Metlen Exam 2 (master):

**What is a business:**

* A business is a group of people working together with a set of processes to accomplish a specific goal in a specific and, often, dynamic market. These groups and processes are constrained and/or guided by dynamic organizational and governmental structures then who we are as human beings.
* The end goal in business is to produce the correct product such that value as seen by the customer is greater than competitions priced such that other stakeholders can be satisfied, including a profit sufficiently large to satisfy owners in the short and long term.
* Profit is obtained by producing and selling the correct product ethically and legally.
* Process: a structured, measured set of activities designed to produce a specific output.
* Product: good and/or service (tangible and intangible characteristics)
*  Correct Product: Provides more value to your targeted customer than your competition at a price that provides enough revenue to satisfy the wants and needs of the other five stakeholders. Have to be stakeholder centric to achieve this balance.
* Value: what a person gives up for what they receive. Time, money, effort…
* Six Stakeholders: Owners/stockholders, employees, suppliers, customers, community, environment.
* Having the correct adaptable Mission, Vision, and Strategy. (high level goals)
* Being able to operationalize MVS (process mgt, everything we do in the preceding slide)
* Operationalization occurs through goal congruency (lower level goals aligned with high level goals)

**Purpose of a Process:**

What is a process:

 “A network of activities performed by resources that transform inputs into outputs.” Anupindi et. Al. 1999
“A set of logically related tasks or activities performed to achieve a defined business outcome.” APICS Dictionary 1995
“The collection of activities and operations involved in transforming inputs, which are the physical facilities, materials, capital, equipment, people, and energy, into outputs, or the products and services.” Evans & Lindsay 2002
“A collection of activities and decisions that produce and output for an internal or external customer.” Devane, T. 2004

Purpose of processes 🡺 create the correct product (greater value than competitors at a profit that provides enough to meet needs of stakeholders in a perceived equable manner) in a given context

Context: market demand, market share, technology (machines, computers, software) and resources (knowledge, materials, people, infrastructure, power) available to execute process

How to judge a process:

How well does it meet demand (step one queue if tied to arrival of orders, capacity, Takt time, cycle time, business rules)

How well does the process utilize resources (utilization (people and machine, rate of consumption of power), WIP (holding/queue or process, or total), power, pollution, safety, material)

 How well does it produce the customer described/demanded product

 Cost relative to achievable price

Why & how to simulate

* + 1. Existing: To learn about the process and to do what if analysis
			- 1. conceptual model,
				2. data flow,
				3. resources (costs),
				4. demand,
				5. interfaces,
				6. business rules,
				7. collect data from observation

arrival rate, demand, step cycle times, TPT (use for verification), capacity (use for verification), batch size, set up costs, resource costs, mean time to break down/chance of breakdown, time down, scrap, rework, items produced per step,

* + - * 1. Enter into simulator
				2. Verify data and model (does the model produce the same results every time as expected (costs and output))
				3. Validate the model (does the model mimic the real outputs of the actual process)
				4. Do what if analysis, including statistics
		1. Green Field: To learn about the process and do what if analysis
			- 1. conceptual model,
				2. data flow,
				3. resources (costs),
				4. demand,
				5. interfaces,
				6. business rules,
				7. collect data from projections
				8. arrival rate, demand, step cycle times, TPT (use for verification), capacity (use for verification), batch size, set up costs, resource costs, mean time to break down/chance of breakdown, time down, scrap, rework, items produced per step
				9. Enter into simulator
				10. Verify data and model (does the model produce the same results with simple data as mathematically solving the model)
				11. Do what if analysis, including statistics

**Process Management**

Process Management (process owner activities: advocacy/influence, boundary management, collaboration, improvement, metrics, know relationship of process to stakeholder satisfaction)

 Design/re-design (concepts to keep in mind are TQM, Six Sigma and lean, tools used in this class simulation and workflow)

Needs analysis & definition (simulation and history): goals, scope/boundaries, participants, constraints, schedule so design, implement and management follow nicely (Cost, time, quality, scope🡺project management) Goals should be SMART (specific, measurable, attainable, realistic, tangible) Three C’s of leadership (clarity, consistency, and commitment)

 Tech

Knowledge of Process logic (steps) schematic needed, Data flow logic, Resource consumption per step, business rules, interaction with other processes (often overlooked) and firm’s stakeholder satisfaction goals

How going to measure (quality control policy)

 Implementation (workflow and simulation): probably not the big bang, will not come to a better mouse trap

 Buy-in through communication in design and implementation

 Rests on design

 Take care of silent dissent as well as voiced dissent

 7 c’s of implementation: common goal and measures, cross-functional commitment, continuity, clear communication, competent project management, credible coaching, celebration

 Management/control (workflow and simulation)

Who is the owner, cannot be at too low of level or will keep silos and lose cross-functional involvement

Quality control statement (measures should link customer satisfaction drivers to financial outcomes, metrics should be visible (communication))

 Training of resources

 Evaluation/assessment

 Accountability

 Cross-functional involvement communication

Continuous training for executive and management on enterprise process management (so old do not forget and new learn so there is process management continuity)

 Continuous Improvement (simulation and workflow)

 Needs to be culture: obtain culture through metrics, rewards, and training

 Take action on what find in mgt/control steps

 Where are, where want to go, how going to get there, is it worth it

Important considerations when managing processes

Purpose of process relative to bottom line of company (how does the output and variation of output impact the bottom line🡺what processes does the output inform, path from output to $ in)

Interfaces with other processes smoothly

Interfaces across functions within process go smoothly

Design human interaction portion of processes relative to human physiology and psychology

Process control policy

Effectiveness of process (correct output done correctly🡺form/function, time, cost, quality

**Processes we need to manage**

Processes we need to manage & how to tell if a company is good at process management

Process mgt steps of:
 management and control throughout.

Support Processes

 Corporate planning SWOT

 Develop Mission, Vision, Goals, Strategy

 R&D

 Design Products

 Manage/develop technology

Knowledge mgt

Accounting

Information Tech

Improvement and change

Assessment (internal, self, external supplier/customer/environment/owner, up, down)

Goal congruency

Finance

 Capital Structure

 Capital and operations budgets

 Resource, real property and others mgt

 HR

 Develop (train educate) and Manage (hire, fire, control, desk audits TDRs) Human Capital

 Procurement

 Manage supply side relationships
 Process Mgt steps of: design, implementation, redesign, implementation

Primary Processes

 Logistics

 Manage supply and customer side relationships

 Operations

 Make products

 Marketing & Sales

 Manage customer side relationships

 Service

 Manage customer side relationships

Bridging Processes

 Product Development Process

 Internal processes

 Internal services

 Internal goods

 External products

 Knowledge Management

 Process Management

Why categorize:

The same reason we make a high level logic flow diagram for a process before we start breaking down the sub-processes, categorization gives a birds eye view of the process flow in a company.

Reminder that we need to look at more than just production processes.

It is the ground work to help guide the interacting links between process output and the end goal (the spaghetti diagram). Shows the enterprise wide view of PM.

Given the above, there is a guide work to find the problem behind the symptom.

Helps to define structure within a company, what needs to be done.

Helps with data flow and business rule formation; prioritization of what should be done when.

Helps with, if I change X process, how will that affect the enterprise.

Helps with understanding the people, processes, control mechanism, and organizational structure and interactions of a firm, or six major dimensions of an organization: knowledge communities/functions, processes, content, marketplaces, culture, and organizational structure.

