

2a) MACHINE CAPABILITY STUDIES HELP PROVIDE INFORMATION ON TOTAL PROCESS PERFORMANCE.

Before CONDUCTING A MACHINE CAPABILITY STUDY:

- EQUIPMENT MUST BE CALIBRATED
- PARTS MUST BE ACCEPTABLE
- AN UNINTERRUPTED RUN UNDER STANDARD CONDITIONS

b) C_m INDEX IS MACHINE CAPABILITY: IT IS THE NUMBER OF TIMES THE SPREAD FITS WITHIN THE TOLERANCE WIDTH. THE HIGHER THE C_m VALUE, THE BETTER THE MACHINE

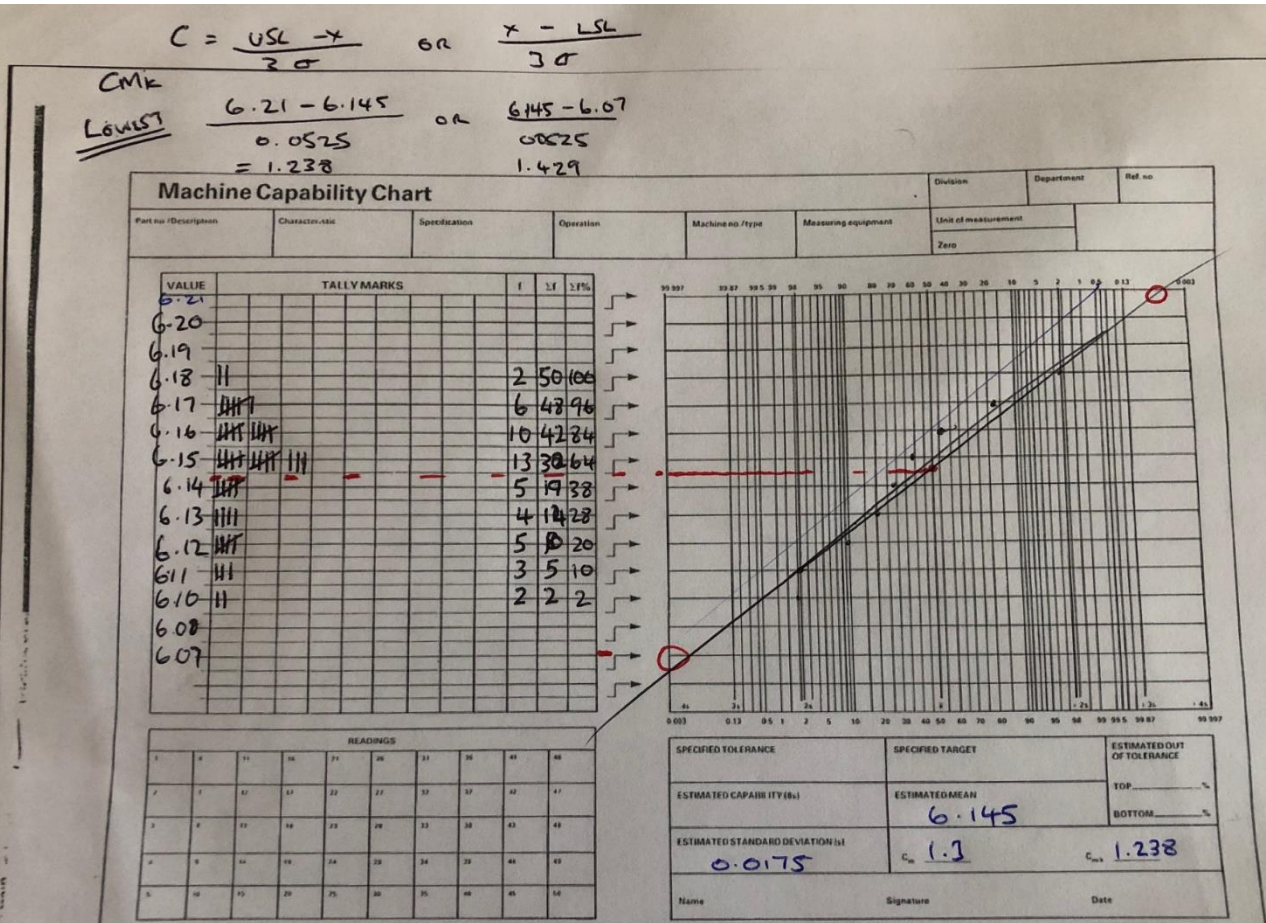
A C_m ABOVE 1 IS ACCEPTABLE, ~~WITH~~ A C_m OF 1.3 IS ^{DESIRED} ~~VERY GOOD~~

C_{mk} IS THE POSITION OF CAPABILITY IN RELATION TO THE TARGET. HIGH C_{mk} INDEX SHOWS THE MACHINE HAS A SMALL SPREAD, AND IS WELL CENTERED WITHIN THE WIDTH

c) THIS IS THAT ~~VALUE~~ ^{THAT} OF σ_s FALLS WITHIN SPECIFICATION LIMITS. THE VARIABILITY IN THE MACHINE MUST BE LOWER THAN IF ONLY σ_s FELL WITHIN LIMITS.

THERE IS A BETTER CHANCE THAT THE TIME THE MACHINE IS COMBINED WITH OTHER ITEMS ON OTHER MACHINES WITH DIFFERENT OPERATORS/MATERIALS/ENVIRONMENTS, THAN σ_s FOR THE PROCESS WILL FALL WITHIN PROCESS SPEC.

2b Machine capability chart.



$$8s = 6.21 - 6.07 = 0.14 \quad CM = \frac{\text{TOTAL TOL}}{6 \text{ STD DEV}} = \frac{0.14}{0.105} = 1.3$$

$$s = 0.14 / 8 = 0.0175$$

$$3a) L_d = 130 + 50 + 130 = 310$$

$$L_e = 70 + 50 + 70 = 190$$

