



Making the Connection: Real-time Manufacturing Execution Systems (MES) and Industry 4.0

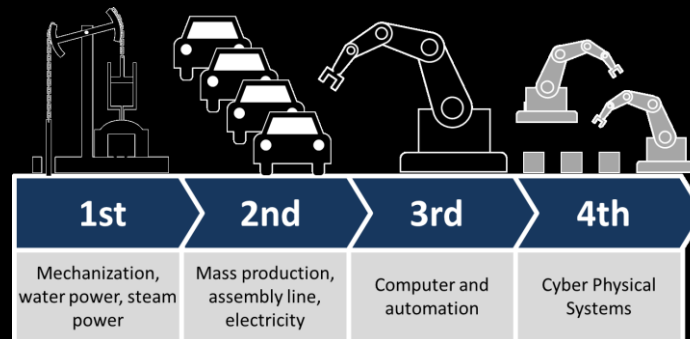
Andrew Jewell – MES Consultant



Classic Definition of “Industry 4.0”

Industry 4.0 creates what is or can be called a **"smart factory"**. Within the modular structured smart factories, cyber-physical systems monitor physical processes, create a virtual copy of the physical world and make decentralized decisions.

Over the **Internet of Things**, cyber-physical systems communicate and cooperate with each other and with humans in real time, and via the Internet of Services, both internal and cross-organizational services are offered and used by participants of the manufacturing value chain (Wikipedia).





What is the objective of “Industry 4.0”?

- **Inter-operability:** The ability of machines, devices, sensors and people to connect and communicate with each other via the Internet of Things (IoT)
- **Transparency (of Information):** Real-time transmission of key raw sensor and machine data to higher level (and higher-value) information systems i.e. shop-floor to top-floor/manufacturing to global enterprise systems... sensor to eventual Enterprise ERP and BI
- **Technical assistance:** Easy to interpret information for allowing individuals to make more well-informed decisions and solving urgent problems in real-time. Also, to support people by conducting a range of tasks that are repetitive, mundane, exhausting, unsafe and so on
- **Decentralized decision-making:** Localised controls and systems make/take local decisions (as far as possible). Exceptions are interference and conflicting goals (that require higher level computer and/or human input).



How does this translate into (real-world &) real-time MES?

The basic principle of Industry 4.0 is that by **connecting sensors, machines and software systems (including people)**, businesses are creating more intelligent and quicker networks along the entire value chain that can more automatically and autonomously control each other and create “added value” (increased productivity/profitability) in the process.

Example: Software/machines that can predict a failure and trigger a maintenance process autonomously (prior to an unscheduled/catastrophic failure).

Production, machines, equipment and people will become more and more networked until everything is inter-linked with everything else.

In an Industry 4.0 scenario, the boundaries of individual factories will most likely no longer exist. Instead, they will be lifted in order to inter-connect multiple factories across multiple geographical regions.



Problem resolution:

OEE got better ...
but nothing
else did.

SPC/SQC...what's
the best way to
tackle it?

New machine or
different
maintenance
schedule?

We **have** data ...
why does it take so
long for answers?

Production
problems cause
schedule conflicts.

Why are some shifts
better than the
others?

Does this sound like your plant?

We can't take on more
business unless we
buy more machines.

...but the ERP
system says we can
complete all these
orders today...

We calculate OEE
how many different
ways???

Let's do something
to avoid recalls.

We're
[not] capacity
constrained.

Why are our
machines not
running
consistently well?

What can we do to
boost quality and
on-time orders?

We're a "Lean"
shop ... why aren't
we getting better?

What's the real
story on efficiency
and utilisation?

Why are we always
shipping orders
"last minute"?



Applicable Industries & Verticals - Discrete Manufacturing

- Plastics and rubber
- Automotive components/parts
- Electronic boards
- Medical devices/mouldings
- Printing
- Assembly operations
- Containers (Plastic/Paper/Card)
- Food
- Pharma
- Packaging
- Fabricated metals, metal parts
- Injection moulding
- Thermo-forming
- Metal pressing/forming
- Composites
- Extrusion
- Blow-moulding
- Die-casting
- Metal extrusion
- Cable manufacturing
- CNC machining (Computer Numerical Control)



Collecting Machine and Shop Floor Data?

