

Improving Manufacturing Intelligence Through Digitally Connected Operations



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Stefano Pandini (Sr. Manager, Business and System Integration, Kennametal)

Description: During the past 29 years, Stefano Pandini has been focused on delivering ERP solutions, with an emphasis on SAP implementation throughout the past 17 years. During this time Stefano has served in multiple roles from project manager and process lead to subject matter expert across different business areas, including marketing to supply chain. His current role is business and system integration with a focus on end to end processes.

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Barry Weaverling (Sr. IT Business Solutions Analyst, Kennametal)

Description: During the past 23 years, Barry Weaverling has been focused on delivery ERP solutions, with an emphasis on the SAP Production Planning and Quality Management modules along with supporting the North American shop floor system. During this time Barry has served in multiple roles from support to SAP implementations. His current role is business solutions analyst with a focus on the application processes.

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Jay Monahan (Senior Director – ERP Manufacturing Portfolio – SAP)

Description: or over 20 years, Jay Monahan has focused on designing, delivering and managing software solutions from the ERP to the Shop Floor. During this time, Jay has served as a practice lead, project manager and subject matter expert across both process and discrete industries. Current role is to support the NTT SAP ERP manufacturing portfolio through strategic alignment with our customers and SAP, to maintain and expand our existing offerings.

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[Video](#)

