization purposes.

Key Output Measures

- Improved performance of FFS packing machines enabled by a cost effective and simple reporting system;
- Improved performance insight to aid decision support;
- Data easily accessible for customizable Excel reports;
- Performance and downtime reported on an hourly, shift, daily, weekly basis;
- Downtime Reporting via Pareto diagram of top downtime “bad actors” via predefined reason codes;
- Data to be historically archived and retrievable for creation of user defined customizable Excel reports.

Scope of Work

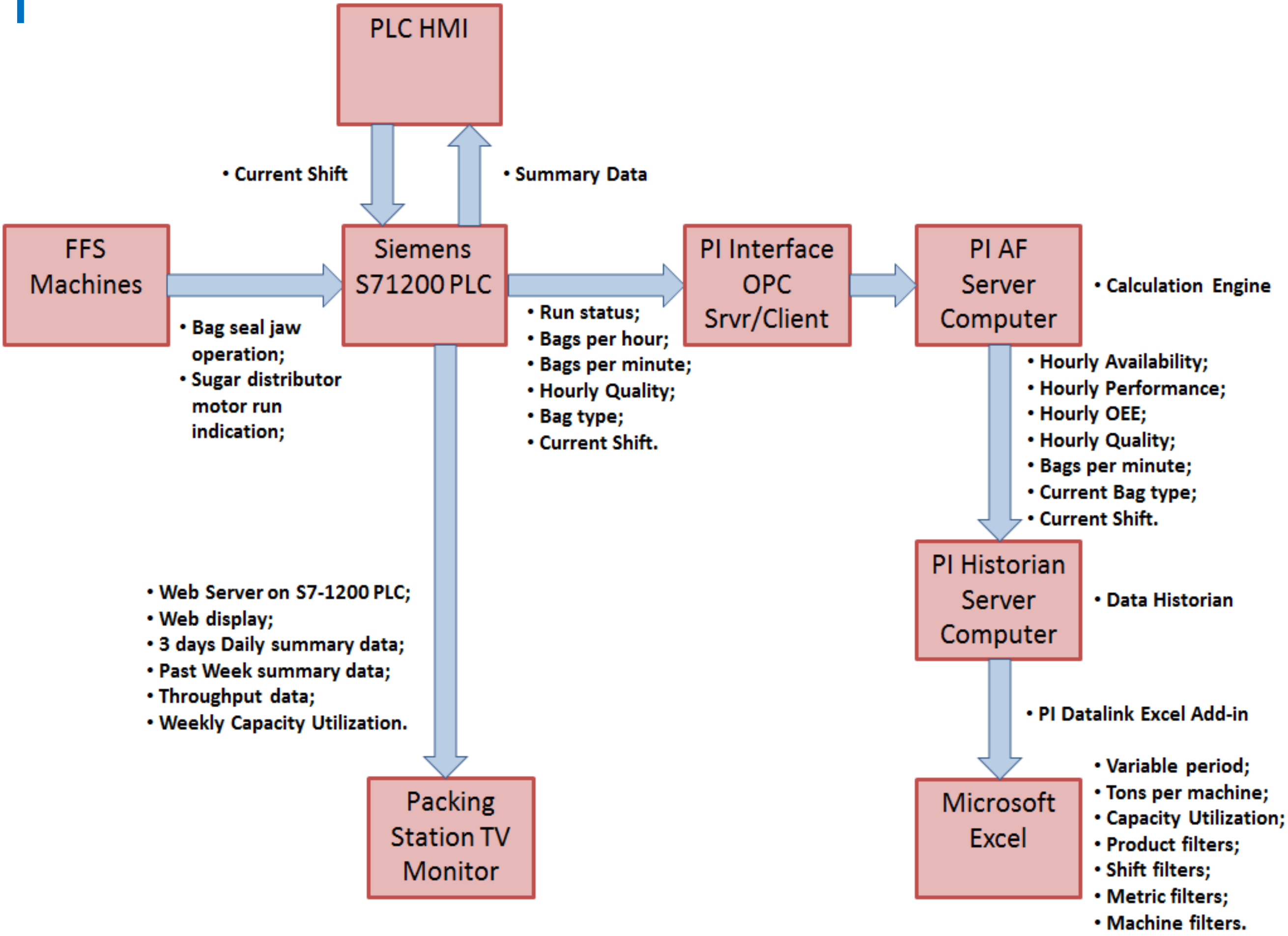
- Nakambala (Zambia): 11x FFS Machines, 4x Fawema, 2x Stick Pack;
- Dwangwa (Malawi): 12x FFS Machines;
- Nchalo (Malawi): 8x FFS Machines;
- Msolwa (Tanzania): 6x FFS Machines;
- Ruembe (Tanzania): 6x FFS Machines;
- Total of 49 Machines at 5 sites across 3 countries.

Implementation

Defining the OEE Metric

- OEE stands for Overall Equipment Effectiveness and shows the effectiveness of a machine compared to the ideal machine as a percentage. The difference between the ideal and the actual is made up of the time, speed and quality loss.
- OEE measures the losses occurring on machines in order to be able to increase the productivity and effectiveness of those machines.

OEE System Overview



PLC HMI

- Current Shift

- Summary Data

FFS Machines

- Bag seal jaw operation;
- Sugar distributor motor run indication;

Siemens S71200 PLC

- Run status;
- Bags per hour;
- Bags per minute;
- Hourly Quality;
- Bag type;
- Current Shift.

PI Interface OPC Srvr/Client

PI AF Server Computer

- Calculation Engine

- Hourly Availability;
- Hourly Performance;
- Hourly OEE;
- Hourly Quality;
- Bags per minute;
- Current Bag type;
- Current Shift.