Current adopted methods

- Manual/paper based time-sheets
- ERP - MES functionality
- Scanning bar-codes
- Direct from sensors/machines/equipment





Key Requirements – Automated Manufacturing Execution System

- Production monitoring
- Process monitoring
- Real-time plant-floor scheduling/planning
- Real-time & historical reporting and analytics: Plant and Enterprise
- Energy monitoring
- Quality monitoring
- Will provide real-time, accurate data
- Allows for asking the right questions
- The result is well-informed, timely decisions to allow human and/or automated adjustment to improve the current situation i.e. improve productivity and profitability



Real-time MES

- Data directly from equipment (via electronic & computer interfaces)
- Monitor machines automatically, analyse production and performance 24x7
- Operators provide additional input. Easily add/retrieve data

Translates into:

Increased production in the same (available) time, with the same (or a lesser) quantity of machines, labour and/or energy

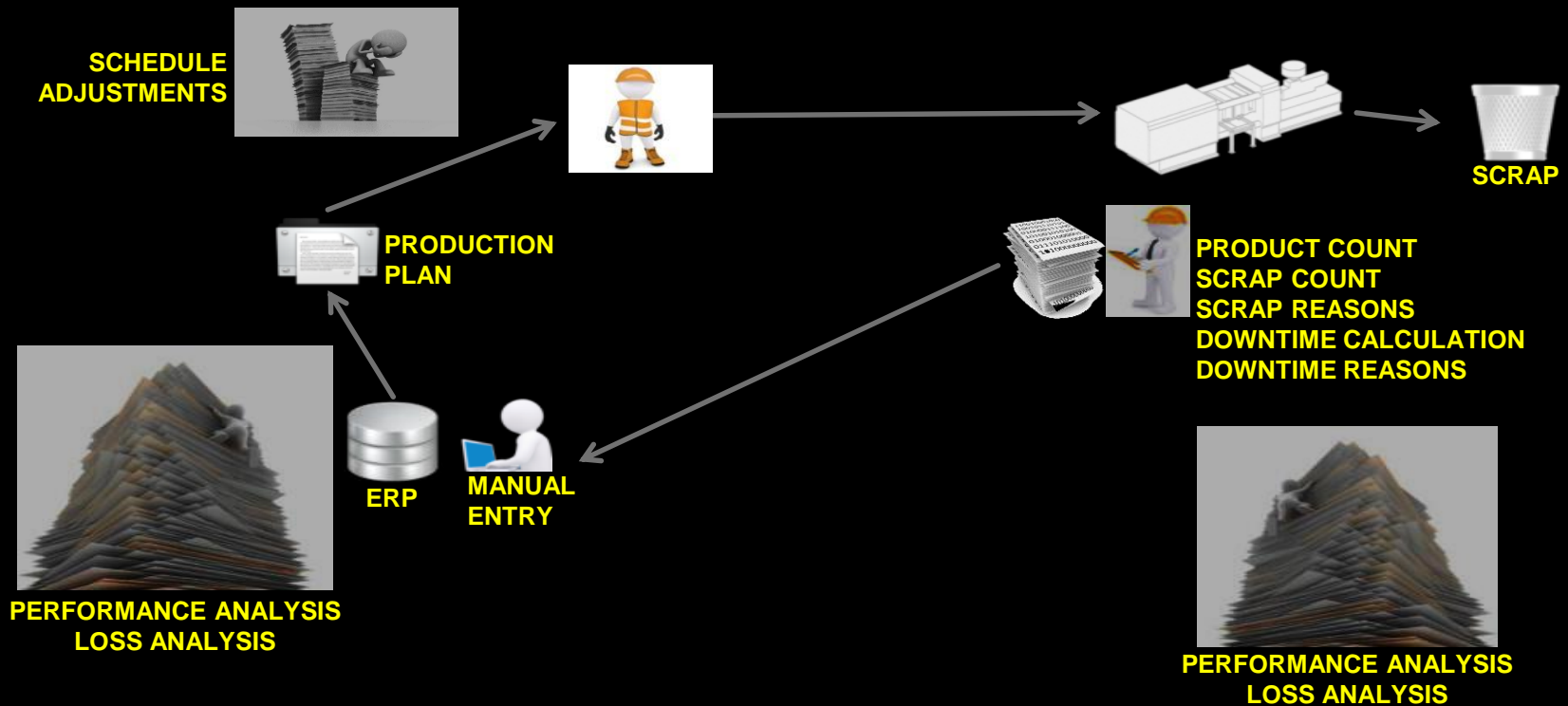


Real-time MES solves manufacturing/shop-floor problems...

- More **CAPACITY** without more assets
Less downtime for more parts and less cost
- Improve **THROUGHPUT**
Reveal and analyse loss – output speed/cycle-time/line rates
- Improve quality/**REDUCE SCRAP**
Reveal quality losses and reasons
- Improve Overall Equipment Effectiveness/Efficiency **OEE**
- Improve use of (direct & in-direct) labour – **REDUCE COST**
- Monitor energy consumption – **LESS ENERGY USE**

