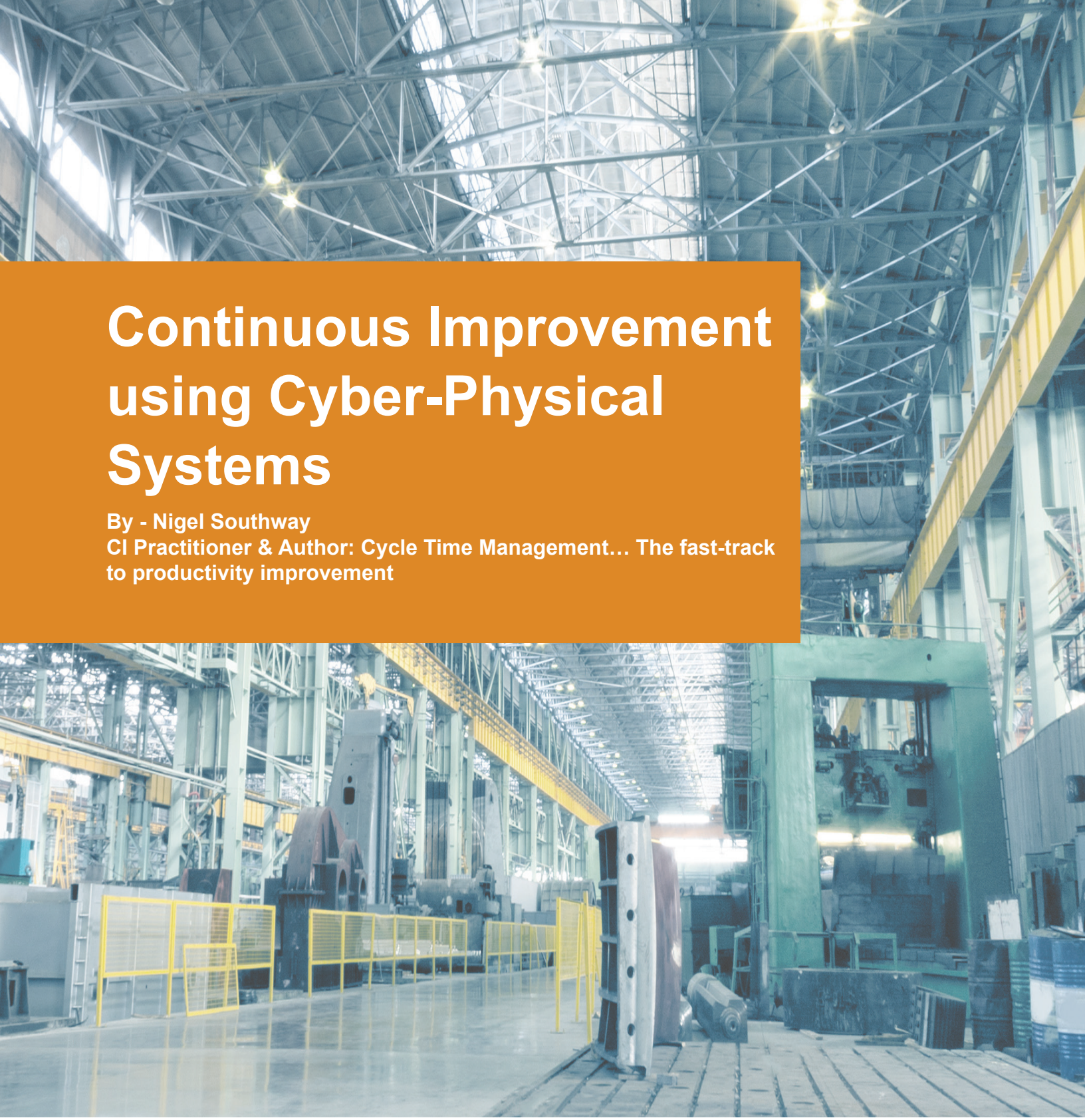

Continuous Improvement using Cyber-Physical Systems

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MEMEX
Measuring Manufacturing Excellence™
MERLIN

A recent industrial study indicates that 70% of business leaders in North America are revisiting both Continuous Improvement (CI) and Disruptive Technologies as strategic differentiators

The goal is to further improve operating processes and better harmonize future products and processes to achieve more integrated, waste free and sustainable products, processes and services to meet customer expectations.