PI Historian Server Computer

- Data Historian

- PI Datalink Excel Add-in

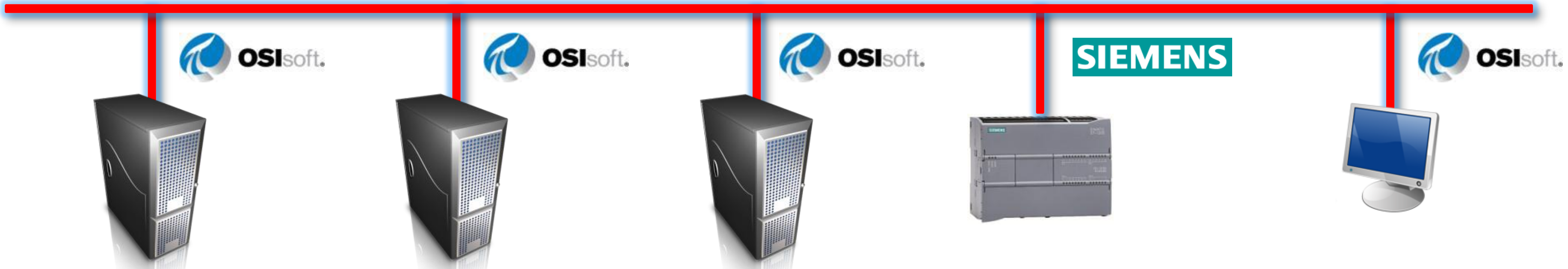
Microsoft Excel

- Variable period;
- Tons per machine;
- Capacity Utilization;
- Product filters;
- Shift filters;
- Metric filters;
- Machine filters.

- Web Server on S7-1200 PLC;
- Web display;
- 3 days Daily summary data;
- Past Week summary data;
- Throughput data;
- Weekly Capacity Utilization.

Packing Station TV Monitor

PI System Individual Products



AF Server

PI Server

Interface Server

S7-1200 PLC / HMI

Data View

Event Frames:
FFS Machine Downtime Events.

Asset Framework:
- Packing Station Hierarchy.
- OEE Analytics

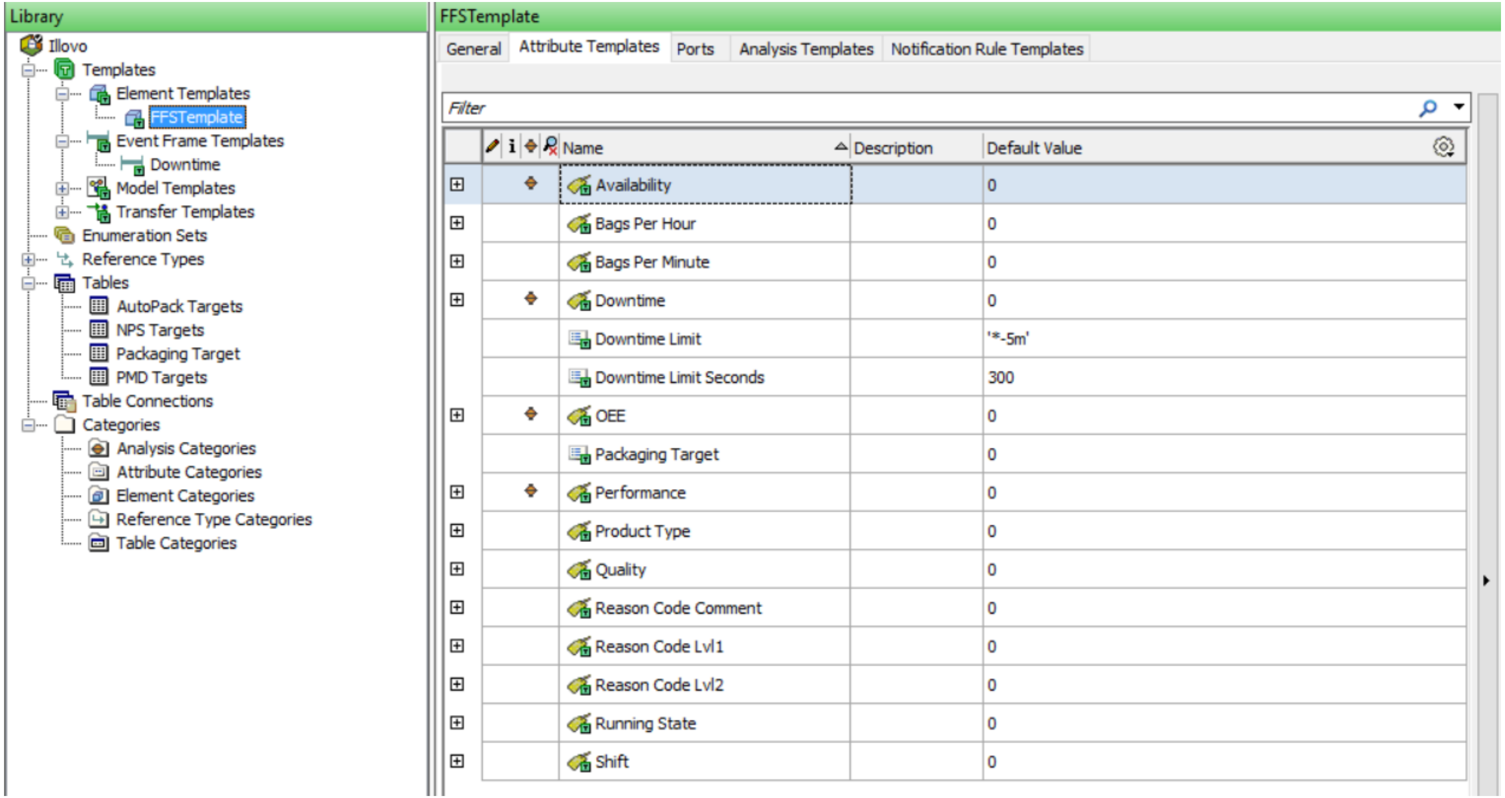
PI Tags:
Historical storage of OEE data.