At a glance

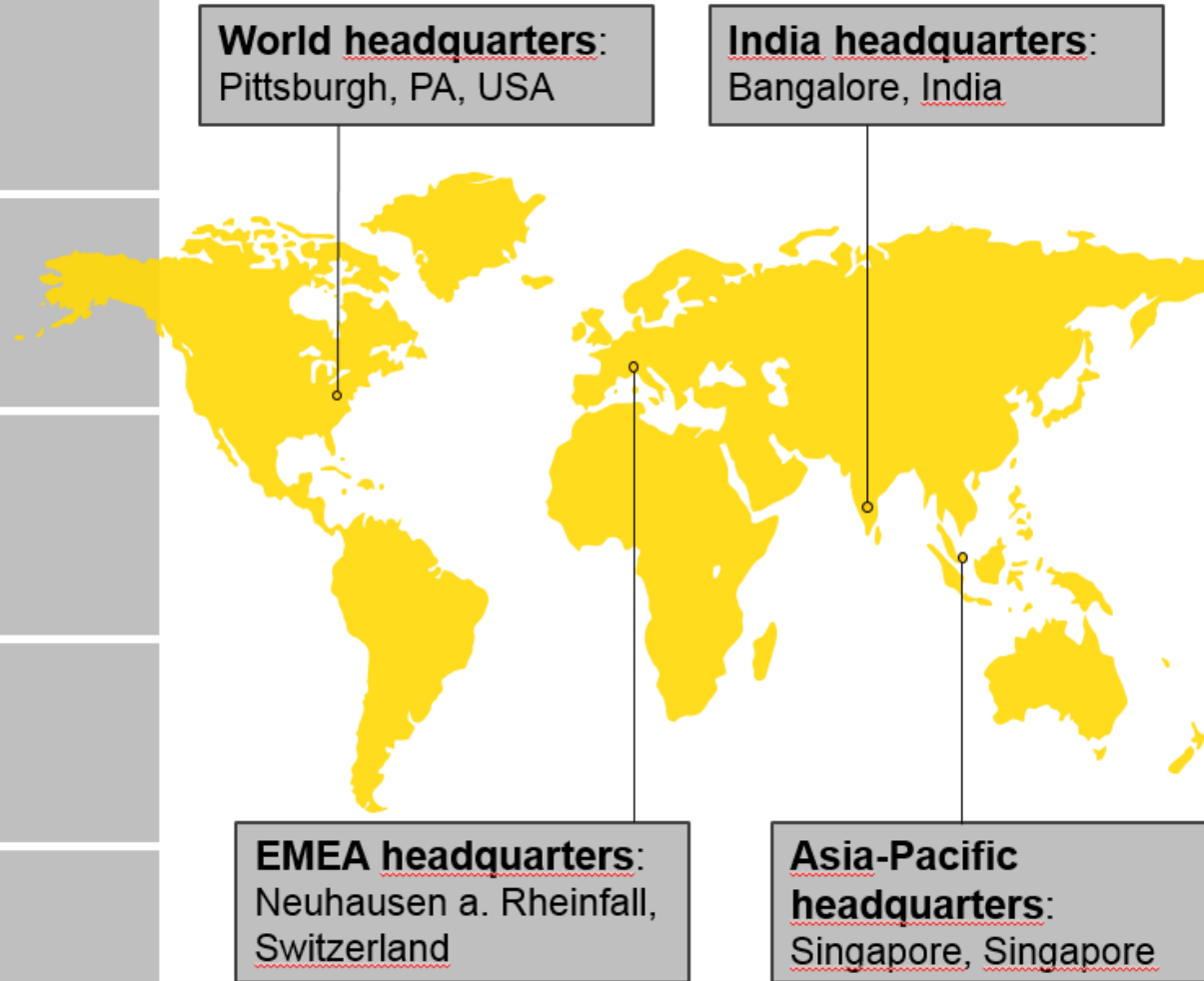
11,000
EMPLOYEES

\$2.1 BILLION
IN REVENUES

80,000
CUSTOMERS

>60
COUNTRIES

1,500
ACTIVE PATENTS



Three newly-defined Business Segments

INDUSTRIAL

Kennametal Tooling and Metalworking Services



INFRASTRUCTURE

Engineered Products, Precision Surface Management and Life Extension Solutions

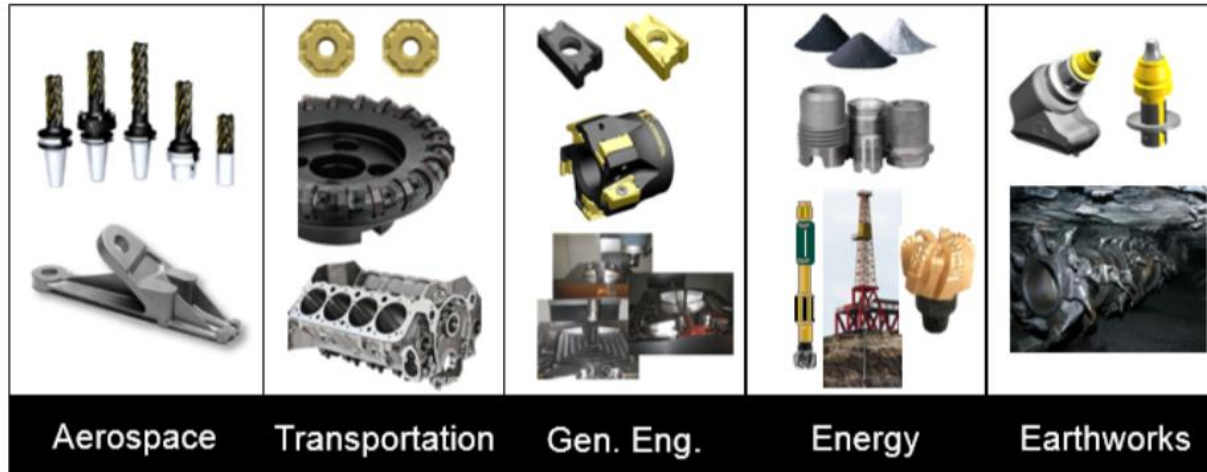


WIDIA

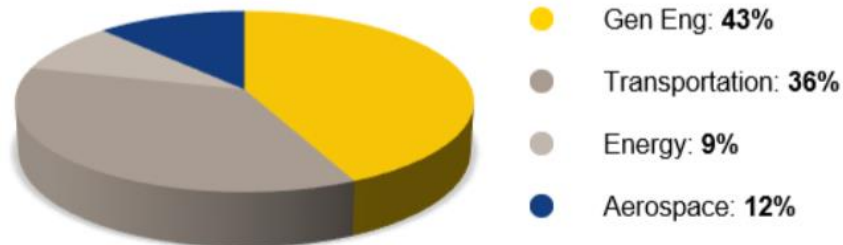
WIDIA Products Group



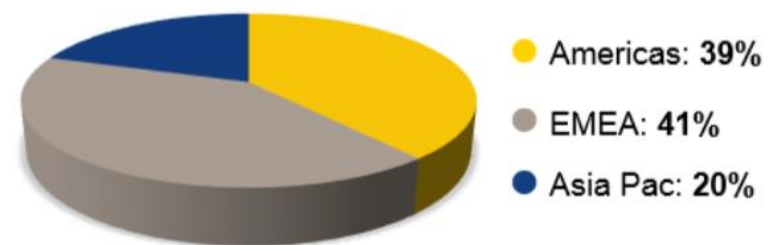
Focusing on core end markets to grow organically around the globe



Sales by End Markets

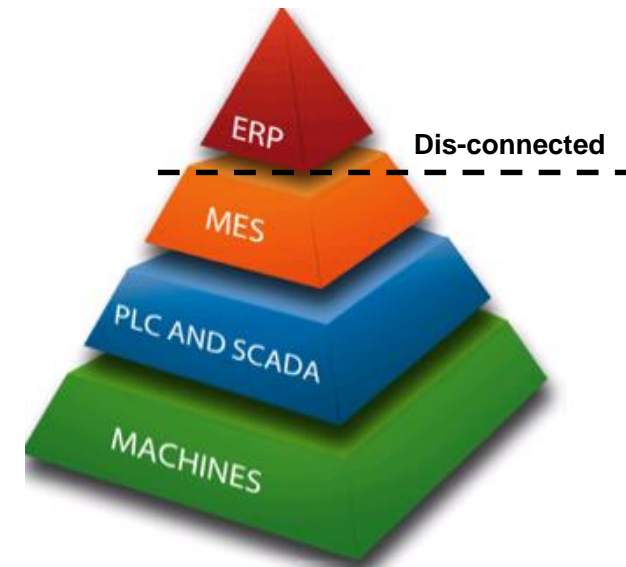
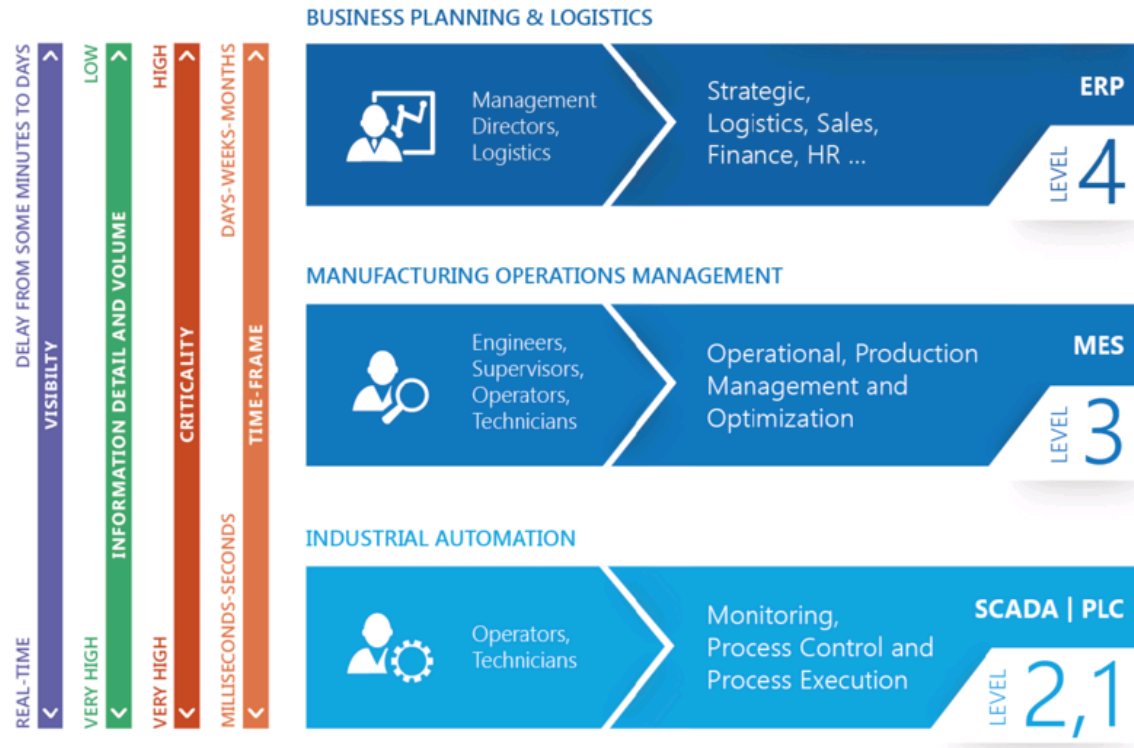


Sales by Geography



Why did we look at SAP MII?