These Disruptive Technologies such as advanced robotics, smart sensors, cyber physical systems, Big data, the Industrial Internet of things (IIoT), and 3D printing will impact and improve the new business operating processes.

CI practitioners must also start to integrate these cyber-physical solutions into their CI methodology to significantly improve the way they undertake the CI journey to meet this strategic requirement.

Getting good real-time data has always been the challenge…

I still hear the complaint from CI practitioners that getting good real time and continuous process data to focus on CI issues and start the problem-solving journey or build a CI Evolution plan is an ongoing challenge.

Traditional process level data has been via direct labor reporting that has been an accounting driven need to control costs more than make improvements. Or, it is generated by a quality system that uses historical inspection, test or catastrophic corrective action data mainly focused on responding to issues rather than planning improvements.

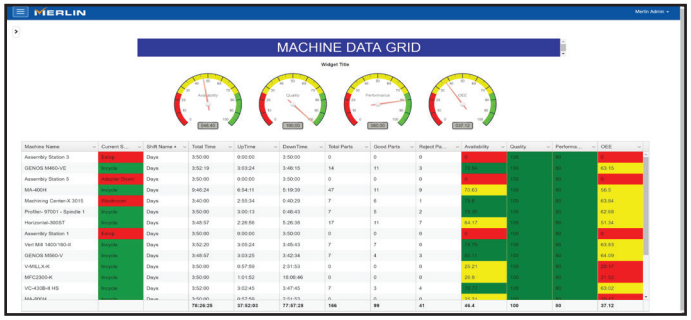
In most processes, any additional data collection has been deemed overhead generating as it involves extra manual data reporting by process operators who are already burdened with running the process and getting output levels as well as watching for quality issues etc. This has meant that the CI team must depend on limited information or instigate special data collection studies to get the focus needed to undertake a CI project.

Most CI training and implementation tool-kits still adopt a very manual approach to problem solving, and still portrays a vision of cross functional teams working on flipcharts and whiteboards and at the most spreadsheets. Much team effort gets consumed on manual sorting of specially collected data to get to the focus of the CI solution… Although this intensive effort can be used to team build and validate data this manual methodology is very time consuming, and can distract teams from getting on with the CI journey. A Further worry is that younger and more computer oriented team members may frustrate with this retro approach.

MERLIN… A far better way to get data…..

Their now exists a far better way to get data to undertake this important CI journey.

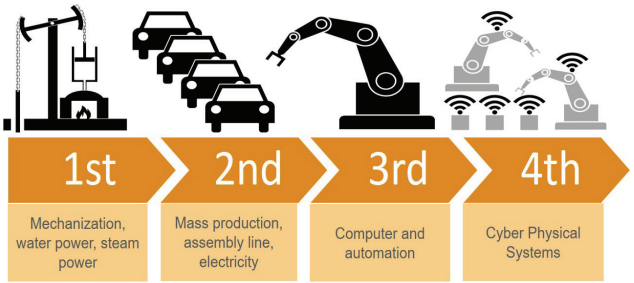
MEMEX (MemexOEE.com) has over the years developed the MERLIN Process Measurement System that acts as a cyber-physical system that provides direct connectivity to a work-cell process and uses Operating Equipment Effectiveness (OEE) as the process measurement focus to both manage and improve operational processes.



Cyber-physical systems will lead the 4th Industrial Revolution…

MERLIN is an important component in this 4th Industrial revolution, where such cyber-physical systems can eliminate the burden of managing computers by humans and allow direct linkage between the computers and the process.