**Process Management Framework**

High level: What is the organization (relationship between people, processes, control mechanisms, and org structure), can it support a process management perspective

Organizations are composed of people, processes, control mechanisms, structure (what is relationship in the given firm and how well does the composition react to environment (including external stakeholders))

 Communication flow (including how goal congruency is achieved)

 Functional relationship

 Board and C?O

 History of continuous improvement

 Excel test

 Quality of management/leadership, assessment, design, conformance, control in the three levels organizational, process and operational (and three within each: strategic, tactical, personal)

 Culture, is there an enterprise/systems view or is it myopic (expressed and displayed can be different), what is being displayed

Given the correct set of the above

 What is the current state of processes

 Stakeholder satisfaction

 View of stakeholder satisfaction

 Who is looking at the processes, is there a process owner

 Are processes looked at enterprise wide

 Is there an enterprise wide process schematic that shows logic flow, resource needs, information flow/data flow logic, business rules, and interfaces between processes

 Is there a quality control policy for each process, how are processes assessed/evaluated

 What business rules control process drift

How do they design processes

 Are processes tied to wants/needs of stakeholders

 Are processes designed around who people are

 Is there a structured methodology for process design? (HoQ, Axio. Des.)

Are processes designed with consideration for human nature?

During planning of implementation, are users as well as other stakeholders considered?

Where will changes lead us relative to current state?

 How do they implement processes

 Is implementation started in design

 Were people (users, stakeholders) involved in design? Implementation?

Was implementation lead or pushed?

 How do they manage and control processes

 QC policy for each process or set of processes

 Is there a process owner and what is that person’s relationship to the users

 What is the continuous improvement process

 Are there channels for ideas

 Is there education and learning relative to continuous improvement

 What is the reward system

 Is there goal congruency so that process suggestions and changes actually promote high level strategy obtainment and customer satisfaction.

What tools and/or concepts are used

 Lean manufacturing

Simulation

 Statistical (SPC, 6sigma, ???)

 Other quant and qual tools

 BPM type software

What is the understanding relative to efficiency and effectiveness

Is cost/benefit analysis alive and well

Short version:
How to determine degree of PM expertise a company may have.

Evidence of correct product: stakeholder satisfaction (relative to something, past, industry…)
 Owners: stock price, growth, sustainable mission, vision, strategy
 Employees: turn over, unions or not, incentive programs, compensation
 Suppliers: turn over, evidence of SCM
 Customers: growth, brand image
 Communities: what do they do for their communities
 Environment: what do they do to ensure that they are sustainable from an environmental perspective
What evidence of what part of PM is the driver of their current status relative to ‘correct product’.
 Support processes: MVS creation, knowledge management (accounting, IT, IS, improvement and change, assessment, goal congruency) , R&D of product, Hiring, Training, Compensation, TDR’s, Communication, finance, community relations, R&D of process, the process of process mgt…

 Primary Processes: SCM/procurement, customer relations/marketing, manufacturing, service

 Interface management: how well do all of the above work together

**Process Selection Framework**

Process analysis finds problems with People, Processes, Control, and Structure (PPCS). Since work is done by processes, how we design, execute, control, and bind processes determines our effectiveness in providing higher value than our competitors to our customers at a profit; that is the goal. Thus we can ID processes that need modified by:

Degree of Frustration and/or dissatisfaction with performance (speed, flexibility, cost, quality)

 Time of process lens

 Percentage of process time analysis (value added vs. non-value added steps)

 Processing, Waiting, Rework, Moving, Inspection, Setup

Cost of Process lens : will probably want to standardize relative to something square feet impact, etc.

Quality of process lens:

Flexibility of process: relative to meeting stakeholders needs

 Waste framework: (1) over production, (2) waiting or idle time, (3) transportation, (4) inefficiency of the process itself, (5) inventory, (6) unnecessary motion and effort and (7) defects MORE: FG not sold at determined price, remove waste in one area that enables value added in another (not seeing the whole system)

Types of stakeholder dissatisfaction that triggers process change

 Things take to long

 Mgt throws people and $ at symptoms without solving underlying problem (five whys)

 Employees are frustrated

 The processes that span departments have resources that point away from them

 No process QCP policy and if there is, it is not executed

 Low utilization of resources

 Redundancy of all types, data and work

 Micro mgt (reviews and sign offs)

 Exceptions aren’t

 Expedite and de-expedite are common

 No process owner, only step owners that do not talk communicate much

 Firefighting

Are there issues

Away issues: current hurts, want to move (pain, danger, frustration)

Move to issues: OK where at, but better if we move

**Quality Control Policy**

1. Determine context of the production process relative to best of practice and why that specific context exists. Determine what portion of the context should be changed and if it can be changed, and what it would take to create that change?

Context is organizational structure, organizational culture, approach to human resource/capital, and attitude towards quantitative and qualitative tools to make sound decisions. How effective is the firm relative to the three main ideas of QM (stakeholder centric, goal congruency (employee involvement), continuous improvement) and their skill in executing management/leadership, assessment, design, conformance, and control (MADCC ) in all levels of the organization. Production process means you are making something, a good, a service, a decision, a strategy, a report, a … These processes encompasses both support and primary processes (Michel Porter’s value chain).

1. Determine what is the product the production process is currently creating and why is it that product, is it the correct product

 Characteristics of product (Garvin 8, Kano 3, Juran 3)

1. Determine the current production process for producing the product in question (process flow diagram). This step in conjunction with the next step is a ‘lean’ analysis.
What steps of the production process determines appropriate levels of the characteristics delineated in number two above
What inputs, resources, and information are utilized at each of the above steps
What are the duration times
What is the bottleneck, Takt time, throughput time, and capacity
How well is the bottleneck managed
How are they controlling and assessing the current process
What is wrong with the current production process and control process
What ‘waste’ (lean) is apparent
This process is the production process, not the proposed control process or proposed production process

What is the current performance level?

1. Determine what level of performance (actual product) is currently achieved relative to expected (correct product) (specification and/or DPMO) and the degree to which the process addresses those expectations. What does the current level of performance cost them in lost revenue, rework, inspection, and/or additional costs relative to possible/desirable outputs? Current and expected level of performance of the production process, one should also delineate what level of capability the control policy should have based on what is possible with current technology. This step is part a lean, waste analysis.
2. Develop a set of controls, assessment and/or process changes you think would achieve expected performance and an over arching, general statement of the purpose for the various control methods and process changes you propose. For each step of the production process, determine how you are going to control the activities of that step. Really, you are creating a control process for the production process 🡺 to maintain real time control we will…. To determine overall effectiveness of the production process and control process we will perform end of production process evaluation by ….. To get here, the information from 3 above or your new improved process steps and characteristic there of is absolutely necessary. Do you control the inputs and/or the resources used to alter/shape/evaluate the inputs, how do you know the information received and sent is correct…..
3. Referencing the production process, how good does this production process have to be to satisfy customers? Where will you set the control limits for those steps that you are using SPC, at the standard +/- 3 standard deviations, more than 3, or less than 3? The answer to this question will determine how ‘good’ the control process has to be and help you calculate the costs of Type I and Type II errors, which determines how many standard deviations you set your control limits at, how often you measure, and the sample size you take when you measure.
4. For each of the controls and assessments in number five above, determine what to measure (inputs, outputs, durations…) that will insure ‘correct product’ status. referring to production process
5. Express why the above measures are necessary and why others are not.
6. Determine how each of the different measures will be made. This step helps to delineate your control process and includes how the control or measure will be done. For instance, will a person take a sample and then analyze that sample with something, or will a machine take the sample and analyze that sample, or will a machine measure continuously and a software program analyze the results, compare to a standard and then direct another machine to adjust the process, or…
7. Determine where on the product, input, and/or process-time-line each measure will be performed. this step helps to delineate your control process
8. Determine where in the production process the product, input, and/or process time line each measure will be performed. this step helps to delineate your control process (think “The Goal” by Goldratt)
9. Determine who and/or what should perform each of the measures this step helps to delineate your control process
10. Determine sample size for each of the measures this step helps to delineate your control process (think rational sub-group and probability of catching a given shift in the mean, measured in standard deviation, and cost of measuring versus cost of mistakes happening.)
11. Determine how often each of the measures should be performed this step helps to delineate your control process (robustness of process, cost of mistakes, cost of measuring and analyzing)
12. Determine how process operators should react to the data generated from each of the measures this step helps to delineate your control process (is it common or special cause of error, is the measure a real time feedback mechanism or an end of production step or process evaluation
13. Determine how (and why) the data from each of the measures should be displayed (most likely a control chart of some type or large board in the production area) this step helps to delineate your control process
14. Determine who (and why) should have access to the displayed data this step helps to delineate your control process and stakeholder relationships
15. Determine how the effectiveness of the QCP should be determined how are you going to ensure that your control process is working (calibration of measuring tools and measurer, is the measure being done ch 12 pp 623-630)
16. Conduct a cost benefit analysis to ensure that the NPV of your proposed quality control process and/or process improvement is positive.