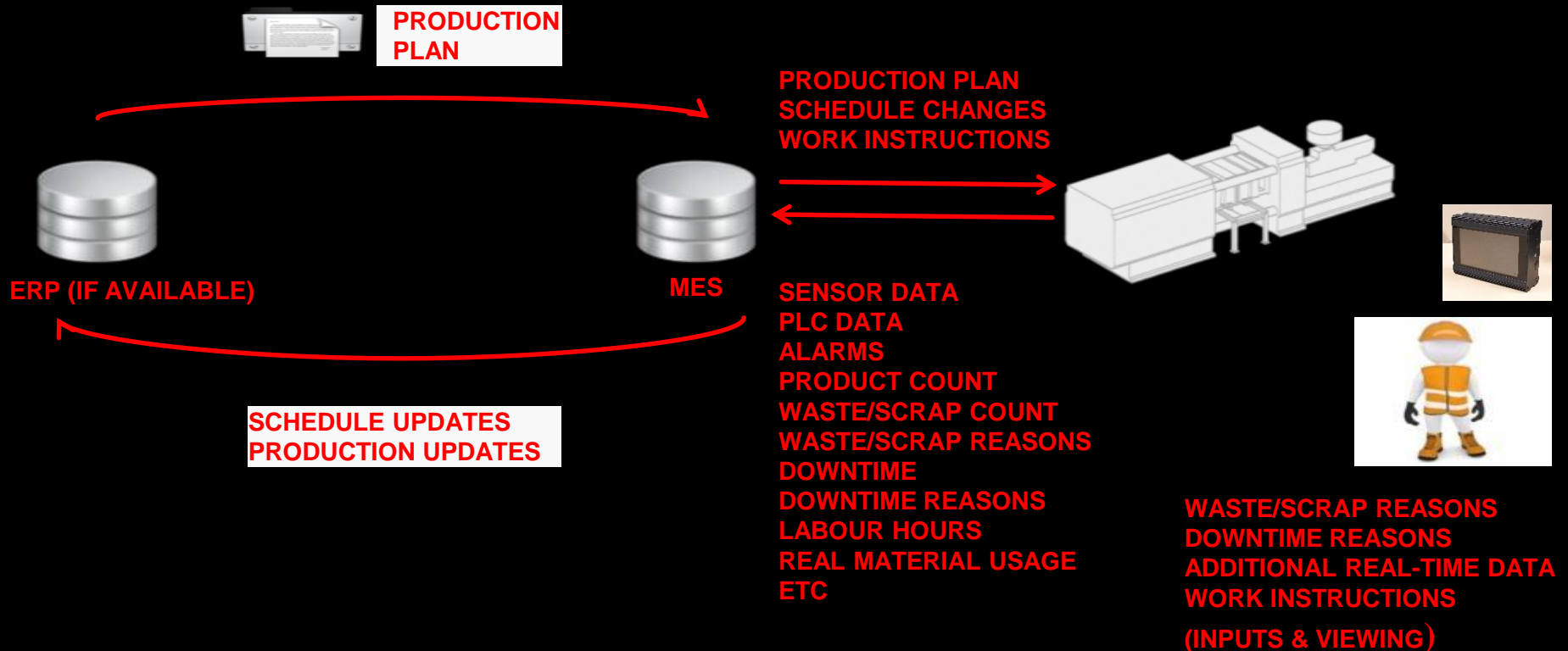


The old way...





A new approach and complementing ERP...

