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Trade and Industrial Organization Support Funding:

To Excel HKSMEs' competitive advantages by Digital LEAN for Building Up the Foundation of Industry 4.0 Enterprises

Specification Report

HKPC Project Code: 10007440
TID Reference Code: T18004006

Project Start Date: 10 Jul 2019
Project Duration: 21 months

Approved by the Vice President on behalf of Hong Kong Mould and Product Technology Association Limited on

Vice President

Table of Content

1. Overview

1.1 Background

Based on the industry experience, currently most of manufacturing enterprises lack of real time data on the state of equipment performance like utilization, downtime, OEE, energy performance and etc. On the contrary, there is also rare on the labor production line for which real time performance like WIP rate, line balancing efficiency, first pass yield and etc.

It is a common practice in most of current situation that it is still relying on the manual data recording for which is not real time and inaccurate in sense. In this case, if the company would like to improve the operation for higher efficiency and productivity, due to the slow response of data, the improvement result would not be able to catch up the rapid change of market. As current practise, the data is manually recorded, which leads to latency of data availability. Due to the latency of data, it delays the data analysis, decision making and implementation. The whole improvement operation will be delayed and the efficiency will be affected, which leads to slow response to rapid change market. On the contrary, Digital LEAN enables data transparency through real time data acquisition, which leads to faster data availability and shorten the decision-making latency. Therefore, the real time data availability and transparency could excel the LEAN effectiveness. (See Appendix 7.2)

This report provides specified requirements of hardware and software to measure labour-intensive assembly line in order to practice Digital Lean and the procedure is outlined as below.

1. Define Existing Common Problems
2. Define lean Tools for addressing problems
3. Quantify factor for problem study
4. Define existing sensor/method for measurement
5. Define hardware and software requirements for auto-collecting real time data
6. Design Proof of Concept
7. Expected Result

Report provides a simple solution to collect and analyse real time data. Report shows that summarizing the problems and measurements, it could use sensors and Human-Machine interface to collect the real time data in one device and be able to demonstrate 3 different functions. All the real time data would also be analysed and displayed on dashboards for responsible people.

1.2 Purpose and Scope

The Industry 4.0 is a new level of organisation and control over the entire value chain of the life cycle of products, and the basis for i4.0 is the availability of all relevant information in real time by connecting all instances involved in the value chain. The connection of people, things, and systems create dynamic, self-organising, real-time optimised value-added connections within and across companies. Digital LEAN enables real time data collection of any value-added processes and simultaneous performance analysis within a manufacturing company.

Digital LEAN enhances productivity and efficiency of Hong Kong Industry, and also as a key enabler towards the foundation of Industry 4.0 (0i-1i), according to Industrie 4.0 Smart Factory Level (See Appendix 7.3) and prepare for detail implementation roadmap for 1i implementation, end-to-end real time data Acquisition which is a foundation for next stage 2i Real-time Data Processing & Integration. Apart from that, it also could help enterprise to speed up OBM/ODM transformation in researching and developing product or prototype through digital LEAN in the optimization of New Product Development Process. Furthermore, it could also increase the HKSMEs professional image and build up the solid foundation towards Industry 4.0. Finally, as also importantly, it could address the market demand of Digital LEAN solution and problems that the HKSMEs facing.

The report only suggests one possible solution to practice Digital Lean on labour-intensive assembly area which is common in different manufacturing industries (See Appendix 7.4). Many other solutions such as Video Imaging Analysis and Machine IOT and Machine Learning could also be used for practising Digital Lean, as long as the solution include data acquisition, data analysis and data visualization in a real time basis.

2. Product/Service Description

2.1 Problem Identification

In the labour intensive assembly line, many problems could be found generally and the corresponding lean tool with collecting data of key factors usually addresses those problems. Below table shown the problems, lean tools and corresponding key data factor.

Process	Potential Problems	Lean Tool	Key Data Factor
Quality Inspection	Manual Recording	Automation	No. of Defect
	Too many inspection stations	Quality At Source	Defect type
	Mis-judgment	Andon	No. of Defect
Manual Assembly	Line unbalance	Line Balancing	Processing time
	Too many WIPs	WIP Reduction	Idle time
	Bottleneck	Bottleneck Removal/ Line Balancing/ Takt Time analysis	Waiting time
	Overproduction	Waste Elimination	Response time
	Product loss	Visual Management	Labor efficiency
	Labor efficiency	ECRS / Ergonomic	Productivity
	Manual Recording	Automation	Output rate
	Jig and Fixture Maintenance Problem	Maintenance Optimization	Down time

However, using traditional Lean tools with manual record will cause response latency. In order to collect data in real time, sensor technology or other technology need to be defined for each problem.