$$b) T_c = T_i + \frac{L_d}{V_c} + T_v + \frac{L_e}{V_c}$$

$$T_c = 0.7 + \frac{310}{40} + 0.7 + \frac{190}{40}$$

$$T_c = 13.9 \text{ mins}$$

$$iii) WL = RFFC (85 \times 13.9)$$

$$WL = 1181.5 \text{ mins/Hr}$$

$$AT = 60 \times 0.8 \times 0.9 \times 0.85$$

$$AT = 36.72 \text{ min/Hr per vehicle}$$

$$NC = \frac{WL}{AT} \quad NC = \frac{1181.5}{36.72}$$

$$NC = ~~32.176~~ 32.176 \text{ VEHICLES}$$

$$\therefore NC = 33 \text{ VEHICLES}$$

$$7iii) E_h = \frac{7.75 \times 0.9}{13.9} \quad E_h = \frac{L_d/V_c}{L_d/V_c + T + L_e/V_c} \times 100$$

$$E_h = 50\%$$

THE EFFICIENCY OF THE SYSTEM IS 50%.

RS - ROUTING AIMS TO TAKE THE MOST EFFICIENT ROUTE TO THE LOAD/UNLOAD STATION WILL IMPROVE OVERALL EFFICIENCY. AN IMPROVEMENT IN AVAILABILITY FROM ~~0.8~~ 80% SHOULD ALSO BE

TARGETED.

WITH DECREASED TRAVEL DISTANCES FOR AGVs,
LESS AGVS WILL BE REQUIRED, CUTTING COSTS.

36 BEFORE PURCHASING CONVEYORS, IT MUST FIRST
BE CONSIDERED THE TYPE REQUIRED. SOME TYPES
CAN BE SEEN BELOW

- ROLLER CONVEYOR
- BELT CONVEYOR
- CHAIN CONVEYOR
- OVERHEAD TROLLEY CONVEYOR

IT MUST ALSO BE CONSIDERED WHETHER A
POWERED OR NON-POWERED IS REQUIRED.

EACH TYPE OF CONVEYOR CAN ALSO BE CLASSIFIED
AS

- SINGLE DIRECTION
- CONTINUOUS LOOP
- RECIRCULATING

SINGLE DIRECTION

ARE USED TO TRANSPORT LOADS ONE WAY
TO FINAL DESTINATION.