**Business Rule Framework**

Types of Process Control/business rules:

 Authorization 🡺 Condition: if this limit, do that

 Reconciliation 🡺Action: balance cashier

Review: inventory once per qt

 Mgt review 🡺 Oversight: review weekly sales

 Configuration: Quality control policy

System Access: who has access relative to process information flow and execution

Segregation of duties: checks and balances

Key performance indicator: what ever is tracked to make sure high level goals are meet

Exception or edit: why special causes of variation

 Components of process control

 Environment: does management promote control

Risk Assessment: what happens if we control at x degree, what are the costs (balance cost of failure and prevention)

Control activities: policies and procedures that ensure control if and how control is done

Information and communication: how report

Monitoring: how measure

 Who oversees controls (author says internal audit) what do you think

**What about Simulation**

Simulation of…

System: collections of parts organized for a purpose

 Natural, Designed physical, Designed abstract (math model), Human (family)

Purpose of simulation: understanding, controlling, changing, managing systems

Advantages of simulation: time compression, cost, understanding, real system does not exist

Disadvantages: Can be expensive (relative to benefit), time, data hungry, skill, **OVERCONFIDENCE**

Types of simulation: Throwaway, ongoing use, regular use, generic and reusable

Simulate when you have a complex enough system that deterministic models do not model system and when cost of simulation is covered by possible outcomes.

Conceptual model: description of the simulation model that is to be developed describing the objectives, inputs, outputs, content, assumptions, simplifications (black boxes, rules, and data), data flows, business rules, interactions/interfaces with other process, resource needs and costs. The model should be:

 Valid: sufficiently accurate for purpose at hand (‘good’ data is available: good:

 when model is executed, it mimics real system)

Credible: clients perceive the model as on that is sufficiently accurate for purpose at hand

Utilitarian: both modeler and client believe output of model will be adequate to base decisions on

 Feasible: both modeler and client believe can create computer model

Rules: routes, processing times, schedules, allocation of resources, queue order and length, check offs, quality inspection, …..

Methods of modeling variability, both quant and qual (description of process and actions of players used to develop conceptual model):

Data types/nature

Trace: (assume independence) queue time, cycle time, down time, what happened over time in the processes

 Empirical distributions: distribution of trace

Statistical distributions: fit of trace data to distribution, then use rand()

For this class use a software to fit data, or visual of histogram, ch 7 tells how to determine type of distribution, but there are software solutions for $20 that do this for you

Problem with normal distribution (negative values), might have to use a triangular distribution.

 Bootstrapping: selecting with replacement of trace data at random

Data to gather

 TPT

 Takt time (assuming market demand and production rate are same)

 WIP cost 🡺 queue and in process

 Resource Utilization

 Queue times

 Resource cost

 Arrival rate and interarrival times

 (distributions)

 Step cycle times and distributions (parameters)

 Set up

 Mean time to breakdown

 Maintenance schedule

 Vacation

 Sick leave

Coding, testing, **DOCUMENTING (20 to 30% of time should be donated to documentation, it saves time in the long run)**

Separate data from model (do not hard coed data in an equation, reference data)

Three types of documentation:

Model documentation: the model, assumptions and simplifications, input data including interpretation and sources, results format,

Project documentation: meeting minutes, project specifications (cost, time, quality, scope), verification and validation, scenarios executed and results, final report, project review

User documentation: why you did what so you can do a better job next time

Terminating: business closes or lunch hour is over

NonTerminating: capacity, just let it run (steady state) (warm up period = initial transient and provides initialization bias)

Transient output: stochastic

Determining warm up period: min is achieving steady state

Run length, 10 times warm up period

Number of replications, enough for reliable CI

We are going to use TOC and Lean principles to determine how to improve a model and hypotheses testing of mean differences to determine if we succeeded in improving the model.

Implementation: a concise exploration if this subject will be needed in your project

what barriers do you see that will impede implementation of the new system

 resource (time, money, availability of skilled employees, equipment)

 people issues (buy in or not)

how would you avoid those impediments

Verification: conceptual model is translated into simulation model and the simulation model works as designed

Validation: accurate model, it mimics the actual process

Impossible to verify completely, do best can in time you have

Check against real world (statistics, means testing)

Check against simple model

Does it make sense????

**Conceptual Model**

Conceptual model/Functional Specification pp 47 &48, Ch 13, and appendix 1: First develop understanding of problem situation (client dependent for first round, they may not understand the causal relationships, or see the problem, only the symptom, visiting and back checking are required, several iterations)

Contact information!!!!!!!!!!!!!!
 Objectives: purpose of model, goals of project (know what ‘they want’, what is their definition of project success)
 Understand the system and what the problem is, know the bounds of the system, performance metrics of system and project, what are baseline values of these metrics
 Inputs to change model: experimental factors, elements that can be changed to improve process (batch size, duration times, mix of products, moving components, BRs, resource changes )
 Outputs: reports of simulation executions
 Content: components and connections (scope and level of detail, high level steps, activities)
 Assumptions: how things work
 Simplifications: black boxes to make parts not important to the question at hand simple and fast
 What tool to use to analyze the system: use simulation only when appropriate
 Animation exactness
 Project deliverables
 Project contact, who and where to go for data and discuss changes in scope
 Client review of specification and signed agreement

Some questions to ask, this is not a complete list
 What should be included in model (process flow diagram and detail)
 What level of detail (high level, TDR’s??)
 What are resources, their schedules, their tasks, their costs

Scrap rate by entity type

Distribution of times between failures and downtime duration

Experience curve effects
 What is the process flow, is it up to date, is it always followed, when isn’t
 What are the rules: business rules, procedures, legal, physical 🡺 can they be changed
 How are decisions made (what to do when…. Or if……)
 What data is there, how accurate is it (duration time by step, part, resource; failures: frequency and duration; resources and schedules or assumptions; process inputs and outputs
 If no data, who will collect it and when will it be done, or what are the estimates
 What type of animation is required and how will they be used
 Who will verify and validate the model
 What output is required: through put, resource utilization, costs, revenue, value added, non-value added, should these metrics be ranked
 How general should the model be, can the basic model be used for other processes
 Who will perform the what if, how do you determine to change in your what ifing, how many what ifs will be executed
 What are major milestones of study (when report to your contact)
 What will the project cost
 WHAT ARE THE DELIVERABLES