There has been an increasing demand for closing the loop on disconnected shop floor processes and we searched the market for Manufacturing Operations Management applications. We found that the strongest synergy was within SAP MII as we are running a global SAP ERP platform. To compete in next generation of manufacturing, we need to empower our shop-floor.



Business Challenges

- The plant has various shop floor data collection systems that are outdated.
- Real Time visibility of people, material, and machines.
- Supervisors have to spend more time on computers than on the floor.
- Prioritizing orders at machine level based on changing requirements.
- PLM data is not easily accessible from shop-floor.
- Performance feedback doesn't exist.
- Multiple digital solutions but disconnected.
- Cell Dashboards either not present or manually updated.
- Data Quality reported to ECC is not the best.
- Operators don't have all information and tools before setup.
- Machine integration/automations

Project Life

Project Background

- NTT first introduced into Kennametal in 2014.
- Initial project began in 2015 for shop floor strategy.
- Implemented at first plant in December 2015.
- Rolled out the solution to 2 more plants in 2016.
- Phase 2, approved in May 2016, focused on further enhancements and deployments.

Phase 1: Scope

- Leverage SAP MII as primary operator interface for shop floor data registration and interface to SAP ECC system.
- Deploy SAP MII at Pilot plant in Solon, Ohio.
- Original Estimated Timeframe: 16 weeks.
- Rolled out SAP MII solution to two more plants.

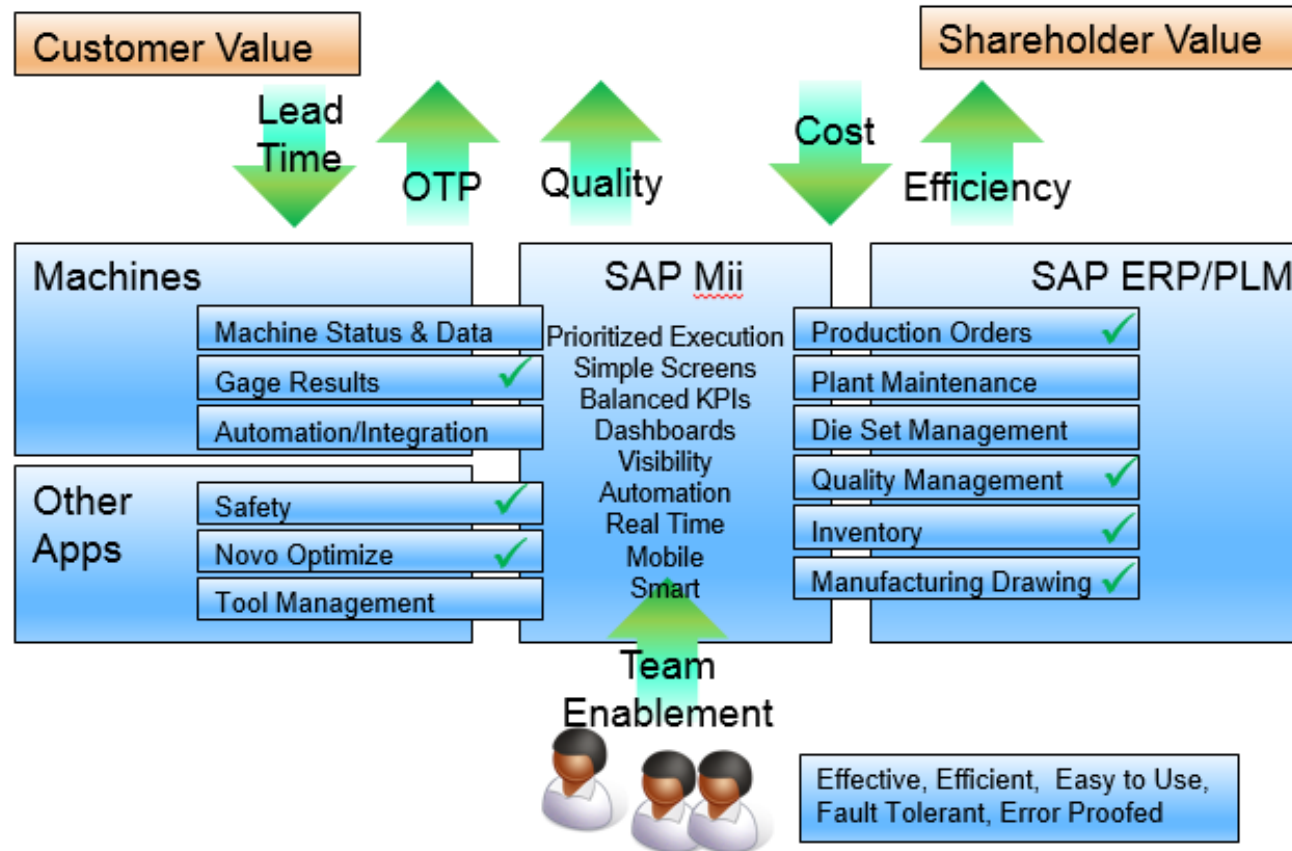
Phase 2 :Scope

- Deploy SAP MII solution to additional 5 locations
- Enhance SAP MII solution with few additional enhancements to improve data quality and optimize some screens help the operator

Phase 3 : Scope - Current

- Continue to deploy the solution to additional 17 sites
- Develop additional functionality to manage and schedule the load of our batch processes
- Manage Confirmation in SAP MII
- Machine integration & OEE
- Preparing phase 4 to complete the deployment to all sites and continue Machine integration