THESE SYSTEMS ARE APPROPRIATE WHEN LOADS ARE
ONLY NEEDED TO GO IN ONE DIRECTION.

CONTINUOUS LOOP

FORM A COMPLETE CIRCUIT (~~IN AN AIRPORT~~
~~BAGGAGE HALL~~). THIS SYSTEM ALLOWS MATERIALS
TO BE TRANSPORTED BETWEEN ANY TWO STATIONS ON
A PATHWAY

RECIRCULATING

ALLOWS MATERIALS TO STAY ON THE CONVEYOR FOR
ONE OR MORE REVOLUTIONS (AIRPORT BAGGAGE HALL)

FOR SINGLE DIRECTION CONVEYORS, IT IS IMPORTANT TO DETERMINE FLOW RATE BY THE LOADING AND UNLOADING. THIS IS LIMITED BY THE RECIPROCAL OF TIME REQUIRED TO LOAD.

$$R_F = R_L = \frac{V_c}{S_c} \leq \frac{1}{T_L}$$

WHERE:

R_F = MATERIAL FLOW RATE (PARTS/MIN)

R_L = LOADING RATE (PARTS/MIN)

S_c = CENTRE TO CENTRE SPACING OF MATERIALS (M)

T_L = LOADING TIME

FOR CONTINUOUS LOOP CONVEYORS, THE LOOP IS DIVIDED INTO TWO SECTIONS

- DELIVERY (L_d)
- RETURN (L_r)

THEREFORE TOTAL LENGTH (L) IS $L_d + L_r$.

TOTAL TIME TO COMPLETE THE LOOP CAN BE EXPRESSED AS $T_c = \frac{L}{V_c}$

WHERE:

V_c = SPEED OF CONVEYER (M/MIN)

T_c = TOTAL CYCLE TIME (MIN)

RECIRCULATING CONVEYOR WORK ON TWO PRINCIPLES

- SPEED RULE
- CAPACITY CONSTRAINT
- UNIFORMITY PRINCIPLE

SPEED RULE,

4.

LEAN MANUFACTURING IS EXTREMELY COMMON IN THE MANUFACTURING INDUSTRY. IT IS AIMED AT EFFICIENT USE OF RESOURCES TO PRODUCE GOOD QUALITY PRODUCTS. BY FOCUSING ON THE PROCESS THE PRODUCTION TIMES, COSTS OF PRODUCTION ARE OPTIMISED. FOR THIS PROCESS TO WORK EFFECTIVELY, MANUFACTURING INDUSTRIES FOLLOW THE 5 PRINCIPLES OF LEAN, WHEN IMPLEMENTING LEAN TECHNIQUES.

VALUE

BEFORE DEFINING CUSTOMER VALUE, IT IS IMPORTANT TO UNDERSTAND WHAT VALUE IS. IT IS WHAT DETERMINES ~~HOW MUCH~~ A CUSTOMER IS WILLING TO PAY FOR.

THIS, IN TURN, DETERMINES HOW MUCH A CUSTOMER WILL PAY FOR A PRODUCT OR SERVICE. TARGET COSTING FOCUSES ON WHAT THE CUSTOMER FINISHES VALUABLE.

IF A CUSTOMER IS BUYING A NOVEL PRODUCT, IT MAY BE DIFFICULT TO ARTICULATE WHAT IS REQUIRED. USING QUALITATIVE AND QUANTITATIVE TECHNIQUES (INTERVIEW, SURVEY, WEB ANALYTICS) IT IS POSSIBLE TO DISCOVER WHAT IS WANTED, HOW IT IS DELIVERED, AT THE RIGHT PRICE. IT IS THE COMPANY'S JOB TO ELIMINATE WASTE AND COST FROM PROCESSES TO ACHIEVE CUSTOMER SATISFACTION AND PROFIT.