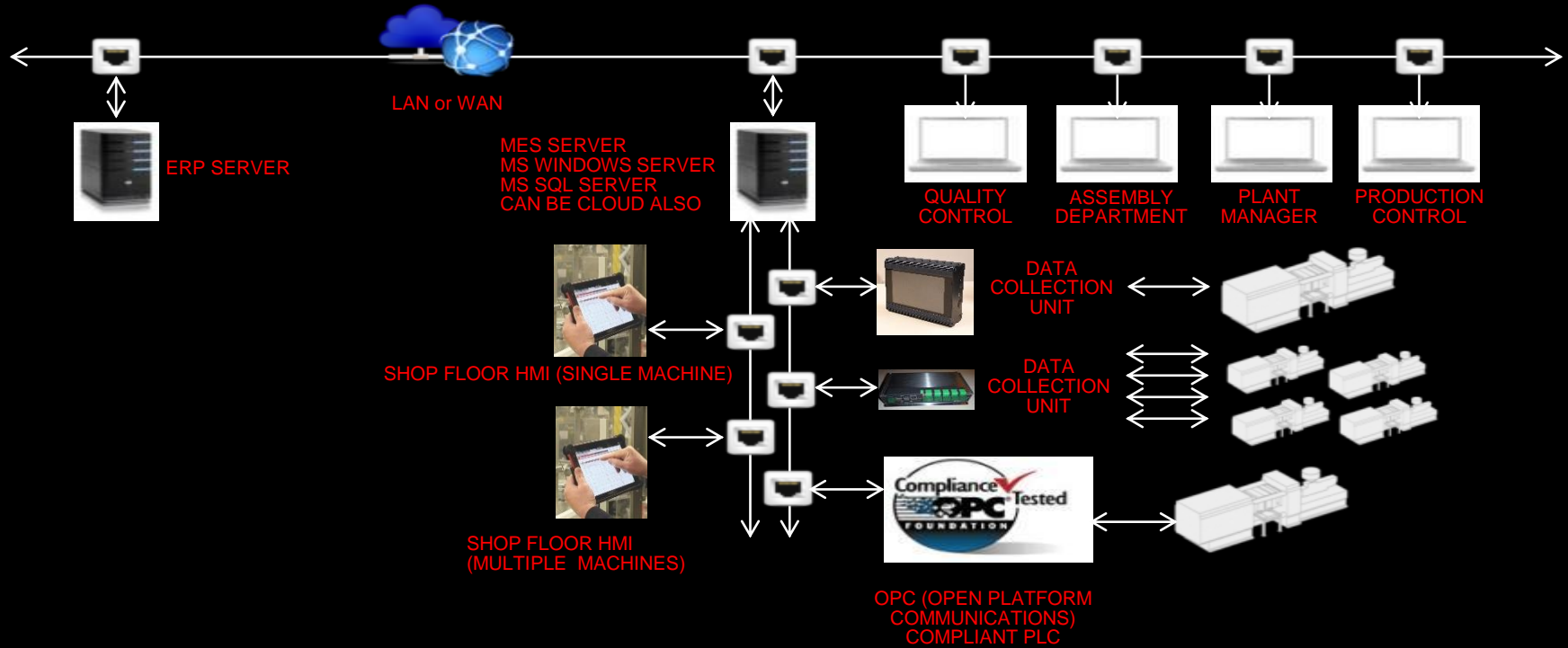




- Data Collection Equipment
- Touch Screen (PC/Tablet) Technology
- Real-time data from any machine via digital and/or analog outputs, OPC and/or direct-to-PLC interfaces
- Real-time insight & data input from machine operators



Achieving system connectivity

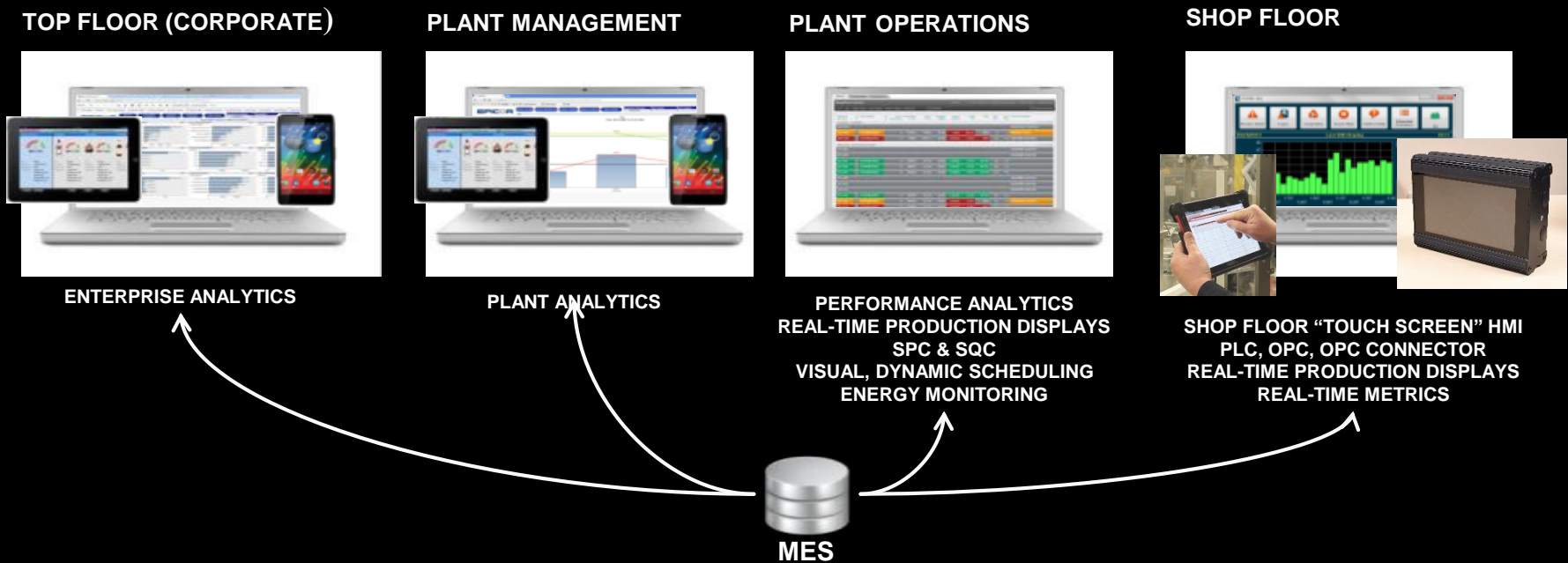




Who uses it and why?