2.2 Definition of the LEAN Tools and Data Measurement Method

Process	Potential Problems	Lean Tools	Key Data Factor	Possible Measuring Method
Quality Inspection	Manual Recording	Automation	No. of Defect	optical sensor weighing sensor pressure sensor
	Too many inspection stations	Quality At Source	Defect type	optical imaging
	Misjudge	Andon	No. of Defect	AOI
Manual Assembly	Line unbalance	Line Balancing	Processing time	Infrared sensor
	Too many WIPs	WIP Reduction	Idle time	Movement Recognition
	Bottleneck	Bottleneck Removal/ Line Balancing/ Takt Time analysis	Waiting time	optical sensor
	Overproduction	Waste Elimination	Response time	optical sensor
	Product loss	Visual Management	Labor efficiency	optical sensor
	Labor efficiency	ECRS / Ergonomic	Productivity	optical sensor
	Manual Recording	Automation	Output rate	optical sensor
	Jig and Fixture Maintenance Problem	Maintenance Optimization	Down time	optical sensor

3. Tool Kit Requirements

Based on the result of study, those data can be collected by an integrated solution tool kit with following specification. The Tool Kit will consist of sensors, Human Machine Interface for data acquisition and visual dashboard for data visualization.

3.1 Functional Requirements

3.1.1 Hardware

Analyzer Appliance Gateway (Max. size 214mm x200mm x52mm)

- Redundant Wireless profile and configuration (400~520MHz)
- Data logging & Alarm
- Interfacing to third party server
- System configuration
- Web Server Engine included
- Support up to 32 remote node

Analyzer

- Display: 5"TFT True Color (16：9), Touch Screen
- Resolution: 800×480
- CPU: TI Industrial Grade Cortex A8
- RAM ： 512MB DDR3 SDRAM
- Storage ：256MB SLC Nand Flash
- Extended Storage： SD Card 32 G
- Power Consumption： 3.4W
- Input Power： DC 24V
- Communication: Vivi Mesh Module Support
- Dimension:
  - Main unit: 165 mm x 105 mm x 32 mm
  - Base Unit: 105 mm x 64 mm x 32 mm
- Language display
- Chinese (default)
- Monitor size: 5” LCD Display
- Power adapter
- Mounting kit

Appliance Server Hardware Specification

- CPU: Intel
- RAM: 4GB/DDR3
- Hard disk: 128GB
- Power Supply: 60W
- No. Core CPU: 4
- CPU frequency: 1.8GHz-2.4GHz
- Wireless: Vivi Mesh support
- RAM Frequency: 1333MHz
- Hard disk type: Solid State Drive

- Core chip set: Intel NM10
- CPU type: g4400

Wireless Gateway Hardware Specification

- CPU: Broadcom BCM2837, quad-core Cortex-A53 1.2GHz
- RAM: 1GB LPDDR2
- Storage eMMC flash, 4GB - 64GB, soldered on-board
- Micro-SD socket
- LAN: 2x 100Mbps Ethernet ports,
- Vivi Mesh interface
- Display and Audio
- USB: 4x USB2.0 host, type-A connectors
- Serial: 1x RS232 port, ultra-mini serial connector
- CAN: 1 x CAN bus, RJ11 connector
- RS485 1x RS485 port, half-duplex 2-wire, RJ11 connector
- Digital I/O 6x DIO, 5V tolerant, 100-mil header
- Real time clock
- Security Hardware protection against unauthorized boot from external storage
- Unregulated 10V to 36V
- Dimensions 112 x 84 x 34 mm (industrial temperature housing)
- Weight 450 gram
- MTTF > 200,000 hours
- Operation Temperature: 0° to 60° C
- Relative Humidity: 10% to 90% (operation)
- 05% to 95% (storage)

Sensor Specification

- Infrared diffuse reflection Photoelectric switch sensor
- Distance: 10-30cm
- Adjustable sensitivity

Others

- Mounting
  - Desktop
  - Rail Mounting
- Installation
  - Mounting remote unit and supply power
  - Power on the appliance Server
  - The remote unit will auto discovery and appear in the status monitor dashboard
  - It will start capture the data
- Wiring
  - Connect the adapter to power socket
  - Power up and start working
- Analyzer button functions
  - The button is customized by software in system configuration

- Variables configuration
  - Variable can be configured via the system setup
- Battery operate for 3 hours

3.1.2 Software

The tool kit function as below.

- Processing time, waiting time and WIP data real time acquisition
- Human Machine Interface with Andon and defect key-in

3.2 User Interface Requirements

The visualization level will divide into 3 levels for different users.

- Front Line management (i.e. Line leader)

Data Type	Display Chart	Remarks
Processing time of each workstation	Line chart	• To compare the takt time and find out the bottleneck
WIP of each workstation	Line chart	• To compare the limited WIP
Hourly output	Bar Chart	• To monitor the hourly output and target output
Overall processing time	Pie Chart	• Display the VA and non-VA time percentage
No. of defect over time	Line Chart	• To alert the defect rate when it rising in short
Defect reason	Bar chart	• Distribution of defect
Idle time for operators	Bar chart	• Waiting time and repairing time of machine repairing for each case

- Middle management (i.e. Production Supervisor)

Data Type	Display Chart	Remarks
Processing time of each workstation per production line	Line chart	• To compare the takt time and find out the bottleneck
Production situation per production line	Clustered 2-Column Chart	• Compare the planned production and real time situation
Daily output over period per production line	Line chart	• To monitor the daily output and target
Overall processing time per production line	Pie Chart	• Display the VA and NVA time percentage