The conceptual and computer models have to be
 valid, credible, have utility, and be feasible
Simulation project specification (scope and expected output) (short hand of 1st section)
 Background to problem situation
 Objectives of simulation study
 Expected benefits
 Inputs, outputs, content, assumptions, simplifications
 Experimentation: scenarios to be considered
 Data requirements: what, when, who, why
 Time-scale and milestones
 Estimated cost
Why the first cut specification (charter) will be wrong: omissions, changes in environment, increased understanding of process and model that identifies new problems
Representing the conceptual model:
 Component list: entity (entity types) and interarrival times, queue and capacity, parts of the process and duration times and p of break down and distribution of down times, resource and skill sets
 Process flow: flow diagram
 Logic flow: if this then that
 Activity cycle diagram: for discreet event

Model simplification:
 levels of processes: a step of a high level process may be a sub process, down to TDRs and can model those, why 🡺 data availability, complexity and time to execute each experiment, software limitations,
 excluding components &/or detail: no variation, if machine is modeled and operator does not influence the duration, do not need to model the operator, however, if set up is the cause of variance and each operator has a different distribution of duration time, then have to model which person is there and set up should be a separate step from the actual machining.

Transportation: lots can go on to influence this, rather than put all of the possible problems and their associated p of happening in, just look at what is happening and use that duration or # per day

Infrequent events: do not include them for normal run times, can do special cases later. What is likely to happen in a ‘simulation run time’
BRs, may not need to include all, 80/20 rule (examples of rules: what route a specific entity type takes, process times, schedules, allocation of resources, Queue management, utilization,
Split model: rather than operate one huge model, split it into parts and the output of one can become the input of the next
DATA, both qual and quant Information is compiled data, so when we get the specified time much of the variability is gone and the model may not be valid to actual
Type A, B, & C data: A is known, B has to be gathered, C is not known and cannot be gathered (estimate or do what if analysis around this type, new processes not operated or study time is too short to obtain enough measures 30-100, perform sensitivity analysis (confidence intervals))
Trace: use actual data for each entity, need the collected data and existing process, hard to perform what if analysis as hard to do multiple executions as amount of data and computer capacity are restricted,

Empirical distributions: frequencies of actual data, randomly pulling from that distribution (can make it discrete or continuous). Restricted to range observed historically, sensitivity is hard, as based on actual
Statistical distributions: fitting or creating a probability density function of actual
 Continuous distributions. normal (mean and SD), exponential Mean (service times, repair times, interarrival times) (can get close to 0 times which is not realistic), Erlang has mean and skew, when skew is 1 is exponential, as it increases, closer to normal becomes

 Discrete distributions: binomial🡺success/failures in a specified number of trials used to model number of defects in a batch of items 🡺 two parameters number of trials and p of success; Poisson🡺 number of events that occur in a given time period (arrivals) or number in a batch one parameter the mean Approximate distributions🡺 uniform low and high; and triangular, mode, low and high

Correlated data: what happens at time x affects what happens at a later time, can attach step duration to entities, can do what if statements
Non-stationary input: arrival rates change or duration times change over time of day (thinning, throw away during slow time) model for different times of day,

Fitting data to a distribution: save population measures in an excel file>open ProModel>tools>stat:fit>paste the column into the document1: Data table>fit> (read help in input analyzer if you get lost)) a histogram and other information will appear>fit>fit all>then look to see what distribution you have, distribution summary will appear 🡺 the higher the value, the better

**Process Analysis**

Deming: If you cannot describe what you are doing as a process, you do not know what you are doing.

Firms are a colletic of (PPCS)

People: TDRs, roles, skills, abilities, motivation, job fit, bind processes relative to physiology and psychology

Processes: Work flow and information flow that produces products that eventually produce the end product

Control mechanisms: Business rules, auto and manual measuring devices that provide real-time, (or not) continuous (or not) feedback for adjustment (or not), values, rewards, punishment, corporate policy, rules of nature, If change process and do not change CM, process will not change

Structure: Org structure 🡺 span of control, who is your boss, departments

Since work is done by processes, how we design, execute, control, and bind processes determines our effectiveness in providing higher value to our customers at a higher profit than our competitors, that is the goal. Process analysis finds problems with PPCS

If blame people 🡺 they blame people, do not report problems, other departments outside of blamers sphere of influence thus problems are never fixed, people do not work as hard, etc.

85% Problems in a firm are with processes, control mechanisms, integration, and structure

15% with People (high)

What binds what with PPCS

Structure binds control, control binds people and process, process and people bind each other. For instance the physiology and psychology of people bind process, but if not taken into account when process is designed, then process constrains the full potential of people more discussion about what binds (look at layers of firm) what in relationship and what is missing (interaction with external environment)

Thus, when analyzing process, start with organizational structure

Traditional structure (T): hierarchical 🡺 thinking is that brains are in management, worker bees everyone below, less brains as you go down the structure, management blames those brainless ones below for all problems (they were not trained, did not follow protocol, no skills, no ability, poor job fit, no motivation). Results of such a structure are: lack of trust, solutions are dictated from the top, few minds solve problem, brains have the answer, training is solution to everything, (Work gets done, but high cost in $$ and human capital, only survive in low competition (government, utilities, monopolies)) Needed in emergencies and OK because….need quick decisions and those decisions are usually simplistic.

Involvement structure (I): some workers have good ideas, structure is same as traditional except there are teams at bottom end looking for problems that may or may not get fixed because they do not fix, only find, people are still the major problem, but there are communication channels opened so ideas can move up (optimize the pieces and whole will be optimized both T and I promote myopic views of system), steps are owned by the function, no enterprise process owner.

Process Mgt of Work: mgt believes most problems are process problems, fear is gone, and people are asked to fix their problems. The fundamental shift has to be made in Mgt minds, process not people are problem. Can use the process tools, but if there is still blame, will still have a T or I. Org chart has fewer middle managers but no cross functional ownership

Cross Functional structure: process control cutting across functional areas, very hard to implement (turf wars and fossilized opinions about where problems lie) save for processes that make a difference?? Still no process owner, process steps still owned by functions, but will work together, for a time. Charismatic leader is necessary and when they leave, the structure reverts because there were no process owners.

Matrix work Mgt structure: Cross functional with an owner, responsibility without resources, functional managers still have control of steps. Lots of turf problems, prioritization of steps of different processes embedded in a resource within a functional area is most likely done by the functional manager. Thus, functional performance may be better than firm performance.

F-Type work mgt structure: above, but owner has resources and power and reports to CEO not the functional managers where steps lie Thus, prioritization is done with firm goals in mind (processes are designed to ensure high firm performance) and firm’s bottom line should be higher. Danger is that functional knowledge may be compromised.

Implementation of the process cycle is different under each structure. Have to work harder and with more sensitivity with T & I 🡺 involve people and communicate what you are doing and why, reinsure that not going to replace people, only help people. Hard to do because of past history.