Real-time MES

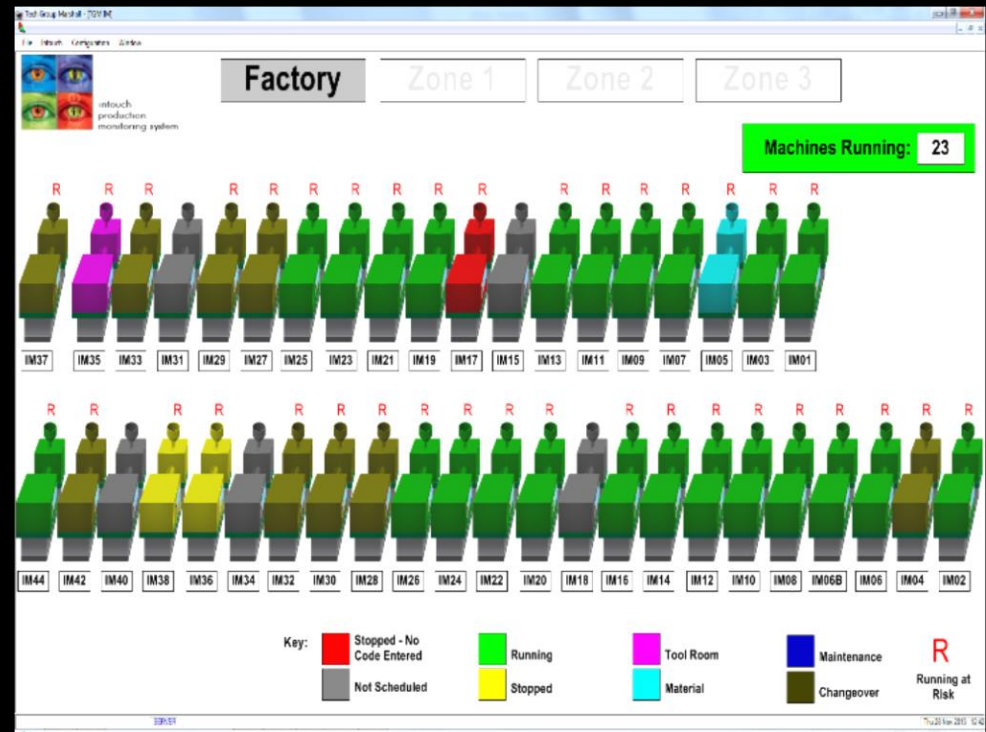


“SHOP FLOOR TO TOP FLOOR (REAL-TIME DATA TRANSFER)”



Real-time Operational Visibility

- Real-time production monitoring (instant data)
- Direct from the machine (fast/accurate data)
- Automatic (eliminate manual intervention)
- Insight (with operator depth and dimension)
- Instant feedback – know the “reality” 24x7



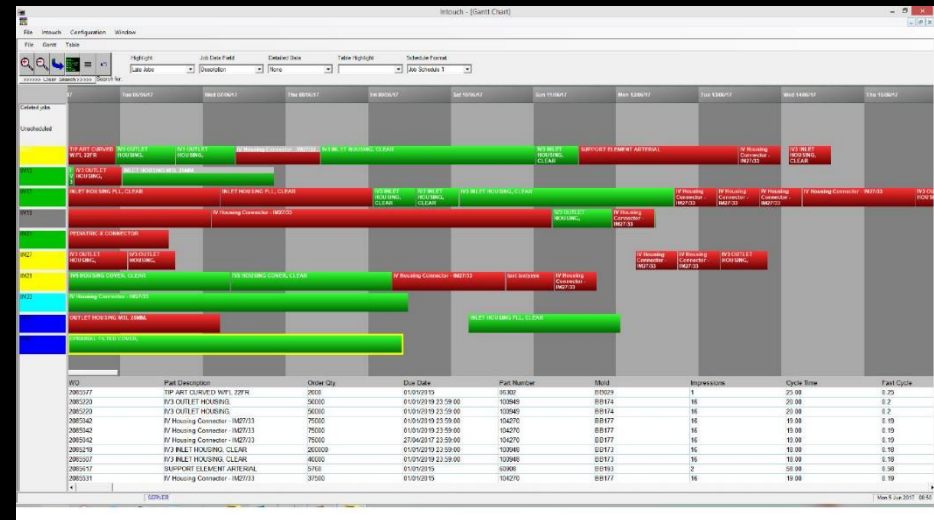


Real-time Planning / Scheduling

Ensure accurate tool – machine – job combinations Identify the right tool for the right job at the right time in real-time

Meet “Promise to Order” Drag and drop reassignment of jobs. Visual highlight of resource & constraints

Avoid resource conflicts Incorporate labour, planned maintenance, materials and planned downtime to optimize production





Ensure Quality - SQC & Process Monitoring

Real-time and flexible

High performance connectivity
Process and SQC tools to achieve
“Zero Defects”