OPC Server/Client:
- OPC Server
- OPC Interface

S7 PLC/HMI:
- HMI Reason code Capture
- Preliminary Calculations
- Local Display

PI Vision & Datalink:
- Real-time data
- Bag Counting Reporting
- OEE reporting
- Downtime Pareto Diagrams

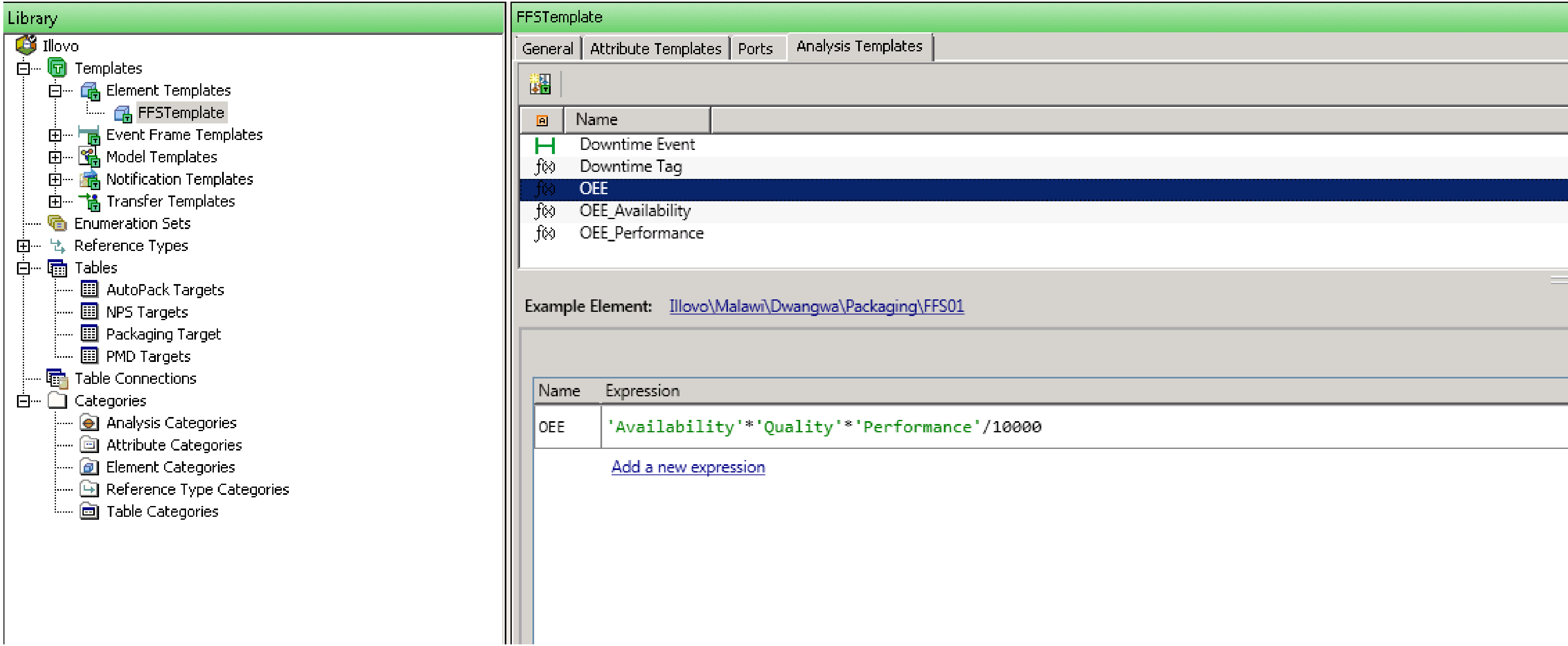
Easily Configure the Asset Framework Hierarchy using Element Templates


Library
FFSTemplate
General
Attribute Templates
Ports
Analysis Templates
Notification Rule Templates
Filter

- Illovo
  - Templates
    - Element Templates
      - FFSTemplate
    - Event Frame Templates
      - Downtime
    - Model Templates
    - Transfer Templates
  - Enumeration Sets
  - Reference Types
  - Tables
    - AutoPack Targets
    - NPS Targets
    - Packaging Target
    - PMD Targets
  - Table Connections
  - Categories
    - Analysis Categories
    - Attribute Categories
    - Element Categories
    - Reference Type Categories
    - Table Categories

Name	Description	Default Value
Availability		0
Bags Per Hour		0
Bags Per Minute		0
Downtime		0
Downtime Limit		'*-5m'
Downtime Limit Seconds		300
OEE		0
Packaging Target		0
Performance		0
Product Type		0
Quality		0
Reason Code Comment		0
Reason Code Lvl1		0
Reason Code Lvl2		0
Running State		0
Shift		0

Easily Configure Analytics using Library Templates


Library
Illovo
Templates
Element Templates
FFSTemplate
Event Frame Templates
Model Templates
Notification Templates
Transfer Templates
Enumeration Sets
Reference Types
Tables
AutoPack Targets
NPS Targets
Packaging Target
PMD Targets
Table Connections
Categories
Analysis Categories
Attribute Categories
Element Categories
Reference Type Categories
Table Categories
FFSTemplate
General
Attribute Templates
Ports
Analysis Templates
Name
Downtime Event
Downtime Tag
OEE
OEE_Availability
OEE_Performance