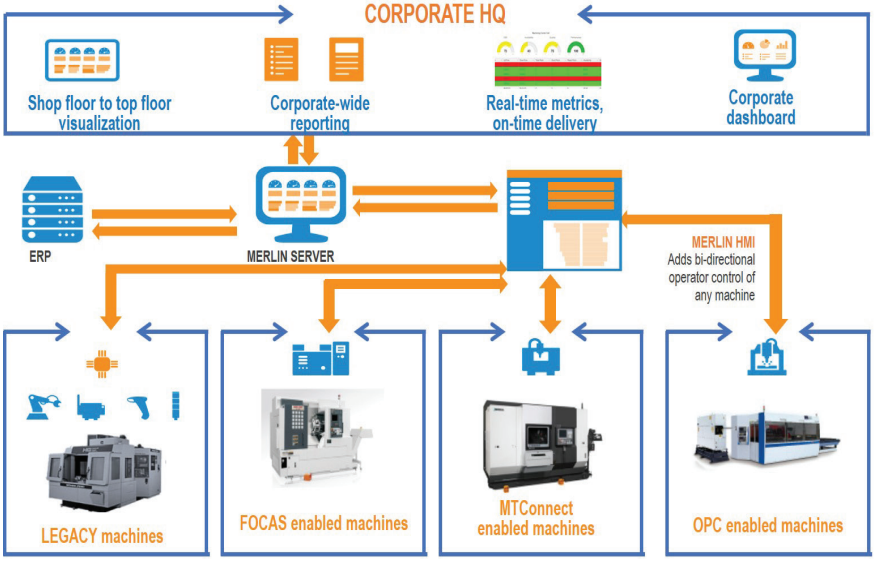
In the last, the 3rd industrial revolution (from 1970 until now) we have added significant computerization to our manufacturing and business processes. But we still have many environments in industry where humans are trapped in the process and end up working for the computer, not the computers working for the process and benefiting us.



A Cyber-physical system uses “SMART” Connectivity, Sensor Technology, and advanced computer networks, to place computers much more directly and seamlessly into our processes so we can eliminate transactional waste and solve some of the major interface issues between computers and process management. This will also allow us to redeploy human skills much more toward improving our processes and even further evolve how we do business.

MEMEX has devised a universal machine interface, and other machine connection methodologies, such that automated data collection is seamlessly integrated directly into MERLIN from the work cell. It leaves no machine behind…. including old legacy process equipment. More attribute type data can also be managed through the MERLIN operator portal, to provide a very rich information to both measure and improve the process.
MERLIN dashboards also provide a real-time visualization at the work cell, or at the plant level, via customizable real time heads-up display formats or through a relational database and customizable report formats. Also, MERLIN creates an environment that can become part of the corporate information system.

MERLIN can integrate data from all work cells so they can directly communicate with ERP planning and control systems within the organization and report upward and provide a plant floor level performance visualization at a corporate level of how that work cell is performing and how all these work cells individually and collectively impact the overall business effectiveness.



Overall Equipment Effectiveness (OEE)..... A powerful work-cell measurement….

MERLIN is an environment that uses OEE to enable everyone to get a clear understanding of the health of the manufacturing process, and what is needed to improve it.