**General rules of process analysis**

Three levels of analysis

Macro, no more than two to 7 steps (no magic number) The book says that if go beyond 7 the map is getting too detailed, but……you need to define scope (beginning and end), and the main elements, boundaries are hard, not enough detail to spot problems

Functional (as in what do, not silo)-Activity Flowcharts or Deployment flowchart or step flowchart. needs to include activity and job title of resource that does activity so can see where work is done, who does it, where problems are, where costs are, determine over &/or under utilization of resources, Include control

 Can spot problems

 Disconnects between resources and departments can be seen

 Calculate process, cycle, wait, and move times

 Costs of step

 Process costs

 Quality issues and costs

 WIP problems

 Cannot train on activities, need next level for that

Seven key elements to step level

General information; brief description; Activity list; forms, policies, procedures, and manuals; deliverables; Applications; Corporate controls

Task or activity procedure flowchart or job description derived from job analysis in HR. What detail, so I can walk in and from the description, do the job. List activity and why it is performed. The why is important because without it, that activity is likely to be performed even when the world has changed and it does not have to be done anymore. Include column for frustration and why, Include how control is maintained

 Used to analyze why have problem in step

Develop new steps and activities, resource has to know how to perform

 Certification, yes we do it and we did it on product number x at time y

 Understand information flow and know it is being done

 Training, job analysis is what it is

Process Control: business rule that makes sure processes is being done according to corporate policies, procedures, and product specification, need to be a yes or no answer, keep it simple But, really two levels, one is control of product, the other is control of process drift

Types of Process Control/business rules:

 Authorization 🡺 Condition: if this limit, do that

 Reconciliation 🡺Action: balance cashier (does outcome match expected)

Review: inventory once per qt Difference between Action and review is that review is what is it vs. match to expected

 Mgt review 🡺 Oversight: review weekly sales

 Configuration: Quality control policy

System Access: who has access relative to process information flow and execution

Segregation of duties: checks and balances

Key performance indicator: what ever is tracked to make sure high level goals are meet

Exception or edit: why special causes of variation

 Components of process control

 Environment: does management promote control

Risk Assessment: what happens if we control at x degree, what are the costs

Control activities: policies and procedures that ensure control if and how control is done

Information and communication: how report

Monitoring: how measure

 Who oversees controls (author says internal audit) what do you think

Lower two levels where start analysis (step and activity)

If redesign, chart what is happening, not what someone thinks should/is happening

If design, design what should happen and place controls in place that ensure process execution, but also put controls in place that allow process to change as needed and to record that change (knowledge mgt)

Well labeled diagrams

Number and name activities

Swim lanes: all activities performed by a resource and/or position should be in that lane

Compliance vs. commitment

 Compliance: do what you are told

 Commitment: be the solution

What process team should do

 Collect and/or verify process data

 Flowchart (as is or best if new)

 Get info. from customer and process executers

 Benchmark self and others

 Redesign or design

 Discuss with process executers, what is the goal

 Develop recommendations, get buy off from users

 Present to Mgt

 Develop implementation plans and get user and mgt buy off

 Train users

 Monitor implementation

 Manage and control

Types of stakeholder dissatisfaction that triggers process change

 Things take to long

 Mgt throws people and $ at problem

 Employees are frustrated

 The processes that span departments have resources that point away from them

 No process QCP policy and if there is, it is not executed

 Low utilization of resources

 Redundancy of all types, data and work

 Micro mgt (reviews and sign offs)

 Exceptions aren’t

 Expedite and de-expedite are common

 No process owner

 Firefighting

Different types of change methodology and strategic framework to approach process mgt and change,

 BPR Business process reengineering

 Process improvement
 TQM

 CPI continuous process improvement
 Lean

 Six Sigma

 Lean six sigma,

Lean plus

 Theory of constraint (TOC)

Steps of Redesign of a Process:
Characteristics for creating a successful Process change

 Mgt commitment + zealous guy for project that has resource control

 Firm understands design principles and implication from start

 Communication from start to keep all on board so implementation goes

 Substantial & continuous communication from stakeholders

 Qualified change team

 Change is driven by positive results for customer

 Use info and other technology correctly

 Metrics are built in

Address issues as they arise, try to preempt by asking what could go wrong and addressing the 20/80 rule possible issues before they arise

Away issues: current hurts, want to move (pain, danger, frustration)

Move to issues: OK where at, but better if we move

How to find problems 🡺 five lenses of analysis

 Frustration (with performance (speed, flexibility, cost, quality)

Time of process lens Percentage of process time analysis

 Processing, Waiting, Rework, Moving, Inspection, Setup

Cost of Process lens : will probably want to standardize relative to something square feet impact, etc.

Quality of process lens:

Flexibility of process: relative to meeting stakeholders needs

Design process around value adding processes

Perform work where it makes the most sense

Provide a single point of contact to customer

Process for each type of entity

Ensure continuous flow of main sequence (nothing stops the process that creates the end product that the customer pays for)

Reduce Wait, Move, & Rework

Reduce setup and changeover times

Reduce batch sizes (usually)

Substitute Parallel processes for sequential processes (parallel product development, be careful)

Perform steps in natural order

Reduce checks and Reviews (put the power in operator’s hand)

Push decision making to lowest level possible

Build Quality in

Simplify steps

Organize firm by process (process owner, not steps owned by function)

Hybrid centralized/decentralized operations

Bring downstream info needs up stream (can create better outcomes that match downstream needs)

Capture information once at source and then share (reduce redundancy)

Share all relevant information

Involve as few people as possible in performing a process

Redesign first, and then automate

Ensure 100% Quality at beginning

Increase flow and speed to ID bottlenecks, TOC

Eliminate bottlenecks (sort of, author says go lean where line is balanced, not going to work due to variation, and for which product if multiple entities)

Design for manufacturability and serviceability (process and products)

Use design for six sigma DFSS

Create QCP (install metrics and feedback to find and correct problems

Continuously improve

Simulate to test design (math and role playing)

Standardize process

Use co-located or network teams for complex issues

Process consultant in each functional area for enterprise wide processes

Process owner for enterprise wide processes

Use users to design and redesign

Work cells for special cases or exceptions

Use multifunctional teams

Use multi-skilled employees

Create Generalists instead of multiple specialists (be careful)

Employ mass customization

Multidimensional Information Repository: data from current operations are constantly deposited correctly in a relational database, such that reports of process metrics can constantly be reviewed. Allowing real time process adjustment when necessary. Thus,

Activities most be designed so that the data is collected and stored without adding time to the step Information has to flow seamlessly, how does the next step know they can work on the entity, how does management know duration of activities and step for actual work, queue time, load time, set up time.

Export model logic to workflow🡺manages incident flow, case history of each activity performed on each incident, history is always available, monitor incident progress, prevent incidents from languishing by sending reminders and reports if delayed over given amount of time

Simulation for process mgt buy in, including change, inexpensive what ifs relative to changing actual system to see if it works.

**Hypothesis Testing**

1. Set up null HO and alternative HA  Set up alternative first, μ unequal symbol ?, μ < ?, μ > ? then null is easy μ = ??
2. Determine test statistic, we will be looking at the test to determine if two population means are different in some way (one greater or less than the other) when standard deviations are not known and are assumed to be different. Null is that they are equal, alternative is that one is bigger than the other. is the test statistic for what we will be doing if standard deviations are different (F test relative to ratio of sample variances). If the standard deviations are the same we have to use the following equation
 Perform F test of the ratio of the variances to determine which of these two models to use. Is the ratio of  within the F decision rule based on size of n and alpha. If F is two tailed, divide alpha by two and the left hand side critical value is the inverse of the right hand side critical value. If F is one tailed, be sure to have the variance of the smaller n be the numerator.

3. Determine significance level (one sided, two sided, cost of type one and type two errors)
4. Define decision rule (p value in this case)
5. Solve 2
6. Make decision

**Distributions and Fitting**: see the website <http://www.statsoft.com/textbook/distribution-fitting/>

**Making sense out of output**

Making sense out of output, did my idea have a significant impact, what is the bottom line if it did?