Kennametal Vision

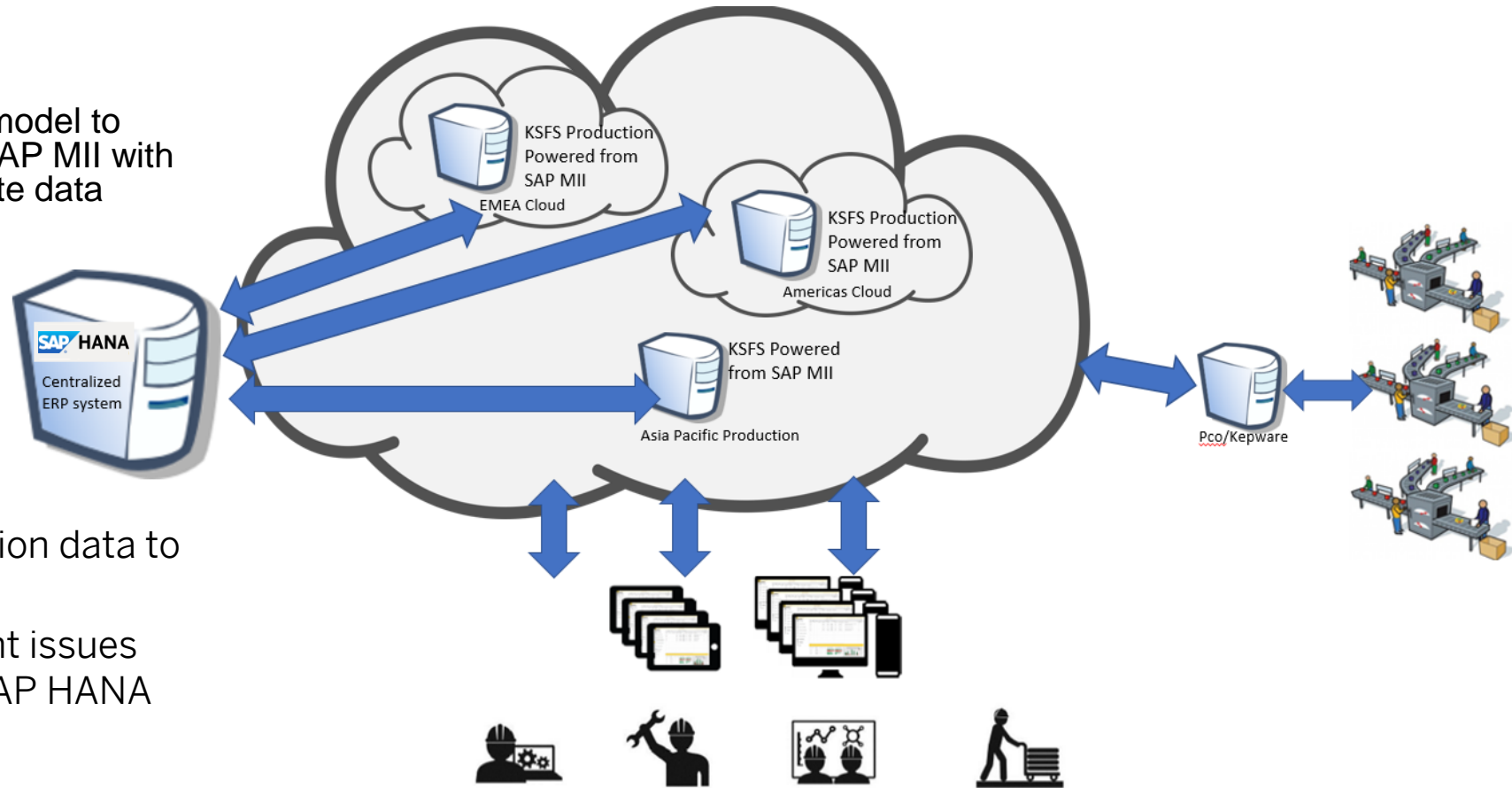


We've Covered the Basics, Let's Move the Needle

System Architecture

SAP HANA:

Big data model to support SAP MII with appropriate data



SAP MII:

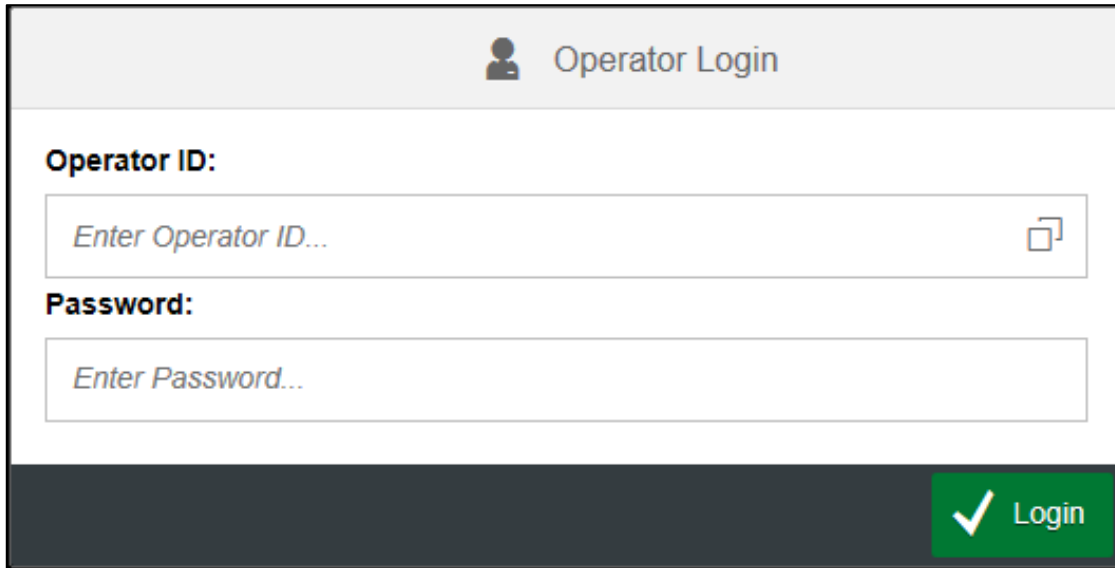
- Send Confirmation data to SAP HANA
- Send component issues movement to SAP HANA
- OEE