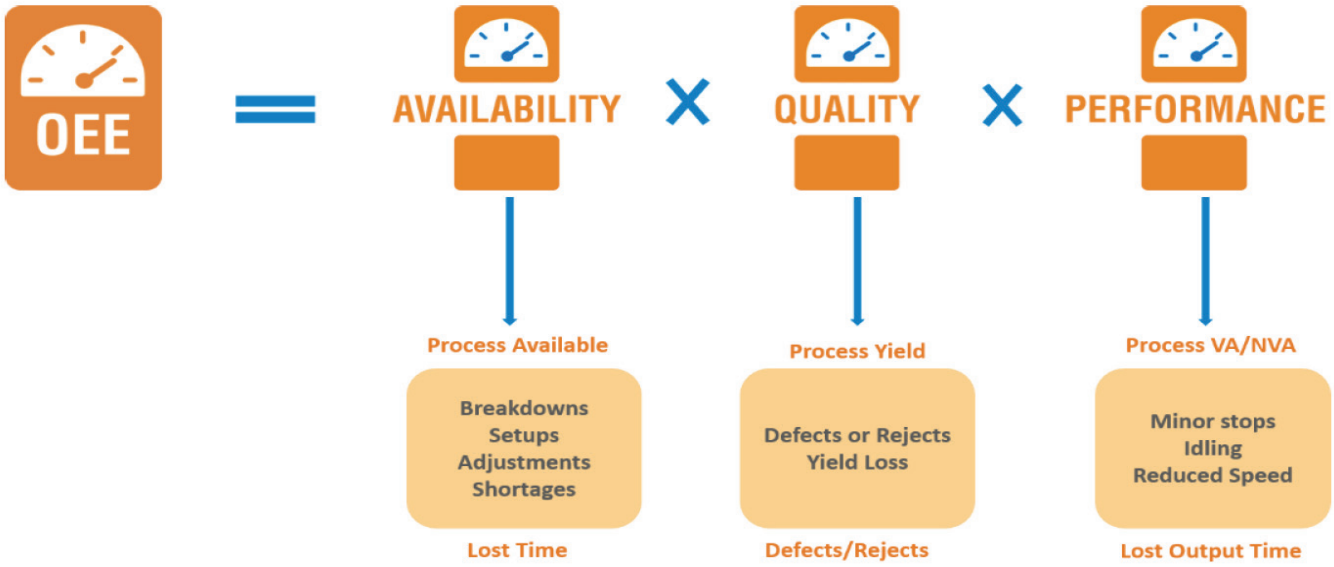
Overall Equipment (Or Process) Effectiveness is a powerful measurement system and can be applied to any process and is represented as a percentage. It is composed of three terms: Performance, Availability and Quality.

Performance is a measure of how much of the process In-cycle or RUN time is spent producing value added output, versus such factors as reduced speed, measured against a work standard for the machine in-cycle RUN time.

Availability is how much the machine is available to be put In-cycle or RUN mode.
So, it's a measure of lost time such as hard machine stops, breakdowns, preventative maintenance, labor shortages, material shortages, setups, adjustments, tooling issues, etc.

Quality is a measure of the level and nature of process defects in the work cell output.

Each of the 3 terms is represented as a percentage and OEE as an overall percent is the multiplication of all 3 terms. This provides a very pure and exacting measure of equipment performance.



Process work standards may have to be Redefined

OEE as a performance measurement standard, is very rigorous and absolute as a measure at defining the perfect world loss in any process. Most management performance systems using standard costing for productivity measures tend to have built in loss allowances as they are used in standard cost transfer, and typically have a significantly higher % of performance than OEE which measures all forms of waste reduction opportunities. So, for the continuous improvement journey OEE is a more meaningful baseline performance measure as it takes the absolute value added which the process is capable of meeting and compares this against real output and waste. This means that a baselining process to correlate OEE against current process work standards is always worthwhile so that the CI improvement targets and the business savings possible can be targeted correctly.