Points to make relative to NPV, CI, Distributions, variability, sensitivity analysis…

NPV, ROI, Breakeven
 ROI: start putting in larger values for APR if want to see what discount rate gives a zero NPV (definition of ROI) or put in smaller values of APR to see when you might make a hurdle. Can get a CI for ROI by seeing what APR gives a zero at upper and lower CI for the NPV
 Breakeven: create a CI for the PMT and take the mean, lower, and upper values and develop a CI

Sensitivity analysis: can actually determine how much the answer moves relative to a movement in input variables, or you can see how far you have to move before you have negative issues (- NPV). When everything is close to 1 utilization, output is very sensitive to changes in resources and/or arrival rates. When variation is high, there is a tendency that the model will be sensitive.

Method to determine NPV: when low variability, probably can get away with just looking at 30 different dyads, so output can just be compared 1 to 1, 2 to 2, and so on. The more variability in the model, the more likely hood that a more accurate evaluation would be made by pulling 1000 measures from each distribution involved in creating the pmt. The distribution used will also matter the more ‘different’ the test statistics are between alternative possibilities.

Distributions, larger p/smaller the test statistic (in relationship to degrees of freedom), better fit. Think about z scores and the p a given number will be in the same distribution.

How does fitting work: parameters are taken and then a distribution is generated based on a specific distribution, how well does the data actually fit that generated distribution.

**NPV**

1. time line relative to accrual policy
2. rate relative to accrual policy
3. accrual policy
4. cash flows relative to accrual time period, and time zero and end of project
5. Time value of money factor equations
	1. Normal annuity (all monthly cash flows are the same) 
	2. Factor of lump sum (1+r)t
6. PV of annuity due = pmt()
7. PV of future amount = amount/(1+r)t
8. NPV = PV – time zero costs
9. Decide 🡺 is the project required despite outcome of NPV (mandated regulations) how positive is positive, is there a distribution (CI, min, max), Six Stakeholder Lens to be sure all cash flows are accounted for

**How to make Process Change Decisions**

Decision making relative to process changes using simulation, including how to create and report the variability of NPV.

Confidence interval: probability that the interval around the sample mean will contain the actual population mean.
 When population SD is not known: x bar +/- tα/2\* s/sqrt of n
 When population SD is known: xbar +/- Z α/2\*σ/sqrt of n
If we could say that the mean of the sample equaled the mean of the population (we can only be 95% confident that the population mean even falls in the 95% CI of the sample mean) and the distribution is normal, then the probability of being at a given value or less (or more) when we are dealing with a normal distribution is:
 If you have the population standard deviation, then: (value-sample mean)/ σ = Z, use z to determine p of being the value or beyond
 If you just have a sample and you assume it reflects the population (big assumption, why use means) then: value-mean /s = t, use t to determine p of being the value or beyond. A sample of 1000 using modeling to generate samples would probably be safe to consider that the population is represented, that is why the t score and z score converge after about 200 measures.
If the distribution of the sample is not normal, all distributions have a cumulative density function that enables an analyst to make the same statement about a given area within the distribution. Excel has functions for the normal, binomial, chi square, exponential, F distribution, gamma, log, Weibull, and the beta distributions. The formulas and template you need to use the triangular distribution are presented in the file ‘Triangular Distribution Formulas’, just put in the min, mode, and max in the appropriate cells and then in a value in the ‘x’ cell that is within the min to max range.
To determine a CI you need:

1. An adequate size sample that is normally distributed
	1. The more variation within the model and displayed in the output, the larger the NPV sample needed. If the SD of the outputs used to generate the payment and the NPV is less than 10% of the sample mean, let us say that the 30 samples generated by ProModel would be good enough. Otherwise, use Monte Carlo simulation to generate 1000 possible values of each variable used to generate the payment by pulling from the distribution that StatFit indicates.
	2. If the distribution of the NPV’s is normally distributed, than just use that set as the data used to generate the CI. Use statfit to determine if the distribution is normal. If it is not, then use the indicated distribution or bootstrap. Generate 30 samples of 10 data points each to determine the mean of means and their standard deviation so you can determine the CI (central limit theorem).
2. The mean
3. The SD of the sample
So what can a person say about what the NPV will be if the system is changed? We can say that the sample we used to generate the CI indicates that the real mean of the population has a 95% probability of being within that CI. Of course the population in this case is one NPV that we get when we change the system, we do not have a time machine to go back and repeat the time interval used to generate the NPV an infinite number of times to generate a population of possibilities and a population mean. Thus, we might want to inform the manager of the p of being less than some number near the min (min when you have a closed distribution, min and zero if you have a continuous distribution) of the sample used to generate the CI. Then put in the caveat that the CI, the figure and p of being less than that figure only makes sense for the model and output generated, if the base variabilities are wrong or change dramatically (perform sensitivity analysis to determine what dramatically is) then the information will not be an accurate representation of the actual outcome.

**Critical Thinking Rubric**

**Critical Thinking\***

**College of Business and Economics**

**1.** Identifies, summarizes (and appropriately reformulates) the **problem, question, or issue**.

***Emerging Developing Mastering***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1  | 2  | 3  | 4  | 5  | 6  |
| The dimension focuses on task or issue identification, including subsidiary, embedded, or implicit aspects of an issue and the relationships integral to effective analysis. |  |  |

**2.** Identifies and considers the influence of **context** and **assumptions**.

***Emerging Developing Mastering***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1  | 2  | 3  | 4  | 5  | 6  |
| This dimension focuses on scope and context, and considers the audience of the analysis. Context includes recognition of the relevant nature of context and assumptions, the reflective challenges in addressing this complexity and bias, including the way ethics are shaped by context and, in turn, shapes assumptions. |  |  |

**3.** Develops, presents, and communicates OWN perspective, hypothesis or position.

***Emerging Developing Mastering***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1  | 2  | 3  | 4  | 5  | 6  |
| This dimension focuses on ownership of the issue, indicated by the justification and advancement of an original view or hypothesis, recognition of own bias, and skill at qualifying or integrating contrary views or interpretations. |  |  |

**4.** Presents, assesses, and analyzes appropriate **supporting data/evidence.**

***Emerging Developing Mastering***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1  | 2  | 3  | 4  | 5  | 6  |
| This dimension focuses on the evidence of search, selection, and source evaluation skills – including accuracy, relevance and completeness. High scores provide evidence of bias recognition, causality, & effective organization. |  |  |

**5.** Integrates issues using OTHER (disciplinary) **perspectives and positions.**

***Emerging Developing Mastering***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1  | 2  | 3  | 4  | 5  | 6  |
| This dimension focuses on the treatment of diverse perspectives, effective interpretation and integration of contrary views and evidence through the reflective and nuanced judgment and justification. |  |  |

**6.** Identifies and assesses **conclusions, implications, and consequences. [contingency planning]**

***Emerging Developing Mastering***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1  | 2  | 3  | 4  | 5  | 6  |
| This dimension focuses on integrating previous dimensions and extending them as they explicitly and implicitly resolve in consequences. Well developed conclusions do more that summarize. They establish new directions for consideration in light of context and the breadth and depth of the evidence. |  |  |

7. **Communicates effectively.**

***Emerging Developing Mastering***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1  | 2  | 3  | 4  | 5  | 6  |
| This dimension focuses on the presentation. If written, it is organized effectively, cited correctly; the language used is clear and effective, errors are minimal, and the style and format are appropriate for the audience. |  |  |

\*adapted from Washington State University, Center for Teaching, Learning, & Technology

**Define**

Words to define

 Effective

 Efficient

 Value

 Process

 Process Management

 Gap

 Enterprise process focus

Support activities/process (HR, IS/IT, Finance, Accounting, Planning, Leadership, SWOT, Forecasting, SCM)

Primary activities/processes (Logistics (in and out), production, mrk/sales, service)