Key Strategy: Invest in the Network , Palo Alto security , re-cabling our plants

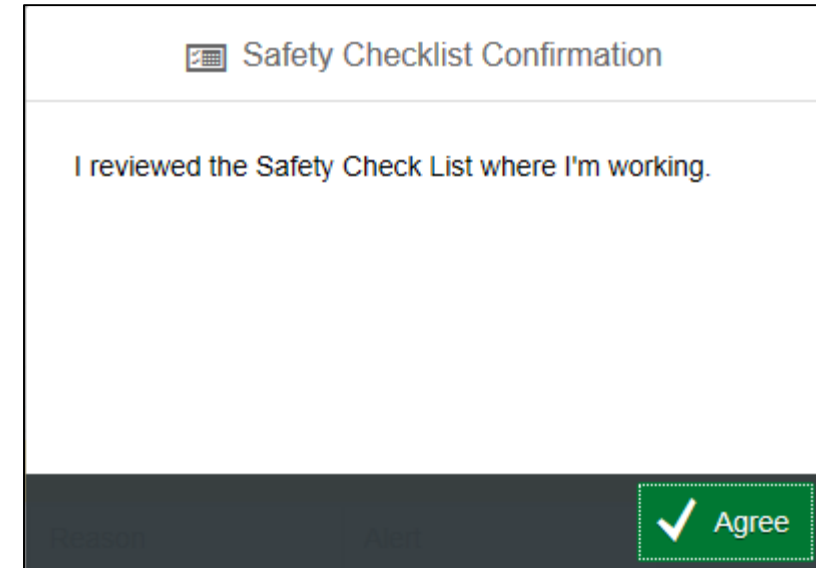
Current Functionality

- Operator Dashboard
 - Operator Login
 - Order Confirmations (Time Event Start/Stop, Normal, Collective)
 - Order Overview (Header, Operations, Documents, Inspection Lots)
 - Component Issue
 - Indirect Labor
 - Request Help
 - Drawing access
 - Quality management
 - Mark pack machine integration
- Supervisor Dashboard
 - Work Center level alerts
 - Resolve help
 - Manage Confirmations
- Cell Dashboard
 - Daily OEE
 - Actual vs Target
 - Schedule Adherence
 - Work In Progress

Operator Login




The screenshot shows the 'Operator Login' interface. At the top, there is a header with a person icon and the text 'Operator Login'. Below this, there are two input fields. The first is labeled 'Operator ID:' and contains the placeholder text 'Enter Operator ID...' with a small icon of two overlapping squares to its right. The second is labeled 'Password:' and contains the placeholder text 'Enter Password...'. At the bottom right of the form, there is a green button with a white checkmark and the text 'Login'.





The screenshot shows the 'Safety Checklist Confirmation' interface. At the top, there is a header with a checklist icon and the text 'Safety Checklist Confirmation'. Below this, there is a text area containing the statement 'I reviewed the Safety Check List where I'm working.'. At the bottom right, there is a green button with a white checkmark and the text 'Agree'.


- Standard NetWeaver Login.
- Crew Primary User Logs then subsequent users are logged in to allow multiple user working for one PC.
- Safety check list check is performed every 20 hours by plant/employee.


Operator Dashboard



Operator Dashboard
25412135
VWANDHS


 Assign


 DeAssign


 Start/Resume


 Pause


 Complete


 Start/Resume


 Pause


 Complete


 Normal

 Collective

 Comp Issue

 Request Help

 Refresh

 More Options

MACHINE ALLOCATION
SETUP
RUN
CONFIRMATIONS
ACTIONS

Total Order Count : 20
Total Order Qty : 698
Only my orders

Op Status	Ord #	Op #	Op Short Txt	Plan Qty	Ord Froz Dt	Op Days Conf	Op St Dt	Op St Dt Diff	Machine #	Operator	Recom #	Priority	Matl #	Matl Desc
RUNNING	114990995	0020	MACHINE THE...	61	10/28/2015	311	10/14/2015	547	801782	VWANDHS	0		2258042	KTIP DRILL BOD...
STOP	114990082	0020	MILL THE BACK...	10	11/05/2015	0	10/12/2015	549	801782	VWANDHS	0		3958167	K-TIP D 8.5 MM...
RUNNING	114955919	0020	MACHINE IN TH...	30	10/20/2015	0	10/08/2015	553	801782	VWANDHS	0		3025730	KTIP095R5SS10...
PARTIAL	114974648	0020	MACHINE IN TH...	50	10/22/2015	0	10/12/2015	549			0		2485917	KTIP0571R3SS0...
PARTIAL	114990992	0020	MACHINE DRILL...	49	10/23/2015	0	10/13/2015	548			0		2250690	KTIP DRILL BOD...
STOP	114955913	0020	MACHINE IN TH...	45	10/26/2015	0	10/14/2015	547	801782	VWANDHS	0		2485900	KTIP0374R3SS0...
RELEASE	115006546	0020	MACHINE THE...	47	10/23/2015	0	10/15/2015	546			0		2268307	KTIP DRILL BOD...
PARTIAL	114820368	0020	MACHINE IN TH...	40	09/08/2015	0	10/19/2015	542			3	R	2485907	KTIP0492R3SS0...
PARTIAL	114862963	0030	MACHINE IN TH...	70	10/09/2015	0	10/19/2015	542	801782	VWANDHS	1	R	2485887	KTIP0492R5SS0...
RELEASE	114955910	0020	MACHINE IN TH...	30	10/16/2015	0	10/19/2015	542			1	R	2485875	KTIP0335R5SS0...
RELEASE	114955940	0020	MACHINE IN TH...	40	10/16/2015	0	10/19/2015	542			1	R	3025745	KTIP110R5SS12...

Suresh Andhale Machine Status

Work Center	Machine #	Machine Desc.	Oper.Count	Ord #	Oper. #	Status	Reason	Alert	PLND QTY	CONF QTY	Setup (Actual / Planned)	Process (Actual / Planned)
21012028	700159	700159	1	114878831	0050	STOP	07-13 16:12	●	1	0	3067.05H Vs 3.00H	636.58H Vs 1.00H
33411001	700174	700174	1	114985332	0020	SETUP STOP		●	7	0	12.00Min Vs 58.20Min	0.00H Vs 1.33H
43011001	700175	700175	2	114985075	0010	SETUP COMP		●	2	0	0.02H Vs 1.00H	0.00Min Vs 21.72Min
25500006	801360	801360	1	115024729	0010	RUNNING		●	500	0	6.00Min Vs 35.28Min	6666.72H Vs 242.00H
25611001	801500	801500	4	115010378	0010	SETUP COMP		●	2	0	1.02Min Vs 51.00Min	0.00Min Vs 30.00Min

- Order Load List which is pre-sorted based on configurations possible at Plant/ WorkCentre level.
- Machine Summary: Show orders users is working on; Actual vs Planned time graphs.
- Start/Pause/Complete Order, Additional Functionality: Component Issue, Order Overview, Add Comments.

