

How to Evaluate Automated Systems and Measure Effectiveness for Operations Transformation

- An idea to be discussed with lean practitioners for expanding LEAN thinking to end-to-end automation management

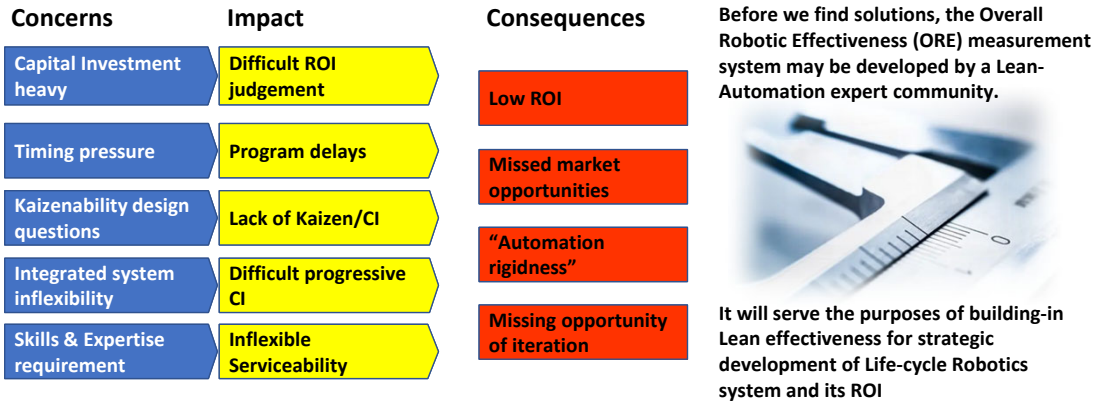
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My Lean Journey



What I love to learn about from the lean community

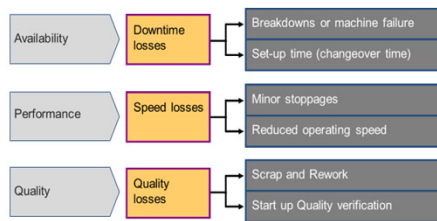
How to manage Automation/Robotics transformation:
How to measure the effectiveness of robotics strategy, planning, investment and operations?



Shall we expand OEE, an effective LEAN platform?

OEE is **Overall Equipment Effectiveness** – an effective LEAN method to identify losses

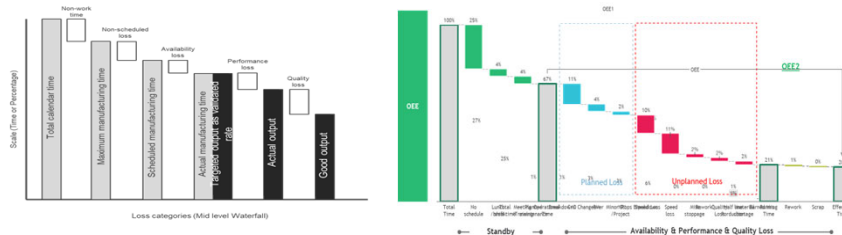
TOPDOWN calculation of OEE
=Availability % x Performance % x Quality %



Success of OEE management

- Allocated Losses
- Allocated Loss elimination
- Allocated Accountabilities

BOTTOM UP OEE
(Waterfall Visual Tool to identify detailed losses)

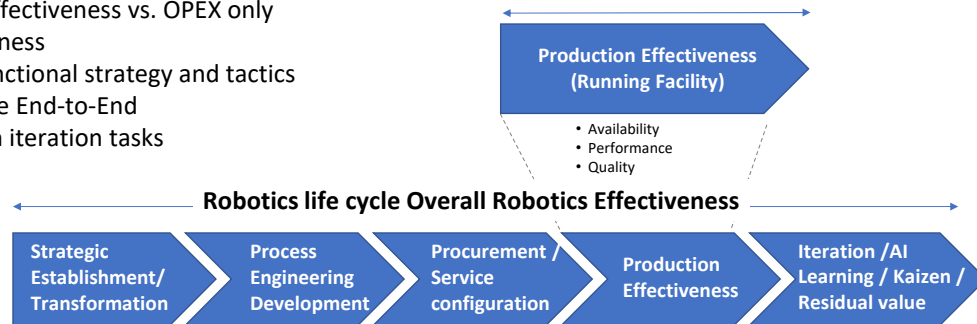


Robotics Overall Robotics Effectiveness (ORE) may cover a wider lifecycle from CAPEX to Resale compared to traditional OEE