Defect rate per hour	Line Chart	• To monitor the quality stability
Idle time for each mechanic	Bar chart	• Evaluate their performance

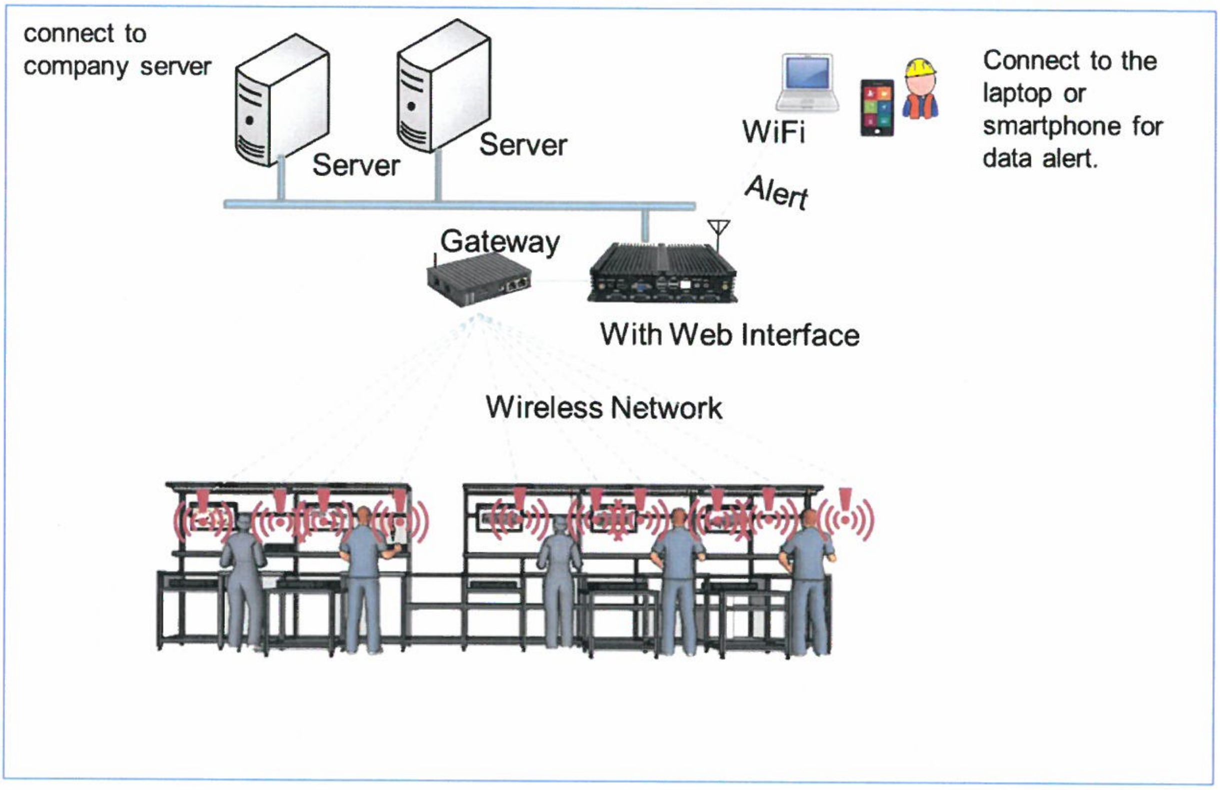
– Top management (i.e. General Manager)

Data Type	**Display Chart**	**Remarks**
Processing time of each workstation	Line chart	• To compare the takt time • Highlight the workstation which is unbalanced
Production situation per production	Clustered 2-Column Chart	• Compare the planned production and real time situation
Overall processing time	Pie Chart	• Display the VA and non-VA time percentage
Average Idle time for each problem	Clustered Column Chart	