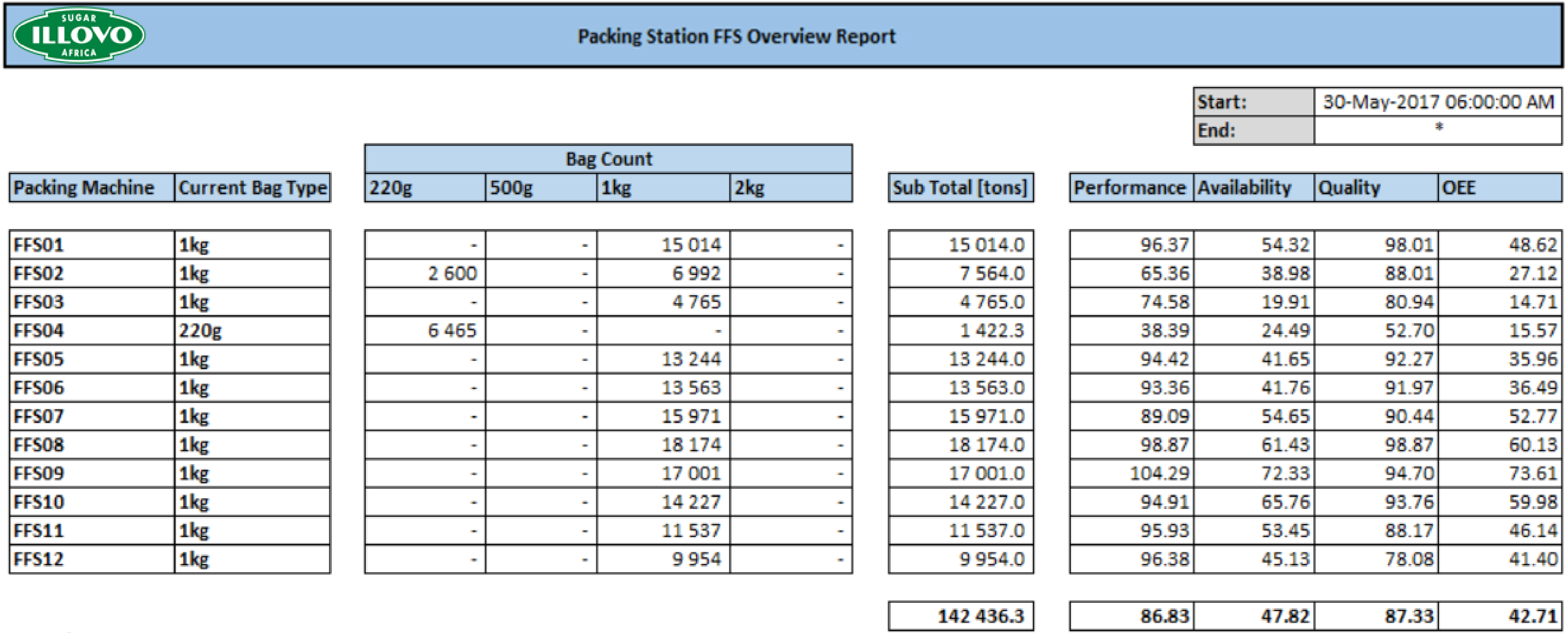
Example Element: Illovo\Malawi\Dwangwa\Packaging\FFS01

Name	Expression
OEE	'Availability'*'Quality'*'Performance'/10000

Add a new expression

Reporting

Create User Customizable Throughput Reports Fast using PI Datalink and AF Elements