Accessible and Intuitive

Operators, Management, Engineering,
Process Technicians, Quality





Energy Monitoring

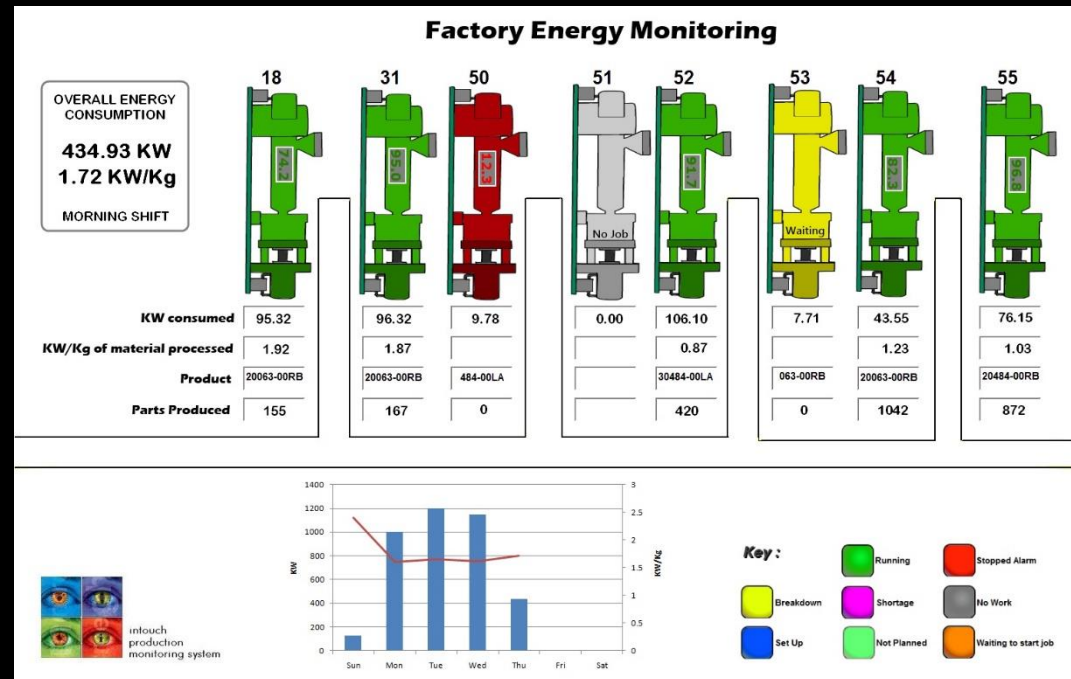
Real-time energy monitoring
(instant data)

Direct from individual machines
(accurate data)

Automatic (eliminate manual
intervention)