3.3 Setup Requirement

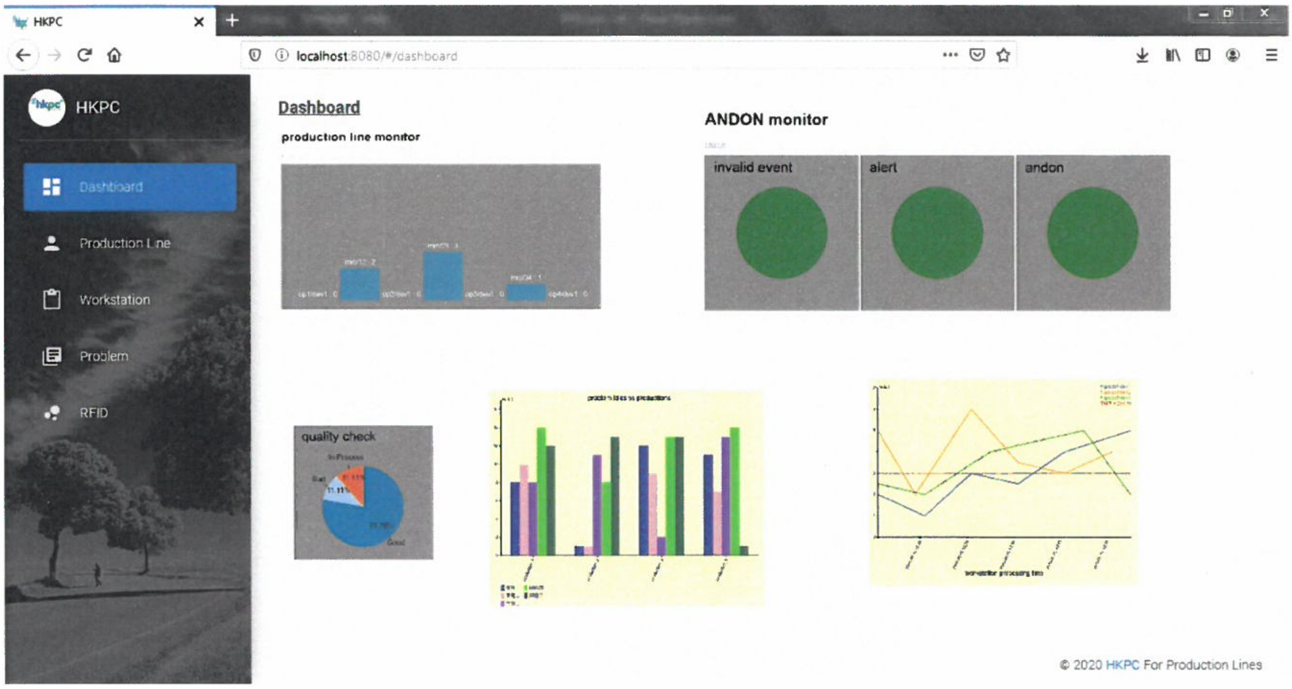
3.3.1 Schematic diagram

- Below schematic diagram shown the setup demonstrating the all-in-one solution to capture, monitor, report and analyse the production line performance and efficiency.
- With the latest in IoT, RFID and other smart technology, it allows data capturing easily and accurately with minimum human intervention.
- It contains its own wireless network that cover 200 meter end-to-end (standalone wireless connection to digital devices like laptop or smartphone for visualization and alert purpose.
- All component including the gateway, server, workstations and accessories are packaged into one transportable case, it can easy to deploy.



3.3.2 Expected Performance

Expected dashboard will be as below to show different production lines productivity, operator efficiency and quality problems in real time.



4. Verification

4.1 Definition of Test Script

Below testing script is for verifying the specification.

4.1.1 Testing Scenario of Processing Time Collection

Input Parameter:

D = Detectable distance
C = Standard processing time
C' = Allowance in percentage
S_1 ,S_2 ,S_3 ,S_4 =Sensor
S_a = Actual processing time in Station 1
S_b = Actual Waiting time
O = Object

Alert Rule:

1. Actual Processing time > Standard Processing time with allowance for 3 times (accumulate)
2. Waiting time > Standard Processing time with allowance for 3 times
3. Accumulate 3 or above invalid records
4. WIP > 3

Expected result:

Abnormal → instant alert or accumulate record is hit 3 times à instant alert
Invalid → no need to count
Normal → need to count and no need to alert
No record → Sensor does not record anything

	Input Parameter				Scenario Setting						
Scenario	D	C (in sec)	C' (%)	WIP	S_1	S_2	S_3	S_a (S_2-S_1)	S_b (S_3-S_2)	Detective Zone	Expected Result
1	40 cm	5	20	3	O is staying at S_1	-	-	-	-	0 - 30cm	Invalid Record
2	40 cm	5	20	3	O is traveling back and forth quickly	-	-	-	-	0 - 30cm	Invalid Record
3	40 cm	5	20	3	O Passed *10	O Passed*10	-	All are within 4 – 6 s	-	0 - 30cm	Normal
4	40 cm	5	20	3	O Passed *10	O Passed*10	-	2 of records are 2s	-	0 - 30cm	Normal
5	40 cm	5	20	3	O Passed *10	O Passed*10	-	2 of records are 7s	-	0 - 30cm	Normal but accumulate record
6	40 cm	5	20	3	O Passed *10	O Passed*10	-	3 of records are 7s	-	0 - 30cm	Abnormal
7	40 cm	5	20	3	O Passed *10	O Passed*7	-	All are within 4 – 6 s	-	0 - 30cm	3 invalid records and abnormal
8	40 cm	5	20	3	O Passed *10	O Passed*7	-	3 of records are 7s	-	0 - 30cm	Abnormal
9	40 cm	5	20	3	O Passed*8	O Passed *10	-	All are within 4 – 6 s	-	0 - 30cm	2 invalid record
10	40 cm	5	20	3	O Passed*7	O Passed *10	-	All are within 4 – 6 s	-	0 - 30cm	3 invalid records and abnormal
11	40 cm	5	20	3	O Passed	O is staying at S_2	-	-	-	0-30cm	Invalid Record
12	40 cm	5	20	3	O passed	O is traveling back and forth quickly	-	-	-	0-30cm	Invalid Record
13	40 cm	5	20	3	O Passed *10	O Passed*10	-	All are within 4 – 6 s	-	41-50cm	No record
14	40 cm	5	20	3	O Passed *10	O Passed*10	O is staying at S3	All are within 4 – 6 s	-	0-30cm	Invalid Record
15	40 cm	5	20	3	O Passed *10	O Passed*10	O is traveling back and forth quickly	All are within 4 – 6 s	-	0-30cm	Invalid Record