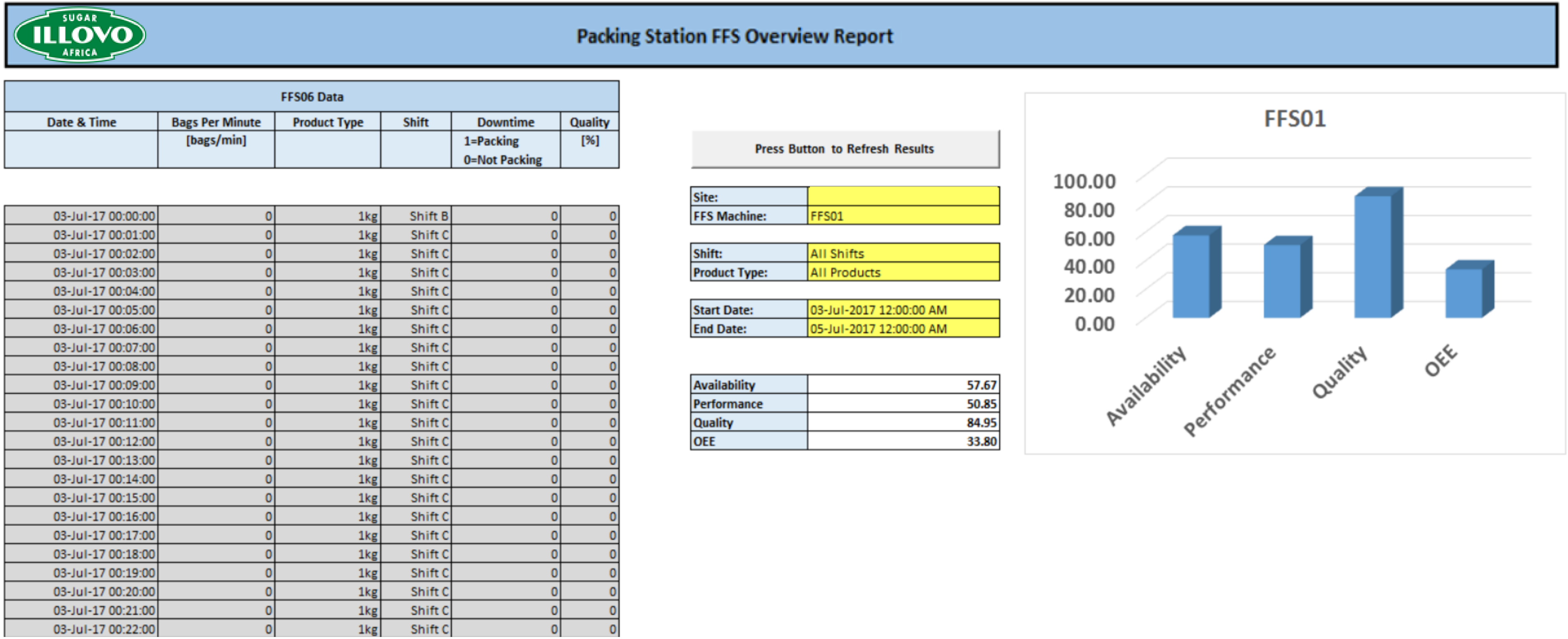


Packing Station FFS Overview Report

Start:	30-May-2017 06:00:00 AM
End:	*

		Bag Count								
Packing Machine	**Current Bag Type**	**220g**	**500g**	**1kg**	**2kg**	**Sub Total [tons]**	**Performance**	**Availability**	**Quality**	**OEE**
FFS01	1kg	-	-	15 014	-	15 014.0	96.37	54.32	98.01	48.62
FFS02	1kg	2 600	-	6 992	-	7 564.0	65.36	38.98	88.01	27.12
FFS03	1kg	-	-	4 765	-	4 765.0	74.58	19.91	80.94	14.71
FFS04	220g	6 465	-	-	-	1 422.3	38.39	24.49	52.70	15.57
FFS05	1kg	-	-	13 244	-	13 244.0	94.42	41.65	92.27	35.96
FFS06	1kg	-	-	13 563	-	13 563.0	93.36	41.76	91.97	36.49
FFS07	1kg	-	-	15 971	-	15 971.0	89.09	54.65	90.44	52.77
FFS08	1kg	-	-	18 174	-	18 174.0	98.87	61.43	98.87	60.13
FFS09	1kg	-	-	17 001	-	17 001.0	104.29	72.33	94.70	73.61
FFS10	1kg	-	-	14 227	-	14 227.0	94.91	65.76	93.76	59.98
FFS11	1kg	-	-	11 537	-	11 537.0	95.93	53.45	88.17	46.14
FFS12	1kg	-	-	9 954	-	9 954.0	96.38	45.13	78.08	41.40
						142 436.3	**86.83**	**47.82**	**87.33**	**42.71**

Combine Excel and PI Datalink Functionality to Create Powerful Report Filters



Packing Station FFS Overview Report

FFS06 Data

Date & Time	Bags Per Minute [bags/min]	Product Type	Shift	Downtime 1=Packing 0=Not Packing	Quality [%]
03-Jul-17 00:00:00	0	1kg	Shift B	0	0
03-Jul-17 00:01:00	0	1kg	Shift C	0	0
03-Jul-17 00:02:00	0	1kg	Shift C	0	0
03-Jul-17 00:03:00	0	1kg	Shift C	0	0
03-Jul-17 00:04:00	0	1kg	Shift C	0	0
03-Jul-17 00:05:00	0	1kg	Shift C	0	0
03-Jul-17 00:06:00	0	1kg	Shift C	0	0
03-Jul-17 00:07:00	0	1kg	Shift C	0	0
03-Jul-17 00:08:00	0	1kg	Shift C	0	0
03-Jul-17 00:09:00	0	1kg	Shift C	0	0
03-Jul-17 00:10:00	0	1kg	Shift C	0	0
03-Jul-17 00:11:00	0	1kg	Shift C	0	0
03-Jul-17 00:12:00	0	1kg	Shift C	0	0
03-Jul-17 00:13:00	0	1kg	Shift C	0	0
03-Jul-17 00:14:00	0	1kg	Shift C	0	0
03-Jul-17 00:15:00	0	1kg	Shift C	0	0
03-Jul-17 00:16:00	0	1kg	Shift C	0	0
03-Jul-17 00:17:00	0	1kg	Shift C	0	0
03-Jul-17 00:18:00	0	1kg	Shift C	0	0
03-Jul-17 00:19:00	0	1kg	Shift C	0	0
03-Jul-17 00:20:00	0	1kg	Shift C	0	0
03-Jul-17 00:21:00	0	1kg	Shift C	0	0
03-Jul-17 00:22:00	0	1kg	Shift C	0	0

SUGAR
ILLOVO
AFRICA
Press Button to Refresh Results

Site:	
FFS Machine:	FFS01

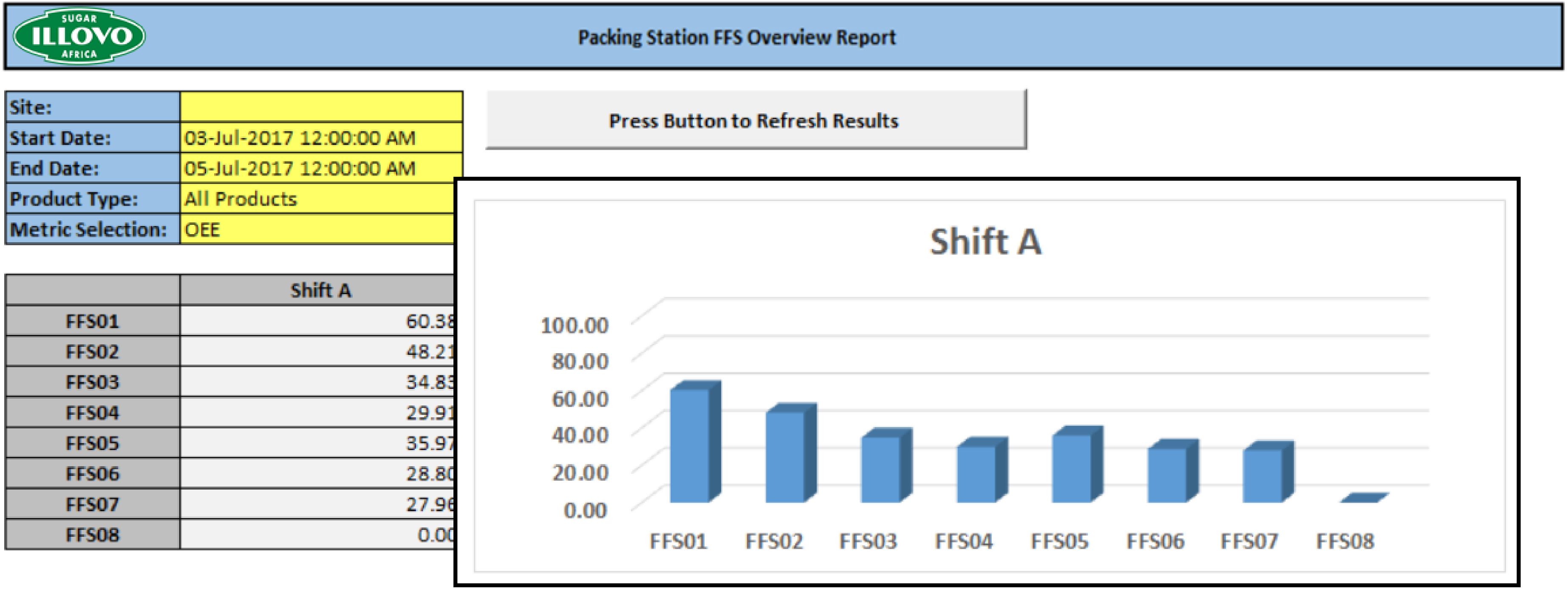
Shift:	All Shifts
Product Type:	All Products