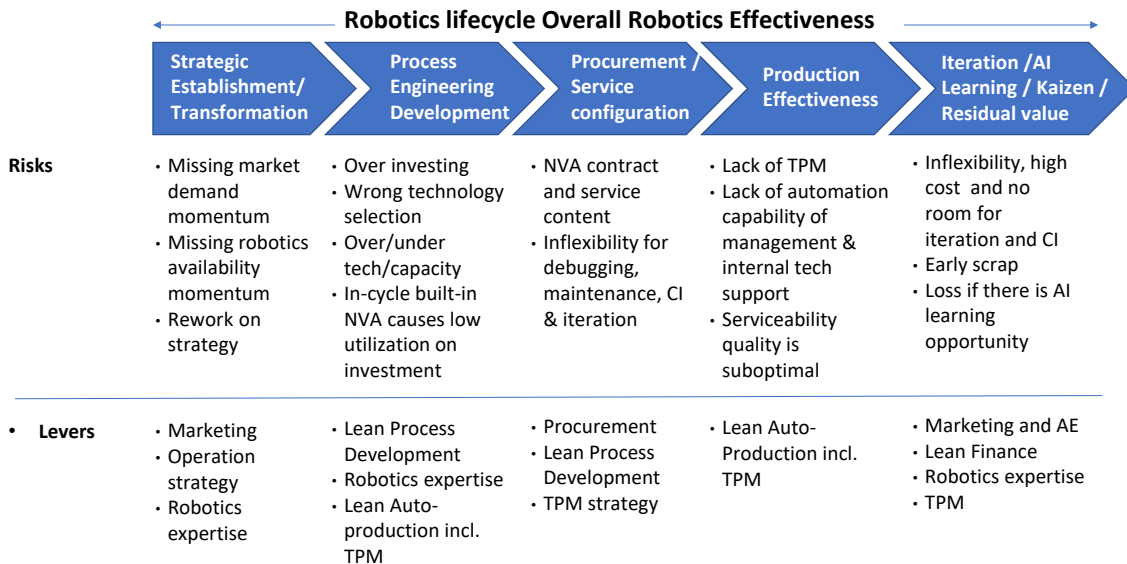
Reason:

- Large investment orientated
- Big transformation tasks
- CAPEX effectiveness vs. OPEX only effectiveness
- Multi-functional strategy and tactics
- Long time End-to-End
- Heavy on iteration tasks

Traditional OEE is based on an Established and "Running Equipment Facility"



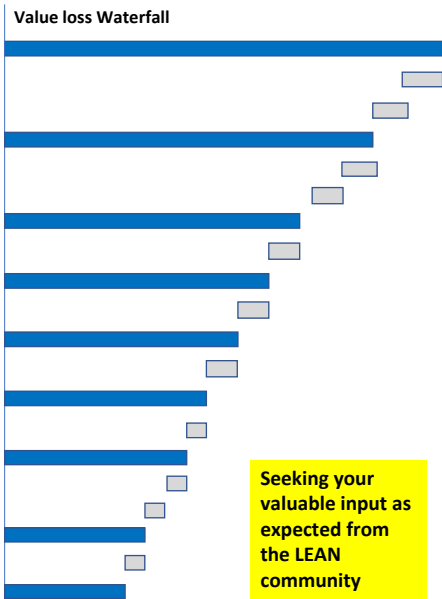
Robotics Overall Robotics Effectiveness (ORE) is to strategically improve the Lifecycle Robotics System ROI