16	40 cm	5	20	3	O Passed *10	O Passed*10	O passed *1	All are within 4 – 6 s	9 of records > C with C'	0-30cm	Abnormal
17	40 cm	5	20	3	O Passed *10	O Passed*10	O passed *7	All are within 4 – 6 s	3 of records > C with C'	0-30cm	Normal but accumulate record
18	40 cm	5	20	3	O Passed *10	O Passed*10	O passed *10	All are within 4 – 6 s	no. WIP within standard	0-30cm	Normal
19	40 cm	5	20	3	O Passed *10	O Passed*10	O passed *10	All are within 4 – 6 s	no. WIP within standard	41-50cm	No record

4.1.2 Testing Scenario of Defect Key-In (For inspection process)

Input Parameter:
F = allowance number of defects
C = Standard processing time
C' = Allowance in percentage
S1 ,S2 =Sensor
Sa = Actual processing time in Station 1
A = Remote Unit
O = Object

Alert Rule:
1. Actual Processing time > Standard Processing time with allowance for 3 times (accumulate)
2. Waiting time > Standard Processing time with allowance for 3 times
3. Accumulate 3 or above invalid records
4. Accumulate 3 or above defectives

Expected result:
Abnormal→ instant alert or accumulate record is hit 3 times à instant alert
Invalid → no need to count
Normal → need to count and no need to alert
No record → Server does not record anything

	Input Parameter			Scenario Setting				
Scenario	**F**	**C (in sec)**	**C' (%)**	**S_1**	**A**	**S_2**	**S_a (S_2-S_1)**	**Expected Result**
1	3	5	20	O Passed *10	-	O Passed*10	All are within 4 – 6 s	Normal and all pass goods
2	3	5	20	O Passed *10	2 input	O Passed*8	All are within 4 – 6 s	Normal and record 2 defects
3	3	5	20	O Passed *10	3 input	O Passed*7	All are within 4 – 6 s	Abnormal
4	3	5	20	O Passed *10	5 input	O Passed*5	All are within 4 – 6 s	Abnormal and alert when defects hit 3 times
5	3	5	20	O Passed *10	1 input	O Passed*10	All are within 4 – 6 s	1 invalid records and normal
6	3	5	20	O Passed *2	2 inputs	-	The time between 2 Input is too short	Invalid Record
7	3	5	20	O Passed*2	-	O Passed *5	All are within 4 – 6 s	3 invalid record and abnormal

4.1.3 Testing Scenario of Andon

Input Parameter:
W = allowance waiting time
R = Standard repairing time
A = Remote Unit
C1 = Mechanics card
C2 = Supervisor card
t1 = operator input time
t2 = mechanics arrival time
t3 = supervisor approval time
ta = actual waiting time
tb = actual repairing time

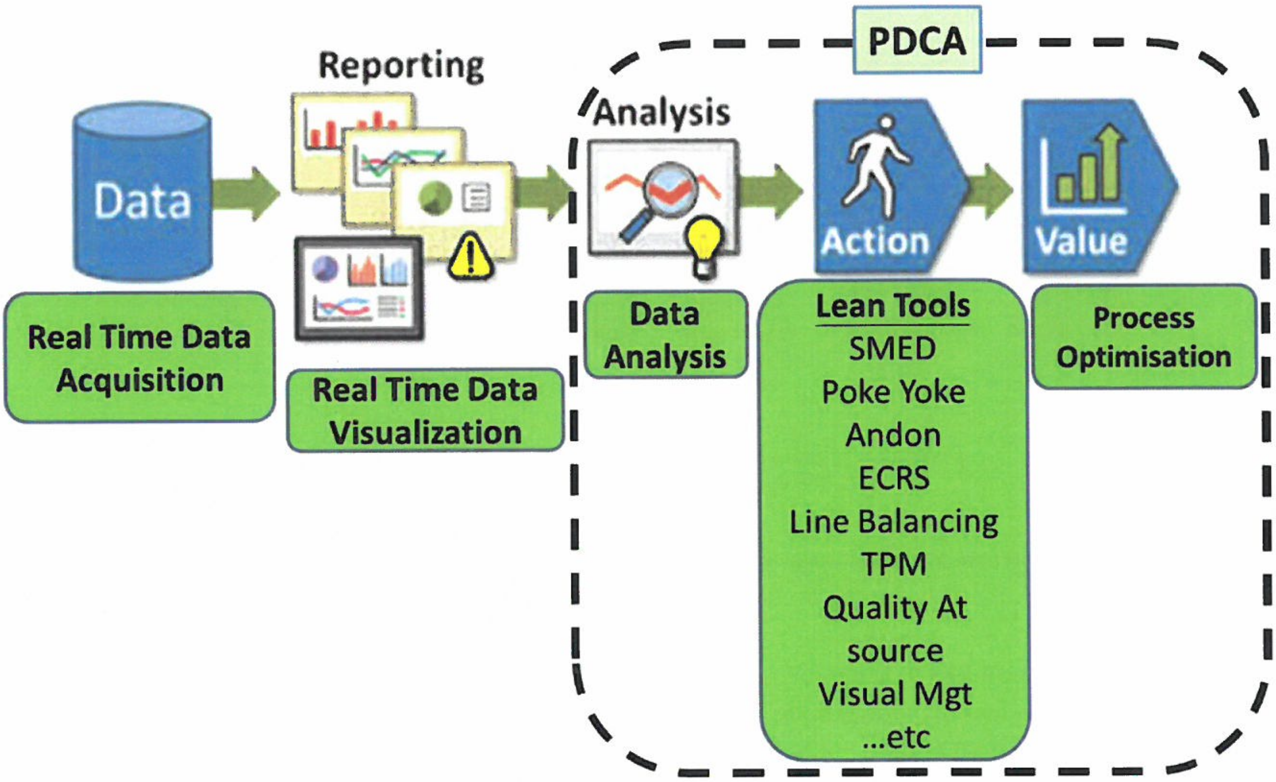
Alert Rule:
1. Waiting time > standard waiting time for 3 times
2. accumulate 3 or above invalid records
3. C1 is read by other A while repairing