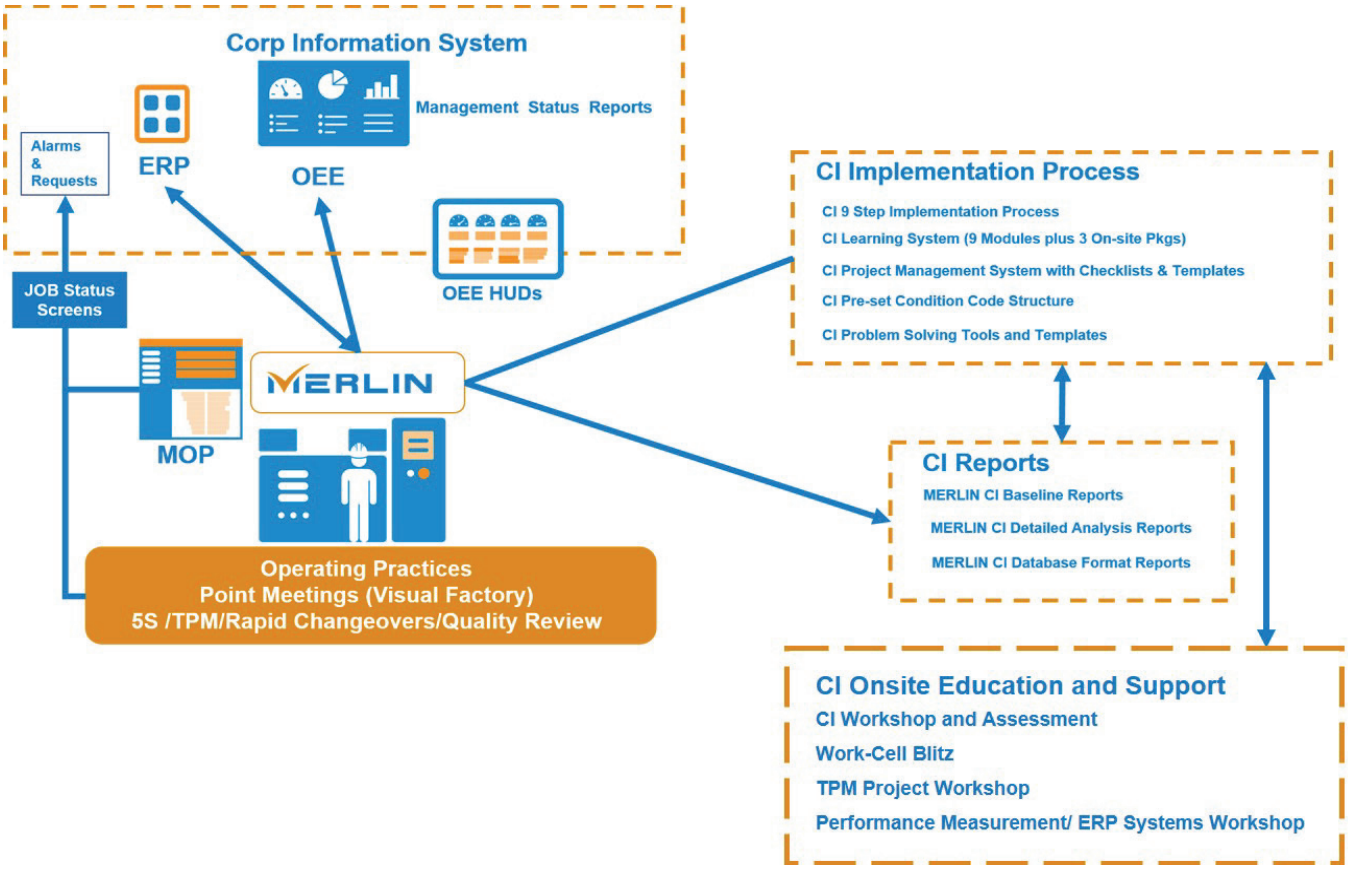
The MERLIN CI Environment…

The MERLIN environment has been expanded to include a measurement structure and methodology and a 9 Step roadmap to install and/or undertake a formal CI environment. The roadmap includes an integrated 9 module learning system that is self-help orientated and a data table structure with all checklists and templates.

Also, problem-solving tools are integrated into the CI offering and the operator portal is configurable to provide the range of alarms, requests and communications outside of the work cell. A series of standard reports to support most CI project activities is included. A fully configurable relational database can generate custom reports for more advanced users.

This MERLIN CI environment can be configured to support each work cell or operating center, and when networked with the corporate business system provides a corporation wide view of operating effectiveness and can assist with business improvement strategies.