VALUE STREAM

IDENTIFYING AND MAPPING THE VALUE STREAM, FROM RAW MATERIAL THROUGH TO DISPOSING OF THE PRODUCT, ALLOWS A COMPANY TO UNDERSTAND WASTES AND VALUE ADDING ACTIVITIES ASSOCIATED WITH A PRODUCT. WASTE CAN BE BROKEN DOWN TO 2 CATEGORIES

- NON VALUE ADDING, BUT ~~NECESSARY~~ NECESSARY.
- NON VALUE ADDING, UN-NECESSARY.

NON VALUE ADDING, BUT NECESSARY SHOULD REDUCED AS MUCH AS POSSIBLE. NON VALUE ADDING AND VN-NECESSARY SHOULD BE ELIMINATED.

LEAN PROMOTES SUPPLIER / CUSTOMER PARTNERSHIPS TO REMOVE WASTE FROM THE VALUE STREAM.

flow

AN IMPORTANT FACTOR FOR ELIMINATING WASTE IS FLOW. FLOW ENSURES ALL STEPS OF THE PROCESS RUN SMOOTHLY, WITH NO DELAY OR INTERRUPTIONS.

STRATEGIES TO ACHIEVE GOOD FLOW OF VALUE ADDING ACTIVITIES INCLUDE:

- RECONFIGURATION OF PRODUCTION STEPS
- LEVELLING WORKLOAD
- MULTI-SKILLED WORKFORCE

THIS WILL MINIMIZE WASTE AND INCREASE VALUE TO THE CUSTOMER.

PULL

PULL ENSURES THAT NOTHING IS MADE AHEAD OF TIME, REDUCING WIP, LIMITING INVENTORY. INVENTORY IS A LARGE WASTE IN PRODUCTION SYSTEMS.

PULL BASED SYSTEMS ALLOW JIT DELIVERIES AND AT THE QUANTITIES REQUIRED. THESE SYSTEMS ARE CREATED FROM THE NEED OF THE CUSTOMER.

PERFECTION

LEAN ORGANISATIONS AIM FOR PERFECTION. IT MAKES LEAN THINKING AND PROCESS IMPROVEMENT A PART OF THE CULTURE. ALL STAFF SHOULD AIM FOR PERFECTION WHILST DELIVERING PRODUCTS BASED ON CUSTOMER NEEDS.

REMOVING THE ROOT CAUSE OF POOR QUALITY FROM PROCESSES SYSTEMATICALLY SHOULD BE ACHIEVED.

THERE ARE NUMEROUS COSTS THAT GO IN TO PRODUCING AND SELLING PRODUCTS. SOMETIMES, THESE COSTS ENHANCE THE PRODUCT, WHILST SOME ARE UNSEEN COSTS, THAT DO NOT ENHANCE THE PRODUCT, BUT ARE STILL ESSENTIAL TO PRODUCTION OR SALE. THIS IS WHERE THE CONCEPT OF VALUE ADDED AND NON VALUE ADDED COSTS ARE SHOWN.

FOR LEAN TO WORK, VALUE ADDING ACTIVITIES ~~AT~~ MUST BE DEFINED. VALUE ADDED COSTS IS A COST THAT ~~ADD~~ ^{IMPROVES} QUALITY ~~OR~~, SERVICE, OR ENHANCES THE CUSTOMER PERCEPTION. VALUE ADDED COSTS ARE AN EXPENSE THE CUSTOMER IS WILLING TO PAY FOR (NEXT DAY DELIVERY). BY CONTRAST, A NON-VALUE ADDING COST INCREASES THE TOTAL COST OF A PRODUCT OR SERVICE, BUT DOES NOT OUTWARDLY ENHANCE VALUE OR CUSTOMER PERCEPTION. LEAN PROVIDES GUIDELINES FOR VALUE ADDED

- THE STEP MUST CHANGE FORM OR FUNCTION OF PRODUCT OR SERVICE
- THE CUSTOMER MUST BE WILLING TO PAY FOR THE CHANGE.
- THE STEP MUST BE PERFORMED CORRECTLY FIRST TIME (RFT).

ANYTHING THAT FALLS OUTSIDE OF THIS, IS CONSIDERED A WASTE, OR NON VALUE ADDED (MUDA). THIS WASTE SHOULD BE REDUCED OR ELIMINATED.