ERP Enterprise resource planning

CRP Capacity Requirements Planning

CRM Customer Relationship Management

More for less vs more with less

BSC balanced score card

CPI continuous process improvement

6 sigma

DMAIC define, measure, analyze, improve and control

IDOV identify design optimize verify

DMEDI define measure explore develop implement

CTC critical to customer How to identify

 Process mapping

 Cause and effect matrix

 Measurement system analysis

 Capability study

 Failure modes and effects analysis FMEA

 Multi-variate study

 Design of experiments DOE

 Control plans

 VOC voice of the customer

 DFSS design for six sigma

BPM business process management

BPMS business process management system

BRE business rule engine

**Process Philosophy**

<http://plato.stanford.edu/entries/process-philosophy/> 1/2010

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The philosophy of process is a venture in metaphysics, the general theory of reality. Its concern is with what exists in the world and with the terms of reference in which this reality is to be understood and explained. The task of metaphysics is, after all, to provide a cogent and plausible account of the nature of reality at the broadest, most synoptic and comprehensive level. And it is to this mission of enabling us to characterize, describe, clarify and explain the most general features of the real that process philosophy addresses itself in its own characteristic way. The guiding idea of its approach is that natural existence consists in and is best understood in terms of processes rather than things — of modes of change rather than fixed stabilities. For processists, change of every sort — physical, organic, psychological — is the pervasive and predominant feature of the real.
Process philosophy diametrically opposes the view — as old as Parmenides and Zeno and the Atomists of Pre-Socratic Greece — that denies processes or downgrades them in the order of being or of understanding by subordinating them to substantial things. By contrast, process philosophy pivots on the thesis that the processual nature of existence is a fundamental fact with which any adequate metaphysic must come to terms.
Process philosophy puts processes at the forefront of philosophical and specifically of ontological concern. Process should here be construed in pretty much the usual way — as a sequentially structured sequence of successive stages or phases. Three factors accordingly come to the fore:

1. That a process is a complex — a unity of distinct stages or phases. A process is always a matter of now this, now that.
2. That this complex has a certain temporal coherence and unity, and that processes accordingly have an ineliminably temporal dimension.
3. That a process has a structure, a formal generic format in virtue of which every concrete process is equipped with a shape or format.

From the time of Aristotle, Western metaphysics has had a marked bias in favor of things or substances. However, another variant line of thought was also current from the earliest times onward. After all, the concentration on perduring physical things as existents in nature slights the equally good claims of another ontological category, namely processes, events, occurrences — items better indicated by verbs than nouns. And, clearly, storms and heat-waves are every bit as real as dogs and oranges.
What is characteristically definitive of process philosophizing as a distinctive sector of philosophical tradition is not simply the commonplace recognition of natural process as the active initiator of what exists in nature, but an insistence on seeing process as constituting an essential aspect of everything that exists — a commitment to the fundamentally processual nature of the real. For the process philosopher is, effectively by definition, one who holds that what exists in nature is not just originated and sustained by processes but is in fact ongoingly and inexorably characterized by them. On such a view, process is both pervasive in nature and fundamental for its understanding.

For more, go to http://plato.stanford.edu/entries/process-philosophy/

**House of Lean**

* Flow
* Heijunka
* Takt time
* pull system
* Kanban
* Visual order
* Robust processes
* Involvement

• Poka-yoke

• Zone control

• Visual Order

• Problem Solving

• Abnormality Control

• Separate human & machine work

• Involvement

**Just-in-Time**

**Jidoka**

**Customer Focus**

Hoshin planning, takt, heijunka

Involvement, lean design, A3 thinking

**Standardization**

**Stability**

Standardized work

Visual Order (5S), jidoka

Standardized work

Kanban, A3 thinking

Visual Order (5S)

Hoshin Planning

TPM, Heijunka

Kanban

**Involvement**

* Standardized work
* 5S
* TPM
* Kaizen circles
* Suggestions
* Safety activities
* Hoshin planning

**The House**

**of Lean**

<http://www.scribd.com/doc/5396036/The-Illustrated-Lean-Agile-and-World-Class-Manufacturing-Cookbook-2008-08-20> is a great site!!!!

Abandon fixed ideas

Think of ways to make it possible

No excuses needed

Go for the simple solution, not the perfect one

Correct mistakes now

Use your ideas, do not hide them Use your wits, not your wallet

Problems are opportunities

5 Whys why did the defect occur, why that…….

Seek ideas from many people

There is no end to improvement

Separate human & machine work (do not mix the flow times together or quality)

Elimination of Muda (waste or non-value added)

Cardinal sin is waste: waste of material (scrap, not used (cut off), FG not sold at determined price), waste of time, transportation, processing, inventory, motion, quality issues, wasted resources,

3C Concern, Containment Countermeasure

3d Dirty, dangerous difficult

5 whys and C/B

Hoshin Planning

 (Metlen’s comments in green; red are just words that leapt at Metlen )The **Hoshin Planning Process** is a systematic planning methodology for: 1) defining the long-range key objectives of the organization or company; and 2) ensuring the implementation of 'business fundamentals ' these would be business rules, all processes, and metrics required to successfully run the business on a daily basis.  Hoshin planning, therefore, is a two-prong planning approach that covers the organization's strategy to achieve breakthrough results through its long-term objectives and ensure continual improvement through its short-term business fundamentals.

Like many modern business concepts today, hoshin planning was developed in Japan the name and disciplined approach, not the concept. The concept has been around forever in organizations that are successful in a competitive environment.. The Japanese words 'hoshin kanri' can be translated into 'direction setting'.  And like many Japanese management concepts, hoshin planning also promotes the involvement of all employees in the process, on the basic premise that desired results can only be attained if everybody in the organization fully understands the goals of the company and is somehow involved in the 'chain' of plans defined to achieve them recognize TQM’s ‘goal congruency’.

The plan generated by the Hoshin process is hierarchical in nature, with the corporate objectives determining the corporate strategies which, in turn, are supported by lower-level strategies that cascade down the organization looks a lot like the three layers and goal congruency to me.  In effect, the goals of every individual should support the goals of the next person up in the hierarchy. Every strategy further consists of tactics or actions that need to be undertaken to accomplish the strategy. This is where the five questions come in: relative to your goals, 1) where are you, 2) why are you there, 3) where do you want to go, 4) how are you going to get there, and 5) is it worth it

The hoshin planning process basically consists of the following steps: 1) identification of critical business issues that the organization faces OT of SWOT; 2) establishment of business objectives to address these issues; 3) definition of the company's over-all goals; 4) development of strategies that support the over-all goals; 5) definition of sub-goals or tactics that support each strategy; 6) establishment of metrics or indicators for measuring process performance; and 7) establishment of business fundamental measures.  The first 3 steps of this process are handled by top management, with the defined over-all goals supported by the rest of the organization through steps 4-7. It would be great to weave these points into your conceptual statement, let me rephrase that, weave these points into your conceptual statement

An important aspect of the Hoshin process is the regular review of the defined plans. It is not enough to have a documented plan - it needs to be checked against actual performance.  Hoshin plans must undergo a major review at least once a year continuous would be the most competitive, that is what control charts linked to automatic measuring are for. During review, Hoshin plans are usually presented using Hoshin review tables, each of which shows a single objective and its supporting strategies. A group or individual responsible for several objectives therefore needs to generate several review tables in order to cover all objectives. Understand and measure the causal variables and have control charts for each overlaid with the chart tracking the output metric, thus there is continuous review

The following details must be shown for each strategy in the review table: 1) the strategy owner(s); 2) the timeframe; 3) the performance metrics; 4) the target(s) on control charts as target for each strategy as defined during the Hoshin planning process; and 5) the actual results at the time of the review.  Any discrepancy between the target and actual results, whether positive or negative, must be noted along with the impact of the discrepancy on next year's plans. As mentioned earlier, hoshin plans are hierarchical in nature, cascading from the top levels to the lower ones, so review tables must likewise cascade upwards.