Order Overview

Order Overview

Production Order:

Order Header | Operations | Components | Documents | Inspection Results

Order #: 114990082	Order Type: OT03	Qty Planned: 10	Initial Scrap: 0
Priority: R	Recommit #: 000	Frozen Date: 11/05/2015	Routing Long Text:
Customer #: 0070742623	Cust. Name:	Sales Order: 0023602113 - 000020	Brand:
Material #: 3958167	Material Desc: K-TIP D 8.5 MM DRILL	Material Group: 39	Src Material Group: MCV01340002
ANSI: DWG 1817622	ISO: DWG 1817622	Grade/Matrix:	Document: 1817622
Comments: <input type="text" value="---"/>			Show less...
Start Date: 10/08/2015	End Date: 11/02/2015	Commit Date: 00/00/0000	Hone Specs:

Close

- Order header level details; add/update order level comments which will be visible on dashboard.
- Check all the operation status details.
- View associated documents & perform inspection result related tasks.

Time Event Confirmation

Event Confirmation - Run Complete

Prod. Order / Operation:	<input type="text" value="Order..."/>	<input type="text" value="Operation..."/>
Machine / Work Center:	<input type="text" value="Work Center..."/>	
Confirmation Type:	<input type="radio"/> Partial <input type="radio"/> Final	
Complete / Rework / UOM:	<input type="text"/>	<input type="text" value="Rework..."/> <input type="text" value="UOM"/>
Scrap / Reason for Scrap:	<input type="text" value="Scrap..."/>	<input type="text" value="Reason..."/> <input type="button" value="+"/>

Next Operation

Plant	<input type="text" value="Plant"/>
Operation	<input type="text" value="Operation"/>
Description	<input type="text" value="Description"/>
WorkCenter:	<input type="text" value="WorkCenter:"/>
Comments	<input type="text" value="Comments"/> <input type="button" value="Save"/>

Event Confirmation - Setup Start

Prod. Order / Operation:	<input type="text" value="115006546"/>	<input type="text" value="0020"/>
Machine / Work Center:	<input type="text" value="Machine..."/>	<input type="text" value="25412135"/>

Event Confirmation - Run Interrupt

Prod. Order / Operation:	<input type="text" value="114955919"/>	<input type="text" value="0020"/>
Machine / Work Center:	<input type="text" value="801782"/>	<input type="text" value="25412135"/>
Reason:	<input type="text" value="Safety Audit"/>	

- Possible Time Events:
 - Setup: Start, Pause, Partial Complete or Complete.
 - Run/Process: Start, Pause, Partial Complete or Complete.
- Report completed quantities with rework or any scrap with reason codes.

Normal Confirmation

Normal Confirmation

Prod. Order / Operation:

Work Center:

Confirmation Type: Partial Final

Complete / Rework / ...:

Scrap / Reason for S...:

Next Operation

Plant:

Operation:

Description:

WorkCenter:

Comments:

Setup time: Machine ti...: Labor time:

Activity 4: Activity 5: Activity 6:

- User can select order from list or can directly click [Normal confirmation] button to start the normal confirmation.
- Report completed quantities with rework or any scrap with reason codes.
- Report data for required activity types (e.g. Setup, machine, labor etc.).
- User can see what is the next operation and work center

Collective Confirmation

Collective Confirmation

+ Add Row

Machine Number :
WorkCenter :
Conf Type :
Heat Number :

	Order	Opr.	Machine #	Work Center	Conf. Type	Complete	Scrap	Reason for...	Rework	Qty UOM	Activity1	Activity2	Activity3
X	114955910	0020	801782	25412135	Final	124	Scrap		Rework	Qty UOM	0.588 STD	0.000 UOM	0.000
X	114955940	0020	801782	25412135	Final	Complete	Scrap		Rework	Qty UOM	0.588 STD	0.000 UOM	0.000
X	114955942	0020	801782	25412135	Final	Complete	Scrap		Rework	Qty UOM	0.588 STD	0.000 UOM	2.800
X	115008916	0020	801782	25412135	Final	Complete	Scrap		Rework	Qty UOM	0.588 STD	0.000 UOM	2.250
X	115008917	0020	801782	25412135	Final	Complete	Scrap		Rework	Qty UOM	0.059 STD	0.000 UOM	1.288
X	115008918	0020	801782	25412135	Final	Complete	Scrap		Rework	Qty UOM	0.059 STD	0.000 UOM	11.200
X	115009000	0020	801782	25412135	Final	Complete	Scrap		Rework	Qty UOM	0.588 STD	0.000 UOM	0.616
X	115009001	0020	801782	25412135	Final	Complete	Scrap		Rework	Qty UOM	0.706 STD	0.000 UOM	4.032

Save
Cancel

- Mainly used by Work Centers who run multiple orders at a same time e.g. Heat Treatment.
- Select multiple Production Orders from the list (press and hold the Shift key while selecting orders) alternatively scan order operation which will pull the default order details.
- Fill out details (partial, scrap, rework, reason for variation etc.), Machine/Furnace number, Conf. type : Final or Partial

Component Issue

Component Issue

Production Order:

Issue Components Include Fully Withdrawn ↻

Item #	Material #	Material Desc	Planned Qty	Withdraw Qty	Issue Qty	UoM	SLOC	Batch	Final Issue	Bin #	Operation #	Reqd Date
<input type="checkbox"/>	0020	2259960	KTIP WRENCH D=12.00[0.473]-13.99[0. CVW1	61	0	61	ST	0001	<input type="checkbox"/>	WH2 8C1	0060	10/19/2015
<input type="checkbox"/>	0030	4002523	QP 35 120 NATURAL PE OUTER	61	0	61	ST	0001	<input type="checkbox"/>	PACKAGING	0060	10/19/2015
<input type="checkbox"/>	0040	3998943	QP 35 120 NATURAL PE INNER	61	0	61	ST	0001	<input type="checkbox"/>	PACKAGING	0060	10/19/2015
<input type="checkbox"/>	0050	4008567	KMT Label 5 K-2106EX	62	0	62	ST	0001	<input type="checkbox"/>	PACKAGING	0060	10/19/2015

Check Stock


Material #	Plant	SLOC	Stg. Bin	Batch	Qty.Unr	Qty.UOM
2259960	CV01	0001	WH2 8C1		195	ST


Close


✔ Select Batch
✘ Close


- Issue the required components.
- Enter Issue Quantity, Storage Location and Batch.
- Check the Stock.