Robotics OEE / ORE Overall Robotics Effectiveness model draft

Illustrative Example

- Robotic system Strategic Initiative Value**
 - Strategy development and Deployment time losses
 - Strategy "Rework" losses
- Deployed Life cycle Value**
 - Overall Robotics value-adding losses (over engineering / over capacity)
 - Tactical NVA losses
- Application Engineered Value**
 - Service ROI losses
- Procured Productive Value**
 - Utilization / Availability losses
- Production Available Value**
 - Performance Losses
- Production Performed Value**
 - Quality losses
- Production Quality value**
 - Iteration / Learning availability time losses
 - Iteration re-invest losses
- Technical Iteration value**
 - Suboptimal condition / early quit losses
- Life cycle value**



Definitions

- 100% Robotics Value**
Robotics automation strategy establishment time loss that missed market value (demand momentum) & robotics availability momentum
Time delay due to wrong strategy correction
- Remaining**
Strategic planned NVA losses (over investment, wrong tech, over tech/capacity, under tech/capacity, etc.)
Robotics process engineering losses (programmed in-cycle NVA such as hesitation, waiting, low loading rate.....)
- Remaining Serviceability** value ineffectiveness (service contract overspending and under performing, incl low service quality, freedom of flexibility loss, etc.)
- Remaining**
Plant/Line idle losses & planned downtime (traditional OEE, no shift, no order, PM)
- Remaining**
Breakdown, changeover, speed loss, misc. stoppages etc. (Traditional OEE). Downtime due to other reasons such as material shortage. NOT incl programmed in-cycle NVA)
- Remaining**
Product quality losses due to the robotics
- Remaining**
Downtime due to robotics iteration, NPI & CI modification
Re-spending on modification (hardware & software)
- Remaining**
Pre-resale reconditioning/restoring expending
- Lifecycle value (incl robotics resale value)**

Failure Modes

- Over or under capacity towards market needs. Building up specific capacity that the market will not need after the completion. The capacity is offset from customer product market trend (e.g. invested automation system for Full-electric vehicle but miss the market opportunity of hydrogen)
- Falling behind the technology early
Low robot utilization which cause over investment, over space and less efficient
- Miss balanced self-service and contract service capability. Service is dominated by limited or obsoleted resource
- Depreciation
Slowing down the ROI
- Low OEE during production. High operational cost. Long lead-time. inflexible
- "Efficiently creating defects"
- Falling behind on iteration such as AI learning
Heavy re-invest on making change
- Loss of resale value due to poor maintenance & iteration

What shall we do next?

Again, seeking your opinions

- Define the needs from the strategy such as 5W1H of future transformation. What's the purpose? And what's the scope?
- How can we assess internal org infrastructure and capability – both engineering and management – to plan for an effective automation/robotics management system?
- Is a small-scale automation transformation pilot needed? And what we are expecting from the pilot?
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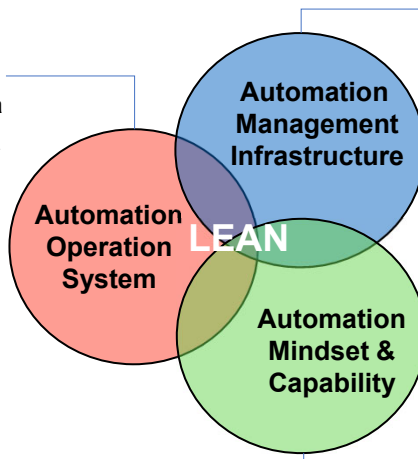


Automation strategy deployment / *Hoshin-kanri* - 3 key elements

For reference

Best ROI asset Value
Streams to maximize
value and minimize Muda

- Automation strategic planning & investment system
- Automation engineering development system
- Automation production management system
- Automation asset management system
- Automation incubator/iteration/modification/kaizen system



Organization, resources, roles & responsibilities, function agreements to support automation operation system

- Automation Hoshin-Kanri
- Automation system functional R&R and management flow
- Automation abnormality management system (i-ANDON)

Individual and team mindset and behavior, leader standard work, and automation capability to effectively run the management infrastructure

- Automation leader standardized work and lean behavior
- Automation capability / skill build system (training and i-DOJO)

• **Thank you!**



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