So, MERLIN operates as a powerful catalyst for CI and can also eliminate existing manual and effort consuming factory data collection systems. It can also link with corporate Enterprise Resource Planning systems to harness all the process data available to undertake the CI journey.



Every picture tells a story...but only after you organize the data input!

As we have explained, the upside of using an automated data collection environment is obvious, however to successfully use a cyber-physical system requires solid planning on how the system data is configured.

It is critical that data structures and data codes define how the data will be utilized not only for management reporting but also for CI activities.

MERLIN CI offers a default OEE code structure as a starting point. This is applicable for 80% of the industrial process applications.

MERLIN DATA TABLE PLAN						
Machine/Work Cell Active Condition Codes						
Code #	Code Source	Code Type	Name/Purpose	State	OEE	%OEE
0	Machine	RUN (INCYCLE)	PROCESS RUNNING	VA	PERFORMANCE %	
1	Machine	Machine Downtime	ESTOP	NVA	Availability	
2	Machine	Machine Downtime	ALARM	NVA	Availability	
3	Machine	Machine Downtime	INTERUPT1	NVA	Availability	
4	Machine	Machine Downtime	INTERUPT2	NVA	Availability	
5	Machine	Machine Downtime	INTERUPT3	NVA	Availability	
6	Machine	Machine Downtime	INTERUPT4	NVA	Availability	
7	Machine	Machine Downtime	INTERUPT5	NVA	Availability	
8	Machine	Machine Downtime	INTERUPT6	NVA	Availability	
9	Operator	Idle	OP_AWAY	NVA	Availability	
10	Operator	Idle	NO_WO	NVA	Availability	
11	Operator	Idle	MATERIALS	NVA	Availability	
12	Operator	Idle	FIRST_OFF	NVA	Availability	
13	Operator	Idle	QC_HOLD	NVA	Availability	
14	Operator	Idle	ADJUST	NVA	Availability	
15	Operator	Mode/Idle	POWEROFF	NVA	Availability	
16	Operator	Mode	SETUPMODE	NVA	Availability	
17	Operator	Mode	HOUSEKEEP	NVA	Availability	
18	Operator	Mode	MAINTSCH	NVA	Availability	
19	Operator	Mode	MAINTUNSCH	NVA	Availability	
20	System Generated	Idle	IDLE	NVA	Availability	
AVAILABILITY					TOTAL (AV%)	
Machine/Work Cell Defect/Reject Condition Codes						
1	Operator	Part Defect/Reject	TBD	NVA	Quality	
2	Operator	Part Defect/Reject	TBD	NVA	Quality	
3	Operator	Part Defect/Reject	TBD	NVA	Quality	
4	Operator	Part Defect/Reject	TBD	NVA	Quality	
5	Operator	Part Defect/Reject	TBD	NVA	Quality	
6	Operator	Part Defect/Reject	TBD	NVA	Quality	
7	Operator	Part Defect/Reject	TBD	NVA	Quality	
8	Operator	Part Defect/Reject	TBD	NVA	Quality	
9	Operator	Part Defect/Reject	TBD	NVA	Quality	
10	Operator	Part Defect/Reject	TBD	NVA	Quality	
11	Operator	Part Defect/Reject	TBD	NVA	Quality	
12	Operator	Part Defect/Reject	TBD	NVA	Quality	
13	Operator	Part Defect/Reject	TBD	NVA	Quality	
14	Operator	Part Defect/Reject	TBD	NVA	Quality	
15	Operator	Part Defect/Reject	TBD	NVA	Quality	
16	Operator	Part Defect/Reject	TBD	NVA	Quality	
17	Operator	Part Defect/Reject	TBD	NVA	Quality	
18	Operator	Part Defect/Reject	TBD	NVA	Quality	
19	Operator	Part Defect/Reject	TBD	NVA	Quality	
20	Operator	Part Defect/Reject	OTHER	NVA	Quality	
QUALITY					TOTAL (QC%)	
OEE					TOTAL (OEE%)	

This will require the organization to meet as a cross functional team to define the appropriate data reporting structure.