Indirect Labor

 Indirect Labor



Work Center (Emp Default): 

Work Center (Work Perf At): 

Reason: 

Work Order #:


Indirect Labor Hours:


 Save  Cancel

- Select Indirect Labor and fill out details (Reason, Work Order #, Hours).

Request Help

? Help

Work Center: 

Machine Number: 

Prod. Order / Operation:

Comments:

- To request HELP, click on “Request Help” icon.
- User can enter Machine number and Production Order number - both are optional.
- Supervisor will see the help notification on his or her dashboard.

Supervisor Dashboard

Supervisor Dashboard

★ WLINDJ

Work Center Summary
 Only Work Centers with Operations

Totals		24/209	24	1783509	3249	958	0			
Help	WC # - WC Name	Machine Active	Operators at...	Sum of Qty	Count of Operations	Daily Qty Confirmed	Daily Qty Scrapped	OTD to Finish Date	OTP to Frozen Date	Alert
	PRCSTAHL	0 / 1	0	14326	32	0	0	Red	●	
	PRCTB11	0 / 1	0	7349	22	0	0	Red	●	
	PRCTB18	0 / 1	0	1627	4	0	0	Red	●	
	PRCWAID	1 / 15	1	47329	70	0	0	Red	●	●
	PRCWAX -	0 / 1	0	12533	18	0	0	Red	●	
	PRCWBO -	0 / 1	0	0	0	0	0			
	PRCWNDT -	1 / 16	1	33007	58	0	0	Red	●	●
	PRB15TS -	0 / 0	0	0	0	0	0			
	PRS20T	0 / 0	0	2682	5	0	0	Red	●	
	PRS30TM	0 / 0	0	3623	11	0	0	Red	●	
	PRS3R -	8 / 11	10	134134	252	958	0	Red	●	●
	PRS3RRK	0 / 0	0	0	0	0	0			
	PRS50TM	0 / 0	0	1440	4	0	0	Red	●	

Machine Status To do list

Machine #	Machine Desc.	Oper...	Ord #	Oper. #	Status	Reason	Alert	Operator	PLND QTY	CONF QTY	Setup (Actual / Planned)	Process (Actual / Planned)
00001274	1274	2	114981499	0036	PARTIAL			---	652	100	0.00Min Vs 39.60Min	0.00H Vs 10.82H
00001275	1275	3	114985044	0050	SETUP COMP		●	---	896	0	0.20H Vs 1.00H	0.00H Vs 18.28H
00001276	1276	0	---	---				---	---	0	0H Vs 0H	0H Vs 0H
00001398	1398	0	---	---				---	---	0	0H Vs 0H	0H Vs 0H
00001399	1399	0	---	---				---	---	0	0H Vs 0H	0H Vs 0H

22

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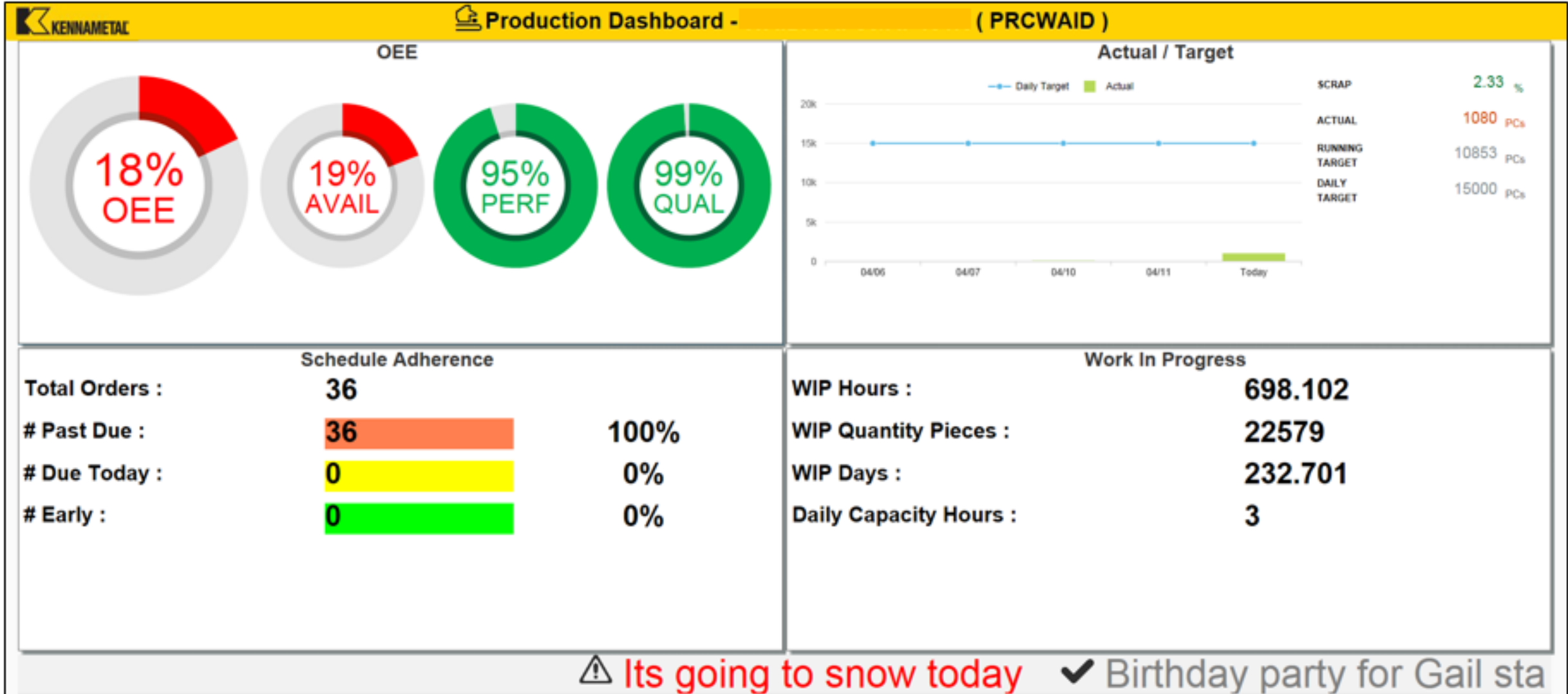
- Summary view of all WorkCentre (or list of favorite work centers).
- If help icon is present in first column that means someone requested help.
- Once the issue is resolved, please click resolve and enter resolution text. This will also close the requested help.
- Alert based on current status of the order.
 - If setup for any production order in that work center takes 120%+ of routing time.
 - If run for any production order in that work center takes 120%+ of routing time.
 - If the setup or run is in pause state for more than 30 minutes.
 - If there is a delay of more than 30 minutes between Setup complete and Run Start.
- To know more details about the work center alert, please select the work center and review information in Machine Status and To-Do List to see the reason of alert.