Expected result:
Abnormal à instant alert or accumulate record is hit 3 times à instant alert
Invalid à no need to count
Normal à need to count and no need to alert

	Input Parameter		Scenario Setting					
Scenario	W in sec	R in sec	A			t_a	t_b	Expected Result
			t_1	t_2	t_3	$t_2 - t_1$	$t_3 - t_2$	
1	5	10	Operator input once	C1 is read	C2 is read	within 5 sec	within 10 sec	Normal
2	5	10	Operator input twice	-	-	-	-	1 invalid record
3	5	10	Operator input once	C1 is read	-	7 sec	-	abnormal and accumulate record
4	5	10	Operator input once	C1 is read twice	-	within 5 sec	-	1 invalid record
5	5	10	Operator input once	C1 is read	C2 is read	within 5 sec	within 1 sec	t3 record is invalid
6	5	10	Operator input once	C1 is read	C2 is read twice	within 5 sec	within 10 sec	1 invalid record

5. Digital Lean Methodology Model

The below diagram showing the methodology model of Digital Lean. In this report, by the adoption of sensor technology (as illustrated in section 2.2) for the real time data acquisition and through digital tool kit (as illustrated in section 3), real time dashboard can be visualized on a real time basis for tracking, monitoring and analysis.



PDCA (Plan-Do-Check-Act) is an iterative, four-stage approach for continually improving processes, products or services, and for resolving problems. The PDCA Cycle provides a simple and effective approach for solving problems and managing change. It enables businesses to develop hypotheses about what needs to change, test these hypotheses in a continuous feedback loop, and gain valuable learning and knowledge. It promotes process optimisation on a small scale before updating company-wide procedures and work methods.

The PDCA cycle consists of four components:

Plan – Identify the problem, collect relevant data, and understand the problem's root cause, develop hypotheses about what the issues may be, and decide which one to test.

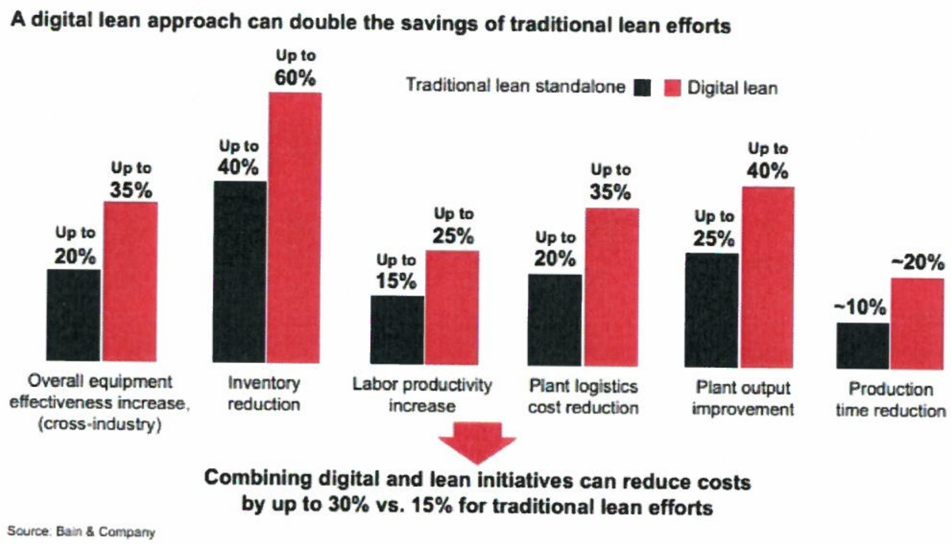
Do – Develop and implement a solution; adopt appropriate lean tools (as shown in the diagram) to gauge its effectiveness, test the potential solution, and measure the results.

Check – Confirm the results through before-and-after data comparison. Study the result, measure effectiveness, and decide whether the process optimisation is supported or not.

Act – Document the results, inform others about process changes, and make recommendations for the future PDCA cycles. If the solution was successful, implement it. If not, tackle the next problem and repeat the PDCA cycle again.