This requires early planning and visioning as to how the Merlin environment will collect and display the data. Failure to do this results in loss of data integrity and shortfall in reporting usefulness.

Many organizations fail to follow through correctly on planning and defining the data table codes correctly and then have trouble in using data from such an automated system. The adage “rubbish in equals rubbish out” firmly applies here.

The MERLIN CI 9-Step implementation process is specifically designed to take the users through an online self-help education and facilitation process to ensure the data structuring process is correctly managed.

For some complex equipment driven processes special codes may need to be added to manage all machine-driven functions. MERLIN can be custom configured so that data is collected correctly in the OEE format.

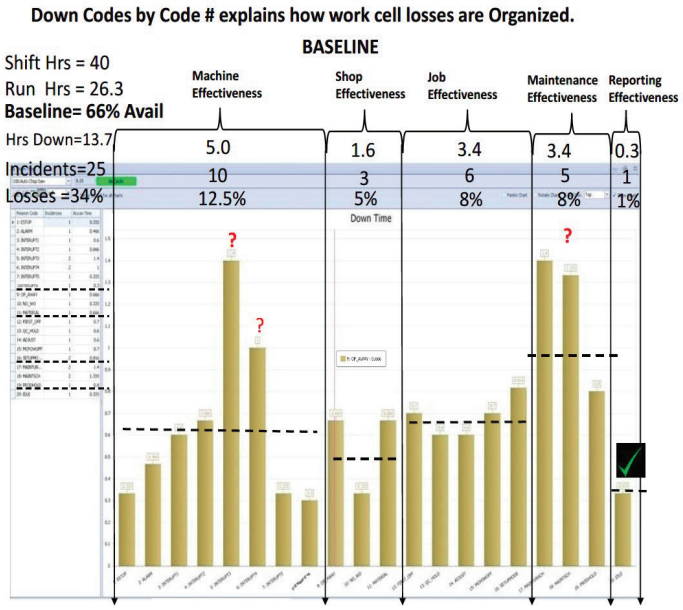
Once the data structuring is undertaken correctly the live data when displayed should create an immediate OEE Effectiveness signature that can be intuitively absorbed by the many different users from operators to supervisors to support people, such as maintenance and material coordinators, as well as management of all types and levels.

This information is typically organized in Effectiveness code groups that displays the losses in each Group:
Process equipment or machine effectiveness: How much loss in the machine process?
Shop effectiveness: How much loss in loading the work-cell with real demand?
Job effectiveness: How much loss in processing a specific job?
Maintenance effectiveness: How much loss due to the reliability of the process or machine?
Reporting effectiveness: How well the operator manages the work cell database?

This format organized by down codes generates an operating loss signature that provides a focus of responsibility for such losses onto the various functions within the organization.

Attacking waste…reduce and eliminate!

Once this CI environment is installed and real-time data collected to measure the baseline performance MERLIN is used to define the improvement opportunities and the CI teams develop CI projects to focus improvement effort using the MERLIN CI tool-kit which includes a range of reports and problem-solving templates, checklists, pareto charts and other problem-solving tools to move the CI journey forward.



The advantage of a work cell focus is that it tends to be at or near to the value stream of the business process. A strong knowledge of LEAN and Bottleneck theory (Theory of Constraints) to focus on the natural capacity bottlenecks always provide the largest savings. A focus within the work cell to improve OEE and then outward and across the business ensures the CI projects are meaningful and get solid results.

Process operators will become the best CI coordinators.

One of the future operational excellence goals is to use the power of cyber-physical systems such as MERLIN to automate all process functions and data gathering, so the process operators can be liberated from these non-value adding tasks, and can focus much more on process management and even more importantly Continuous Improvement (CI) activities.