Instant feedback –
know the “usage” 24x7

Aid reduction in energy usage





Manufacturing Reports & Analytics

High performing reporting & analytics

Meeting elevated user expectations

Easy to interpret real-time/historical analysis

Collaboration

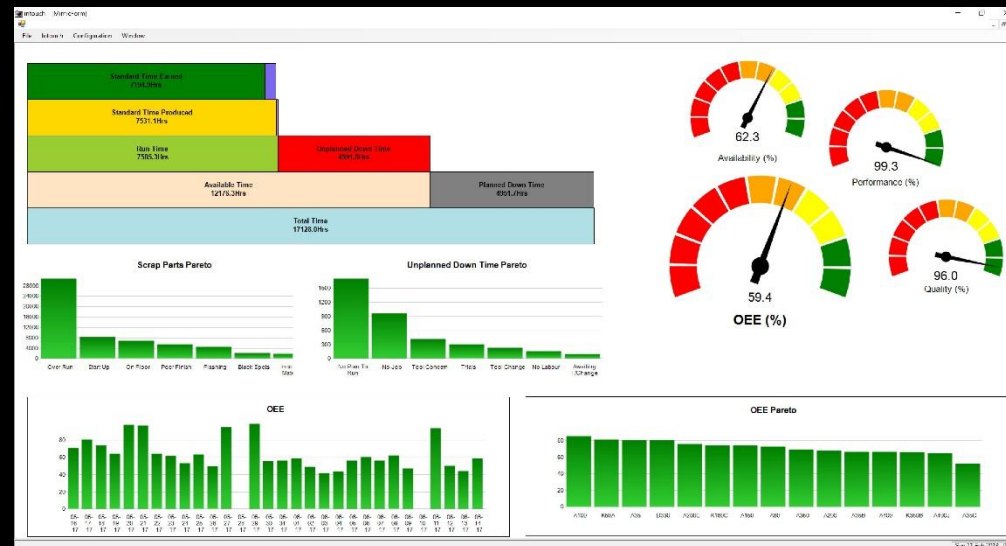
Single plant score-card or enterprise

Drill through / drill down analysis

Out of the box continuous improvement

Flexible reports & analytics

Out the box score-cards with over 1,000 analysis choices





User/Operator Interface

Real-time Shop-floor HMI

Flexible deployment options

Customisable

Support Mobile / BYOD

Rich Experience

Real-time production and

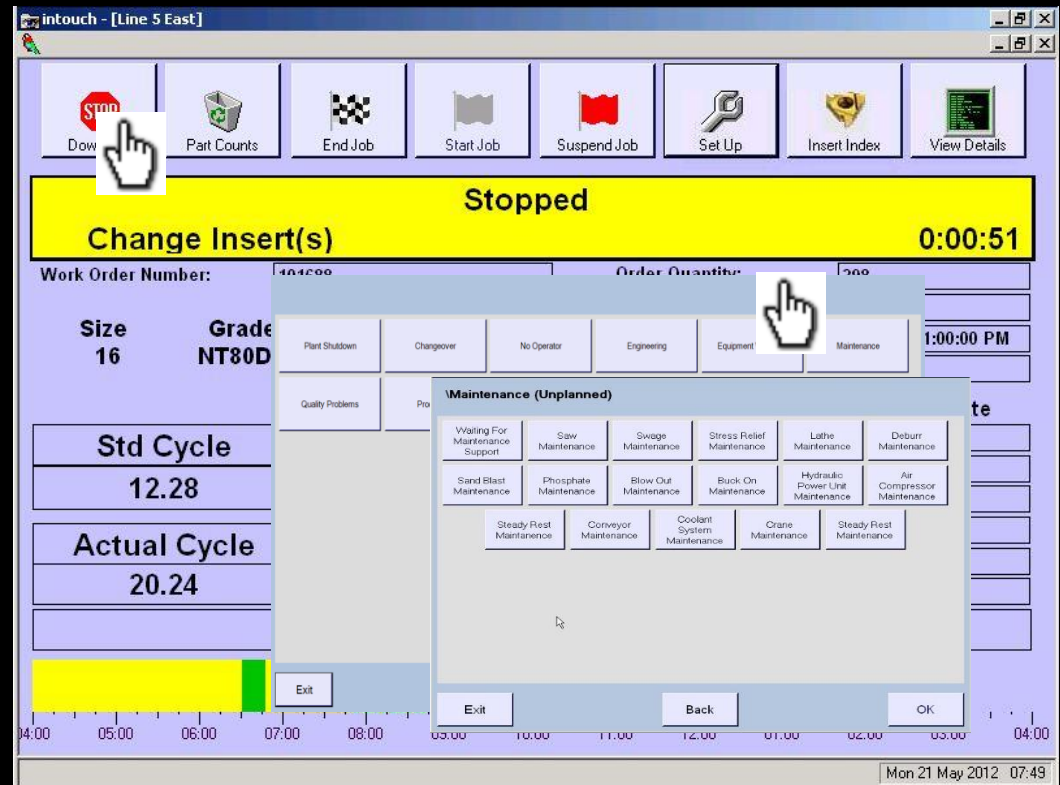
equipment visibility

Alerts and notifications

Accessible and Intuitive

Operators, Process, Quality,

Engineering, Management





“Paper-less” Shop-floor Environment

Embedded context-based videos, PDF, Excel, Word etc files

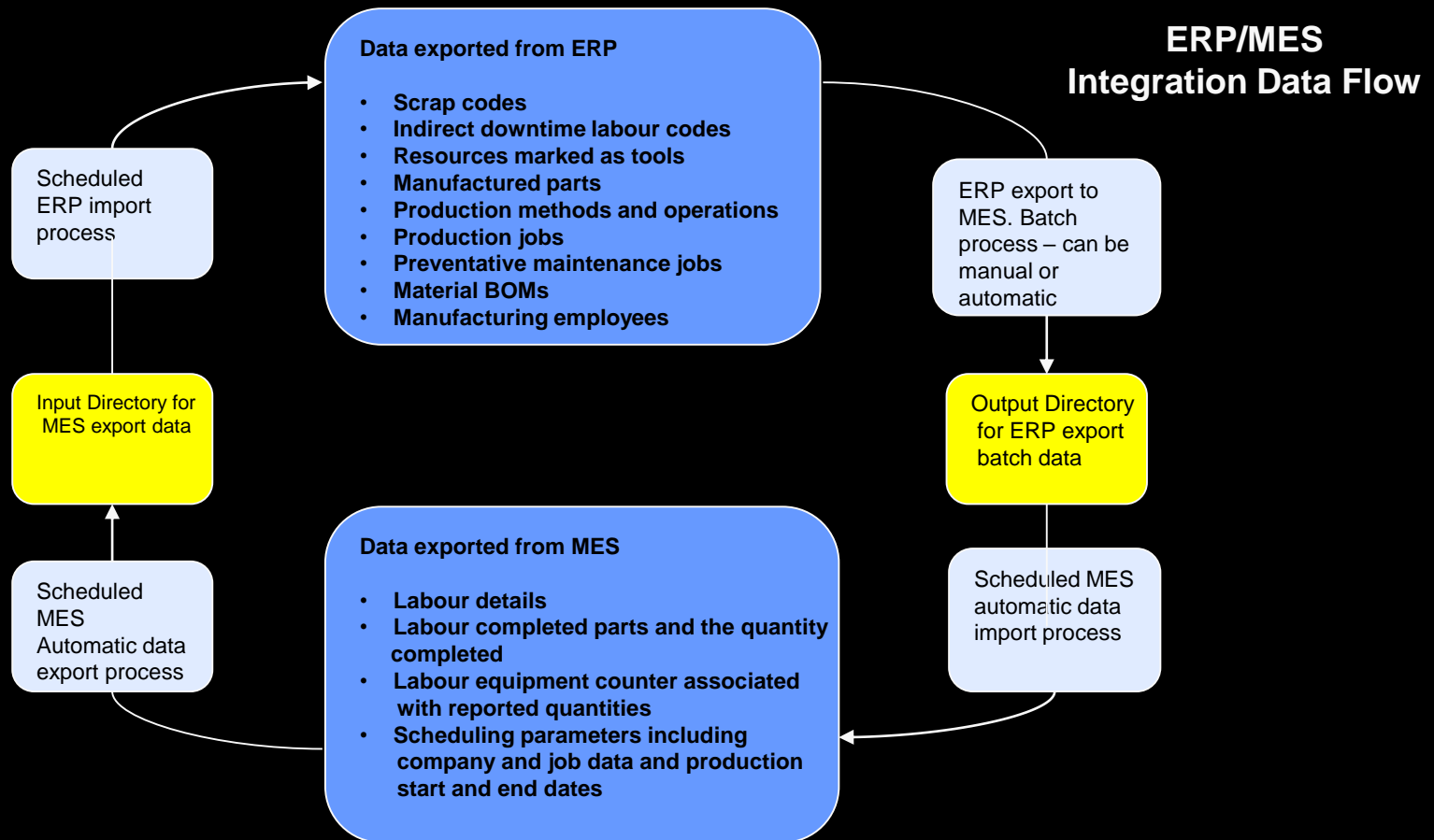
Personalized Information Panels

Additional Workflows

Machine Name	Collector Welder # 2 Op.10	Product Name	XYZ 123 Manifold	
No.	Description	Critical Points		
1	Remove existing part using pliers	<p>Proper bracket orientation / installation</p> <p>Pin in place and locked down -- Button fully extended .</p> <p>Collector covered completely</p> <p>Weld quality: Flange groove filled, welded evenly on flange and tube assembly</p> <p>Visually inspect for weld defects</p> <p style="text-align: center;">Safety</p> <p>Emergency Button Located On Button Control Panel</p> <p>Light Curtains On Each Side Of Opening</p> <p>Part Extremely - HOT!!!!!! -Use Pliers</p> <p>WEAR SAFETY GLASSES & EAR PLUGS</p>		
2	Insert Collector tube through flange opening			
3	Insert flange on to pins with tab covering orange sensor. Lines on flange facing up.			
4	Depress back of clamp with finger: * Insert one bracket #2 on top clamp * Insert two brackets #1 [one on each lower clamp] Short legs must face each other.			