6. Summary

The solution showing in this report provides the concept of using sensors to collect data. The key point of getting the data in real time is to find out the critical factor(s) of the production line and quantify it. In this report, it demonstrates using cost-effective technology to practise Digital Lean concept. The expected result of practising Digital Lean will be as below.



Source: Digital Tools Can Double Lean Six Sigma Savings - Bain & Company

Figure 1

According to the study from Bain & Company, when comparing implementation of Digital Lean to Traditional Lean, it can increase labor productivity by up to 20%, output improvement by up to 40%, and reduce production time by up to 20%. (See *Figure 1*)

7. Appendix

7.1 Abbreviation

Terms		Explanation
Digital LEAN		A digital systematic method for waste minimization within a manufacturing system without sacrificing productivity, which can cause problems.
CNC	Computer Numerical Control	A method for automating control of machine tools through the use of software embedded in a microcomputer attached to the tool. It is commonly used in manufacturing for machining metal and plastic parts.
OEE	Overall Equipment Effectiveness	Evaluation of how effectively a manufacturing operation is utilized
SCADA system	Supervisory Control and Data Acquisition	A control system architecture that uses computers, networked data communications and graphical user interfaces for high-level process supervisory management.
WIP	Work-In-Progress	in-process inventory are a company's partially finished goods waiting for completion and eventual sale or the value of these items.
OBM	Original brand manufacturer	A company that sells an entire product made by a second company or including a component from a second company sources as its own branded product. Selling the product of the second company under its own brand just adds a virtual extrinsic value to the product.
ODM	Original design manufacturer	A company that designs and manufactures a product, as specified, that is eventually rebranded by another firm for sale.
Quick Changeover (SMED) Techniques	Single minute of exchange die	one of the many lean production methods for reducing waste in a manufacturing process
Bottleneck		one process in a chain of processes, such that its limited capacity reduces the capacity of the whole chain
Quality At Source		Lean manufacturing principle which defines that quality output is not only measured at the end of the production line but at every step of the productive process and being the responsibility of each individual who contributes to the production or on time delivery of a product or service.
Value Stream Mapping		lean management tool that helps visualize the steps needed to take from product creation to delivering it to the end-customer. As with other business process mapping methods, it helps with introspection (understanding your business better), as well as analysis and process improvement.

Visual Management		business management technique employed in many places where information is communicated by using visual signals instead of texts or other written instructions. The design is deliberate in allowing quick recognition of the information being communicated, in order to increase efficiency and clarity.
Line Balancing		manufacturing-engineering function in which whole collection of production-line tasks are divided into equal portions. Well-balanced lines avoid labor idealness and improve productivity.
Takt Time Analysis		Takt time is the average time between the start of production of one unit and the start of production of the next unit, when these production starts are set to match the rate of customer demand.
Poke Yoke Initiative		any mechanism in any process that helps an equipment operator (yoke) avoid mistakes (poke). Its purpose is to eliminate product defects by preventing, correcting, or drawing attention to human errors as they occur.
Kaizen		Kaizen is an approach to creating continuous improvement based on the idea that small, ongoing positive changes can reap major improvements.
ECRS	Eliminate, Combine, Rearrange & Simplify	one of the lean improvement methods. Idea is to look at the process and ask ECRS questions and then execute to remove/reduce waste.
Andon		referring to a system to notify management, maintenance, and other workers of a quality or process problem. The alert can be activated manually by a worker using a pull cord or button or may be activated automatically by the production equipment itself. The system may include a means to stop production so the issue can be corrected. Some modern alert systems incorporate audio alarms, text, or other displays.
Ergonomic		the scientific study of people and their working conditions, especially done in order to improve effectiveness
AOI	Automated Optical Inspection	a method of using optics to capture images to see if components are missing, if they are in the correct position, to identify defects, and to ensure the quality of the manufacturing process

7.2 Reference

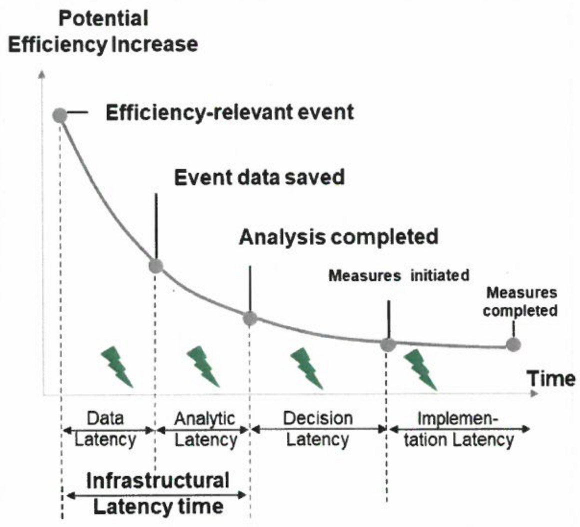


Figure 1a

As shown in Figure 1a, as current practise, the data is manually recorded, which leads to latency of data availability. Due to the latency of data, it delays the data analysis, decision making and implementation. The whole improvement operation will be delayed and the efficiency will be affected, which leads to slow response to rapid change market.