Start Date:	03-Jul-2017 12:00:00 AM
End Date:	05-Jul-2017 12:00:00 AM

Availability	57.67
Performance	50.85
Quality	84.95
OEE	33.80

FFS01
100.00
80.00
60.00
40.00
20.00
0.00
Availability
Performance
Quality
OEE

Use Multiple Filters to Contextualize Data and Highlight Poor Performance Between Shifts



Packing Station FFS Overview Report

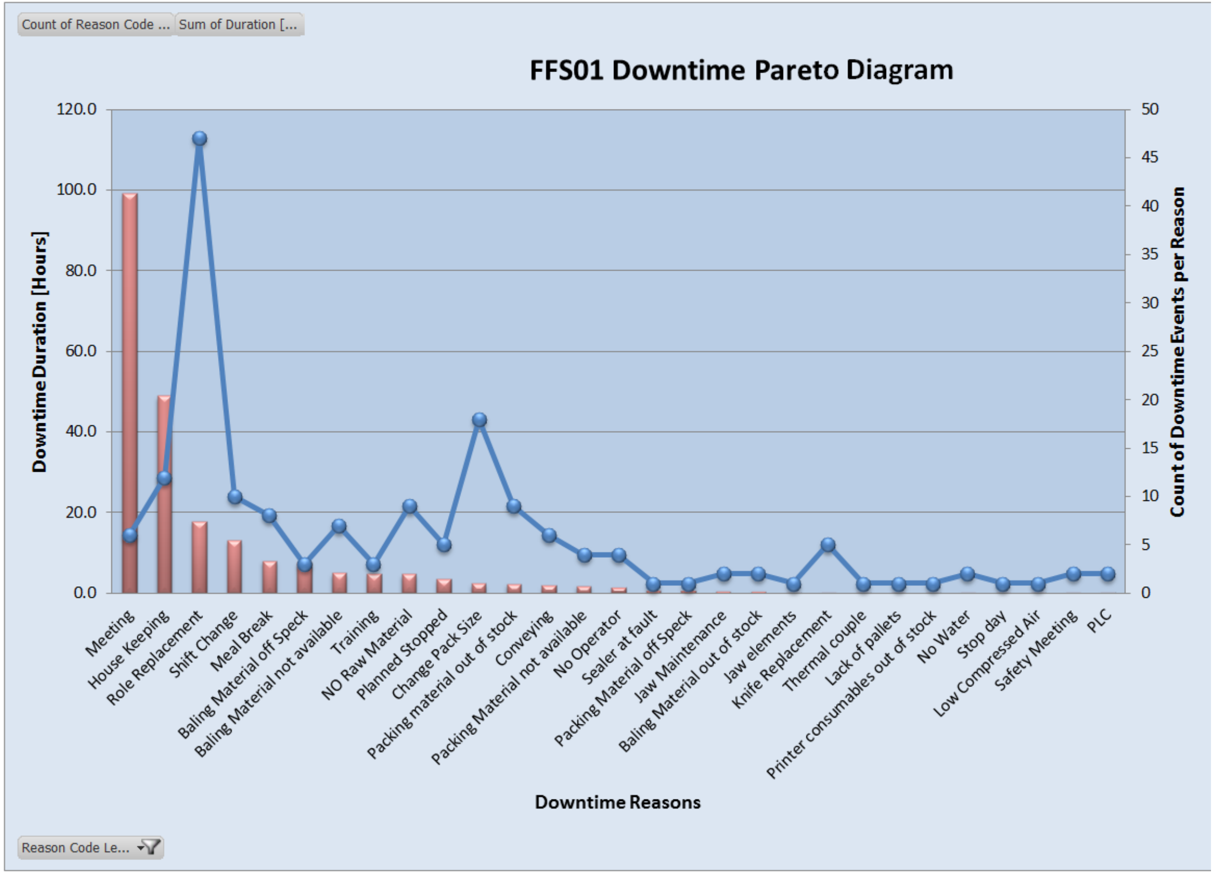
Site:	
Start Date:	03-Jul-2017 12:00:00 AM
End Date:	05-Jul-2017 12:00:00 AM
Product Type:	All Products
Metric Selection:	OEE