5	Place plunger cover thru Collector opening - depress pin & seat - Release - seat into collector - release, extending pin upwards		<p># 3: Flange on pins. Lines up</p>	
6	Swipe actuator or push Op Ready button - Begin		<p># 4. Depress Back Of</p>	
7	Move to next operation (Follow Process Flow Chart)			
<p>Control Point STOP, CALL AND WAIT</p>		<p>Process Time: 25 38 4</p> <p style="text-align: center;"><small>Load Machine Cycle Unload</small></p>		
<p>1st Shift Supervisor _____ 2nd Shift Supervisor _____ Associates / Operators _____</p> <p>Manufacturing Eng. _____ Quality Engineer _____</p>		<p>WIP Levels Min. Outgoing 2 baskets of collectors</p> <p style="background-color: yellow;">Max. Outgoing 3 baskets of collectors</p>		



Integration with ERP Systems





Adopters & Users (Industry 4.0/Real-time MES)

Hanson Building Products

Introduced real-time MES into 6 plants. Original systems were paper based, ambiguous and wasted significant management time analysing the data. Key business decisions can now be made quickly and has resulted in close to a **30% increase in OEE** as a result of using real-time MES.

Plastique Ltd

Plastique runs a 24/7 hour operation, has 2,500 tools in stock and produces 250 new tools each year. Since installing real-time MES, it has **increased annual available time (efficiency) by 2,000 hours**, reducing the need for overtime and allowing Plastique to take on more work in the same time-frame.



John Hardwick

☎ : UK +44 (0)1604 646 144

☎ : Mobile UK +44 (0)7779 322 391

☎ : USA +1 231-903-0119

☎ : Mobile USA +1 231-903-4900

📧 : johnhardwick@intouchmonitoring.com

Andy Jewell

☎ : UK +44 (0)1909 484 272

☎ : Mobile UK +44 (0)7769 491 499

📧 : andyjewell@intouchmonitoring.com

Karl Edwin

☎ : UK +44 (0)1604 646 144

☎ : Mobile UK +44 (0)7887 603 249

☎ : USA +1 231-903-0119

☎ : Mobile USA +1 231-903-4904

📧 : karledwin@intouchmonitoring.com