Manage Confirmations

KENNAMETAL Manage Confirmations																
Production Order :		114981499		Operation :				Get Confirmation Details								
Normal Confirmation		Delete / Re-Confirm Time Event		Save		Cancel		Sync Confirmations From ECC to MII								
Delete	Edit	Prod Order	Oper Num...	Oper Counters	Status	Machine	Act WC	Post Date	Date Time	Qty Conf	Qty Scrap	Qty UOM	Reason	Conf Type	Setup	Setup UOM
		000114981499	0010	00000001	CNF	00052412	PRS3R	07 Oct 2015		680	0	PC		Final	0	MIN
		000114981499	0010	00000002	CNF	00052412	PRS3R	07 Oct 2015		0	3	PC	3615	Final	0	MIN
		000114981499	0010	00000003	CNF	00052412	PRS3R	07 Oct 2015		0	12	PC	3455	Final	0	MIN
		000114981499	0020	00000001	CNF	00031059	TIPSET	08 Oct 2015		674	0	PC		Final	0	MIN
		000114981499	0020	00000002	CNF	00031059	TIPSET	07 Oct 2015		0	6	PC	4258	Final	0	MIN
		000114981499	0030	00000001	CNF	00005304	SNTRPR	09 Oct 2015		674	0	PC		Final	0	MIN
		000114981499	0032	00000001	CNF	00024814	PRCTB18	12 Oct 2015		0	0	PC		Final	0	MIN
		000114981499	0034	00000001	CNF	00024814	PRCTB18	12 Oct 2015		673	0	PC		Final	0	MIN
		000114981499	0036	00000001	PCNF	0001274	PRCWAI	28 Feb 2017		100	0	PC		Par...	30	MIN
		000114981499	0036	00000002	PCNF	0001274	PRCWAI	02 Mar 2017		100	10	PC	D510	Par...	0	MIN
		000114981499	0036	00000003	CNF	0001274	PRCWAI	06 Mar 2017		200	50	PC	D510	Final	0	MIN

- Manager (Delete, Add) confirmation directly in SAP
- Used by Supervisors to correct the bad data entered by Operator or to correct the confirmation entered by mistake

Work Center Dashboard



- Displayed on the overhead monitor in a cell or work center
- OEE Dashboard
 - Availability : Based on data using PCo Interface when machine is connected. If machine not connected based on the confirmations done by the operators.
 - Quality : Based on Good Quantity vs Scrap Quantity produced. It is not based on time lost due to scrap quantity.
 - Performance : The standard time is in the operation level in the routing. The standard machine activity (ACTIVITY02) time will be used.
- Actual vs Target
 - Last 5 day actual quantity vs target quantity for the work center
- Schedule Adherence
- Work in Progress
- Notification Banner

Future Plans (Short Term)

- Operator Dashboard
 - Collective Confirmation for Sintering , PVD work center - Put the results directly in SAP QM - Inspection Plans.
 - Collective Confirmation Bus (list of order/operation).
- OEE Dashboard
 - Plant, Work Center and Machine level OEE based on the date range.
 - Scrap quantity by Work Center, machine and operator.
 - Top scrap reasons by work center, machine and operator.
 - Integration with machine using MTConnect, OPC and PCo 15.1 for availability calculations.
- Work Center Group/ Tree Structure
 - Work Center Tree - Group, Sub group, work center's in tree with summarize data.
- Machine integration
 - Deploy more machine integration to reduce unnecessary time spent from the operator
 - Leverage more automation and machine optimization
 - Mark/Pack machine Integration
 - Integrate Automatic mark pack machine with SAP using SAP MII.
 - Sent the production order details to Mark/Pack machine
 - Interface the data read from the machines to SAP QA for specific tags.
- Rollout of current solution to the plants in Europe and replace the legacy system

Future Plans (Long Term)

- Top 2 Bottom integration
 - End to End optimization of product flow, automation and machine Integration.
- Scheduling/Sequences
 - In ERP (front end scheduling) to automatically schedule 80% of the orders.
 - Capacity, scheduling
 - Sequencing at machine level
 - Better tool management.
 - SPC control using SAP or another tool.

- **Benefits:**

- Real time performance and goal achievement visibility
- Improved Actual time recording enabled optimized product costing processes
- User friendly / easy to learn for shop floor operators.
- Eliminated Interface errors through Real time integration with ERP.
- Component Consumptions and Quantity confirmations as they happen.
- Improved financial overview of production operation.
- Improved data enabled detailed reporting and metrics of factory performance
- Supervisor more on the floor (mobile devices).

- **Lessons Learned:**

- SAP MII is just a system. To move any needle power users have to work by work center with operators, supervisors and lean methods
- Initial priority on “User Adoption” is ok but shift focus to “Move the Needle” on business outcome.
- Installation/configuration of local hardware setup to support existing shop floor footprint.
- Scope discussions exploded once the real potential was understood by stakeholders and group governance.
- We can actually run agile project mode faster then anticipated, we did from zero to go-live in 4 months.
- Good Key User framework (SAP MII and SUITE on HANA) critical for success.