Press Button to Refresh Results

	Shift A
FFS01	60.38
FFS02	48.21
FFS03	34.83
FFS04	29.91
FFS05	35.97
FFS06	28.80
FFS07	27.96
FFS08	0.00

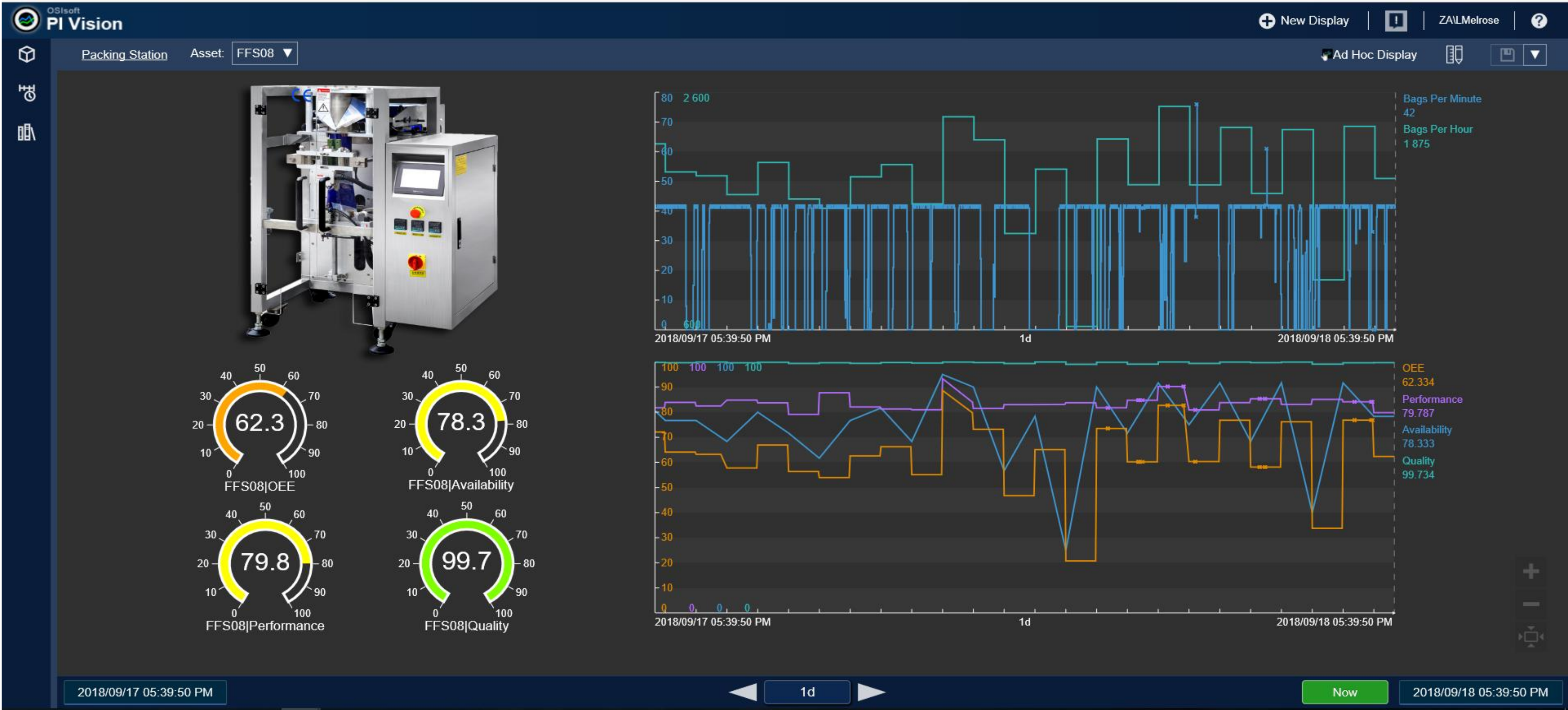
SUGAR ILLOVO AFRICA
Shift A
100.00
80.00
60.00
40.00
20.00
0.00
FFS01
FFS02
FFS03
FFS04
FFS05
FFS06
FFS07
FFS08

Create Downtime Reports Fast Using Event Frames, PI Datalink and Excel Pivot Charts to Highlight “Bad Actors”



Row Labels	Count of Reason Code Level2	Sum of Duration [Hours]
Meeting	6	99.1669
House Keeping	12	48.9323
Role Replacement	47	17.8810
Shift Change	10	13.0331
Meal Break	8	8.0499
Baling Material off Speck	3	7.6832
Baling Material not available	7	5.0999
Training	3	4.8994
NO Raw Material	9	4.7502
Planned Stopped	5	3.4999
Change Pack Size	18	2.4836
Packing material out of stock	9	2.3669
Conveying	6	2.0002
Packing Material not available	4	1.8327
No Operator	4	1.4002
Sealer at fault	1	0.7166
Packing Material off Speck	1	0.6500
Jaw Maintenance	2	0.5333
Baling Material out of stock	2	0.4997
Jaw elements	1	0.3003
Knife Replacement	5	0.2836
Thermal couple	1	0.1500
Lack of pallets	1	0.1331
Printer consumables out of stock	1	0.1331
No Water	2	0.1172
Stop day	1	0.0836
Low Compressed Air	1	0.0667
Safety Meeting	2	0.0500
PLC	2	0.0333
Grand Total	**174**	**226.8299**

Leverage PI Vision and the PI Asset Framework to Create Multiple Dashboards using Templates