MERLIN moves the operator toward this goal, and is a very powerful environment for just about everyone within the organization to understand the health of the manufacturing work cell, and what action to take to improve it.

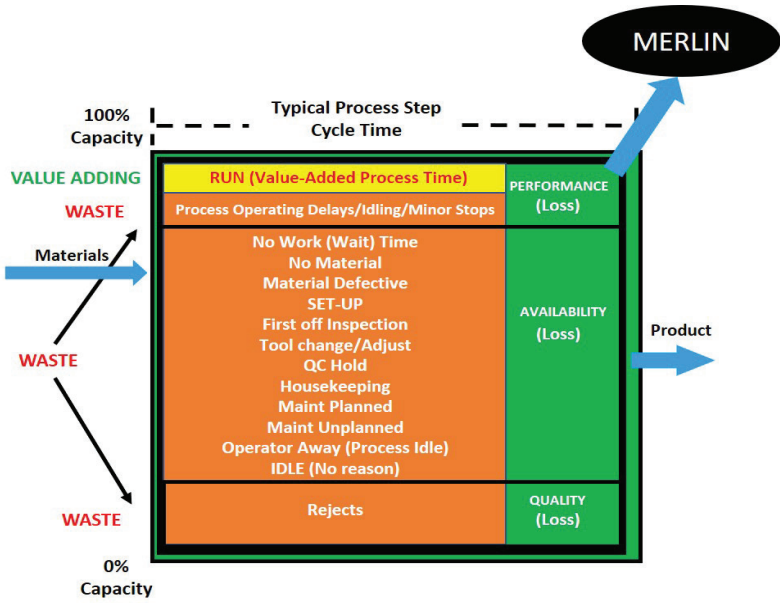
The MERLIN system can deploy automated and operator driven alarms and signals and requests to other parts of the organization that allows the whole business, at all levels, to understand and respond to the real-time health of the work cell and work centers and provides a manufacturing operations management system for operator communication upward from the work order control at shop floor level, to the top floor planning and control system.

This places the operator at the center of the CI initiative in the work-cell and with the correct training and motivation allows a strong combination of hands on knowledge as well as solid real and historical trend data to be brought to bear on both short and longer-term productivity issues.

Although the system can record operator activities, a traditional pre-occupation with monitoring the operator's activities must shift to a more productive focus on looking at how to improve the overall process including equipment, materials, processes and support activities.

Adding the operators to the CI activities is essential to achieve solid results from CI, and a cyber physical measurement system is a strong catalyst for this activity to take place. But it may require some changes in supervision and management thinking to achieve this goal.

PERFORMANCE MODEL



To summarize

MERLIN is a cyber-physical environment that uses OEE to enable everyone to understand the health of the manufacturing process, and provides an integrated CI roadmap to undertake improvements.

A strong understanding of the OEE performance model by every-one will ensure a CI Evolution plan stays on track to reduce waste, improve operating effectiveness and gain increased profitability.

The integration of CI methodology with disruptive cyber physical systems such as MERLIN will unleash the benefits of INDUSTRY 4.0

So, be prepared to start using this CI methodology with these disruptive technologies, or be prepared to be disrupted by the competition.

About MEMEX

MEMEX was founded with a vision to improve the way automated machinery and production equipment work and connect on the factory floor. Since then MEMEX has proved itself a pioneer in IIoT time and again. The company is committed to its mission of “successfully transforming factories of today into factories of the future” and envisions converting every machine into a node on the corporate network, creating visibility from shop-floor-to-top-floor. MEMEX is the developer of MERLIN, an award-winning IIoT technology platform that delivers tangible increases in manufacturing productivity in Real Time. MEMEX’s software and hardware IIoT solution enable customers to achieve tangible IIoT-centric business outcomes. The MERLIN software suite and connectivity products have enabled manufacturers to achieve upwards of a 50% increase in productivity and a 20%-plus increase in profit, on average. Additionally, customers have secured payback in less than four months, which equates to an Internal Rate of Return greater than 300 per cent.

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