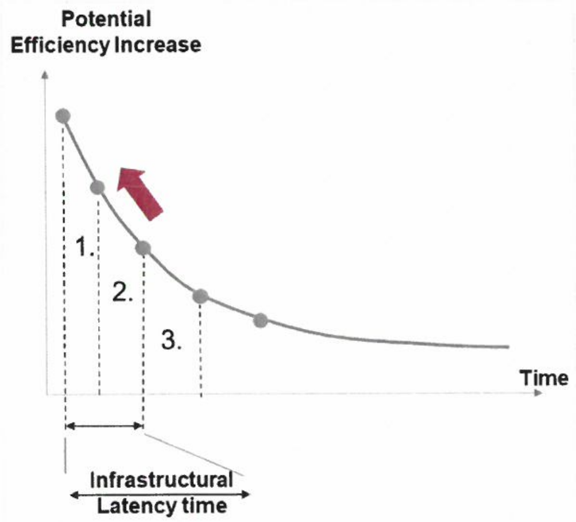


Figure 1b

On the contrary, as shown in Figure 1b, Digital LEAN enables data transparency through real time data acquisition, which leads to faster data availability and shorten the decision-making latency. Therefore, the real time data availability and transparency could excel the LEAN effectiveness.

Source: WZL Benchmarking-Studie Production Systems (2009) Business Process Analytics

7.3 Industrie 4.0 Smart Factory Level

Smart Factory Level			Smart Factory Characteristics & Requirements
4i	i4.0 - Intelligent, Autonomous Processes & Self Organizing System (4i)	Self-optimizing processes and autonomous control of product and process along the value chain	▪ Autonomous automation (Smartify!) ▪ Self-learning, self-organizing and self-optimization ▪ Horizontal integration along value chain
3i	i4.0 - Integration of Cyber-Physical System (3i)	Mobile assistance systems and human-machine/machine-machine collaboration for decentralized decision-making	▪ Decentralized decision-making ▪ HMI/MMI, Industrial apps ▪ Mobile assistance systems ▪ Close-loop process optimization
2i	i4.0 - Real-time Data Processing & Integration (2i)	Development of knowledge and insights through the analysis and aggregation of all available information and data sources	▪ Full digitalization & aggregation of real time data ▪ Smart Data analytics ▪ Improving forecast ability & decision making
1i	i4.0 - Real-time Data Generation (1i)	Generation and availability of data and information of all activities in real time	▪ Data acquisition by sensor and machine IoT (M2M) in real time for process understanding ▪ Vertical integration (Business & Production) ▪ Well established "Single Source of Truth"
0i	i4.0 - Frame Condition (0i)	Organizational and infrastructural enablers for the implementation of Industry 4.0	▪ Industry 4.0 awareness and culture built ▪ IT-infrastructure and data security ▪ Lean processes & reasonable automation ▪ Advanced tools adopted & mastered
-1	Industry 3.0	Predominantly Industry 3.0 process (Discrete Automation)	▪ Discrete automation ▪ Discrete IT system application adopted
-2	Industry 2.0	Predominantly Industry 2.0 process (Division of Labour)	▪ Strong division of labor ▪ No information technology/system adopted

Source: Developed by Fraunhofer IPT & HKPC, 2015

7.4 HK Manufacturing Industries/Manufacturing Processes Matrix

Define the production process in different manufacturing industries.

	Toys	Home Appliance	Garment	Automotive	Metal components	Moulding	Medical Device	Printing & Packaging	Electronic	Optical	Food	Textile	Jewelry	Watch and Clock	Total
Inspection	o	o	o	o	o	o	o	o	o	o	o	o	o	o	14
Manual Assembly	o	o	o	o	o	o	o	o	o	o	o	x	o	o	13
Semi auto Assembly	o	o	x	o	o	o	o	o	o	o	o	x	o	o	12
CNC Machining	o	x	x	x	o	o	x	x	o	o	x	x	o	o	7
Polishing	o	x	x	x	o	o	x	x	x	o	x	x	o	o	6
Spraying	o	o	x	o	o	x	x	o	x	x	x	x	x	x	5
Die casting	o	o	x	o	o	o	x	x	x	x	x	x	x	x	5
Pressing	o	o	x	x	o	o	o	x	x	x	x	x	x	x	5
Injection	o	o	x	x	x	o	o	x	x	x	x	x	x	x	4
Pad Print	o	o	x	x	x	x	x	o	o	x	x	x	x	x	4
Cutting	x	x	o	x	x	x	x	o	x	o	x	x	x	x	3
Sewing	o	x	o	x	x	x	x	x	x	x	x	x	x	x	2
Printing	x	x	o	x	x	x	x	o	x	x	x	x	x	x	2
EDM	x	x	x	x	x	o	x	x	x	x	x	x	x	x	1
Wire cutting	x	x	x	x	x	o	x	x	x	x	x	x	x	x	1
SMT	x	x	x	x	x	x	x	x	o	x	x	x	x	x	1

The result shows that Inspection Manual Assembly are the most common process in all industries. As this project aims to focus on labour-intensive assembly line, Semi Auto Assembly would not be considered as one of the project focus processes.