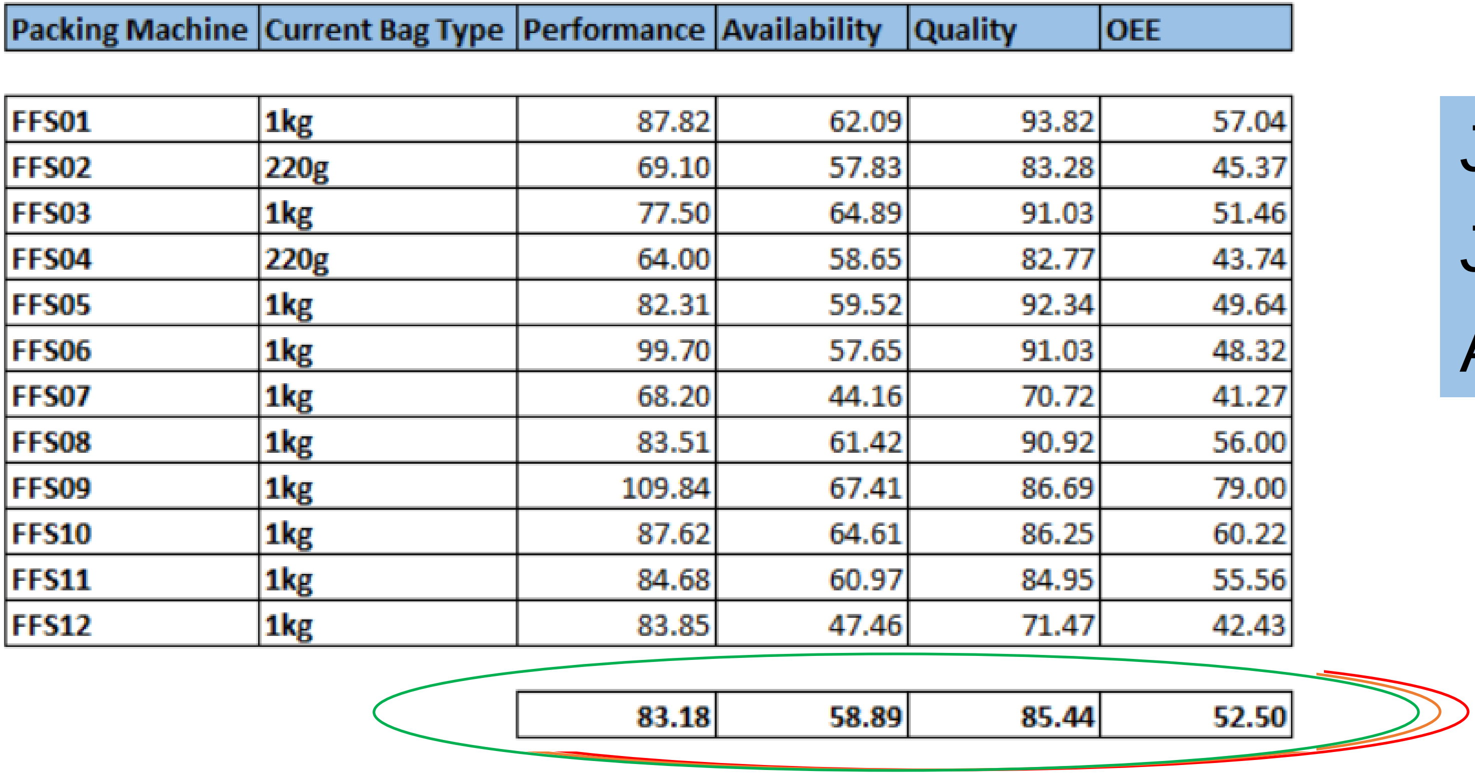


Asset: FFS08

OSIsoft
PI Vision
New Display
ZA\LMelrose
Packing Station
Ad Hoc Display
62.3
FFS08|OEE
78.3
FFS08|Availability
79.8
FFS08|Performance
99.7
FFS08|Quality
0
10
20
30
40
50
60
70
80
90
100
80
2 600
600
2018/09/17 05:39:50 PM
1d
2018/09/18 05:39:50 PM
Bags Per Minute
42
Bags Per Hour
1 875
OEE
62.334
Performance
79.787
Availability
78.333
Quality
99.734
2018/09/17 05:39:50 PM
1d
Now
2018/09/18 05:39:50 PM

Results

Results



Packing Machine	Current Bag Type	Performance	Availability	Quality	OEE
FFS01	1kg	87.82	62.09	93.82	57.04
FFS02	220g	69.10	57.83	83.28	45.37
FFS03	1kg	77.50	64.89	91.03	51.46
FFS04	220g	64.00	58.65	82.77	43.74
FFS05	1kg	82.31	59.52	92.34	49.64
FFS06	1kg	99.70	57.65	91.03	48.32
FFS07	1kg	68.20	44.16	70.72	41.27
FFS08	1kg	83.51	61.42	90.92	56.00
FFS09	1kg	109.84	67.41	86.69	79.00
FFS10	1kg	87.62	64.61	86.25	60.22
FFS11	1kg	84.68	60.97	84.95	55.56
FFS12	1kg	83.85	47.46	71.47	42.43
		83.18	**58.89**	**85.44**	**52.50**

June

July

Aug

Conclusion

Illovo Sugar Africa (Pty) Ltd

Sugar Packing Station Optimization using OEE

CHALLENGE

Improve the performance of FFS packing station enabled by a cost effective, simple reporting system for decision support

- Reliance on shift log sheets for capacity utilization of the FFS packing machines
- Minimal repeatable, reliable data available to highlight controllable constraints for optimization purposes

SOLUTION

A cost effective OEE reporting system implemented using PI AF Analytics for the Sugar FFS Packing Stations

- Real-time information to shop floor
- Improved insight to monitor and optimize performance
- Report on 49 Packing Machines at 5 sites across 3 countries at minimal cost using existing PI infrastructure in 4 months

RESULTS

PI System OEE reporting solution enabled a more focused approach by personnel to improve the performance of the FFS station

- Pilot site Performance improvement of 50% in 3 months
- Pilot site Availability improvement of 25% in 3 months
- Pilot site OEE improvement of 30% in 3 months

OSI Soft South Africa (Pty) Ltd

Wade Potts – Field Service Engineer

Illovo Sugar Africa (Pty) Ltd

Rory van Zyl – Group Continuous Improvement

Alex Janse van Rensburg – Regional Packing Plant Specialist

Group Manufacturing Performance - C&I Department

Computrat cc

Dean Trattles

Credits

Speaker Information

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- Group C&I Engineer
- Illovo Sugar Africa (Pty) Ltd
- lmelrose@illovo.co.za

Questions?

Please wait for the **microphone**

State your **name & company**

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SAN FRANCISCO | APRIL 23-27

謝謝 KEA LEBOHA

DZIĘKUJĘ CI TAPADH LEIBH 고맙습니다

NGIYABONGA GRÀCIES БАЯРЛАЛАА MISAOTRA ANAO SALAMAT

TEŞEKKÜR EDERIM OBRIGADO شكرا

KÖSZÖNÖM DANKIE TERIMA KASIH DANKON TANK TAPADH LEAT

СПАСИБО MULȚUMESC

OSIsoft PI World

РАКМЕТ СІЗГЕ HVALA FAAFETAI

GO RAIBH MAITH AGAT ESKERRIK ASKO

БЛАГОДАРЯ GRACIAS MAHADSANID HVALA ХВАЛА ВАМ

THANK YOU

ТИ БЛАГОДАРАМ TEŞEKKÜR EDERIM

DANK JE ΕΥΧΑΡΙΣΤΩ GRATIAS TIBI ДЗЯКУЙ GRAZIE

TAK DANKE

AČIŪ SALAMAT MAHALO IĀ ʻOE TAKK SKAL DU HA DI OU MÈSI

RAHMAT MERCI

GRAZZI ÞAKKA ÞÉR FALEMINDERIT ありがとうございました ĎAKUJEM

HATUR NUHUN РАХМАТ САҒА SIPAS JI WERE TERIMA KASIH MATUR NUWUN

CẢM ƠN BẠN UA TSAUG RAU KOJ

WAZVIITA ТИ БЛАГОДАРАМ

СИПОС