Reflection, just like in the last step in Project Management which is the analysis of what went right or what went wrong in each strategy and what should/could have been done to improve all, is an important aspect of hoshin reviews. Determining objectively what were done right in strategies that attained the desired results and what need to be improved in strategies that failed to hit their targets is required in the organization's learning process only good if becomes embedded in processes and/or data base. Tacit knowledge has to be institutionalized in some manner. Analyses of how the strategies fared must be done in terms of detailed supporting data see control chart idea above.

There is actually another set of tables used in Hoshin planning, i.e., the strategy implementation planning tables. Implementation plans are used to identify the tactics or action plans needed to accomplish each strategy. Implementation plans usually present the following information: 1) the tactics needed to implement the strategy; 2) the people involved in each tactic and their exact responsibilities; 3) the timeline of each tactic, usually presented as a Gantt chart; 4) performance measures; and 5) how and when the implementation plans will be reviewed. Points to weave into your final report!!

Key strategies cannot be pursued effectively unless the company's operations are sound and stable. This is the reason why the Hoshin planning process also involve the definition of business fundamentals and their metrics, which are documented in a business fundamental table.  Business fundamentals, or the basic elements that define the success of a key business process clarification here, in the first paragraph the authors are talking like the processes are fundamentals, here they are saying that the fundamentals are what measure the processes. Let us say that business rules, all processes, and metrics are fundamentals and all are monitored through metrics (yes even metrics can be measured) , are monitored through its corresponding metrics.  These business fundamental metrics indicate whether or not the various value-adding operations or activities are doing well In a strict sense, most processes are not value adding, the only value added steps are direct transformation of stuff into more valuable stuff that is sold. Thus, the only steps that should be retained in an organization are those in production. Obviously this is not possible, so the definition of what is value added needs to be expanded. Why wouldn’t they be measuring non value added steps, they also should be controlled if they are not eliminated. BFT figures must be in control before the long-term strategies are attended to.

Lastly, Hoshin planning, to be truly effective, must be cross-functional, i.e., they must promote intra- and inter-process cooperation.  This only reflects the reality that the various departments of a company need to support each other in order to achieve remarkable synergistic results. Enterprise wide processes and the three ways of integration (flow, share, fit)

Primary Reference:  [www.qualitydigest.com](http://www.qualitydigest.com)

Heijunka: level production

**Heijunka: Leveling the Load**

September 1, 2004

*“The slower but consistent tortoise causes less waste and is much more desirable than the speedy hare that races ahead and then stops occasionally to doze. The Toyota Production System can be realized only when all the workers become tortoises. Why not the hare that races in the correct direction and does not need to stop, the hare would always win.*

*- Ohno, 1988 -*

Many companies today are working towards the ultimate Lean goal of continuous or one-piece flow. They want to be able to make just what the customer wants when they want it unless demand is steady, means marketing has to control orders, then to do one-piece flow when the customer wants it, a firm would have to hurry and then not hurry. Instead, what we often see is a “hurry up, then slow down” build-to-order approach. Customers’ orders vary from month to month, creating uneven production scheduling. Build-to-order companies will be building huge quantities, paying overtime, and stressing their people and equipment one week, but then sending them home the next due to light orders. This environment can also create large amounts of inventory, hidden problems, and poorer quality. What many organizations fail to do is the difficult process of creating a true balanced lean workflow. This is the Toyota concept of *heijunka,* leveling out the work schedule.

*Heijunka* is the leveling of production by both volume and product mix. This system does not build products according to the actual flow of customer orders. *Heijunka* takes the total volume of orders in a period and levels them out so the same amount and mix are being made each day sounds like forecasting and push to me, or putting the uncertainty o f the future on the shoulders of the customer . In a true build-to-order system you build products **A** and **B** in the production sequence of customer orders (e.g., **A, A, B, A, B, B, B, A** …). This causes you to build product irregularly. If your orders are twice as much on Monday compared to Tuesday, you end up paying overtime on Monday and sending employees home on Tuesday. The answer is to build a level schedule everyday by taking the actual customer demand you are assuming you know this far enough in advance that you can do this, a luxury most do not have, determine the pattern of volume and mix, and building your level schedule That is fine if you have level and consistent demand. If you know you are making five A’s and five B’s, you create a level schedule of **ABABABAB why not AAAAABBBBB unless you are delivering after every AB**. This is called leveled, mixed-model production.

**Figure 1** gives an example of traditional unleveled production, for Company X that manufactures tractors. The line makes small, medium, and large tractors. The medium are the big sellers and are made early in the week, Monday through part of Wednesday. There is a changeover and the small tractors are made Wednesday through Friday morning. After another changeover the largest tractors, which are in smallest demand, are made Friday afternoon. This typical unleveled method creates four problems: if change overs are feasible to make the ‘level schedule’ they would be here also and more time is saved because you will never get rid of all change over time. If I know the order due dates for the one, then I do for the other and I will produce more, with better quality with the first line. This is the problem with lean, they are not looking at all of the associated costs, they are taking what works in one place and saying it will work everywhere.

         Customers usually do not buy products predictably. If the customer decides to buy the large tractors early in the week the plant is in trouble. Flexibility in production is great, but it has a cost. Training your customer and passing on enough value gained through lower production cost to keep that customer is the key.

         The risk of unsold goods that must be kept in inventory. maybe

         The use of resources is unbalanced. maybe

         There is an uneven demand on upstream processes. maybe

**Figure 2** represents an example of mixed model leveled production. By reducing the changeover time and employing other Lean methods, the plant is able to build the tractors in any order they want to on their mixed model assembly line. The four benefits of leveling the schedule is:

         Flexibility to make what the customer wants when they want it. Can be expensive, can you get a better price or more sales that generates a greater profit??

         Reduced risk of unsold goods. Perhaps

         Balanced use of labor and machines. Or not, have to look at what is used on what product. We do want to utilize resources EFFECTIVELY

         Smoothed demand on the upstream processes and suppliers. Over what time period and what is the cost and who gets the benefit

**Figure 2. Leveled Production** 23 change overs or they have created three lines, each producing all day

To achieve the benefits of continuous flow, companies must level out the workload. *Heijunka* will eliminate waste by leveling your product volume and mix, but most importantly, will level out the demand on your people, equipment, and suppliers. Without leveling, waste will increase as people are driven to work like mad and then stop and wait, just like the hare. Are you going to do this by building FG inventory or restricting when people come in, sorry come back for lunch at 3:30!!!!!

[**Click here**](http://www.emsstrategies.com/newslettersignup.htm)to subscribe to our free e-newsletter *Learning to Lean* and receive three articles like this one each month.

 **About the Author**

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**Jidoka**, as practiced at Toyota has several meanings. It may mean "automation with human intelligence"  (*Autonomation*). Jidoka also refers to the practice of **stopping a manual line or process when something goes amiss.**

### [Autonomation](http://www.strategosinc.com/autonomation.htm) (Jidoka)

In one form, Jidoka uses limit switches or devices that shut down a process when:

* The required number of pieces have been made.
* A part is defective
* The mechanism jams.

**The purpose is to free equipment from the necessity of constant human attention, separate people from machines and allow workers to staff multiple operations.** This form of Jidoka relates closely to Shigeo Shingo's concept of Pokayoke.

### [Line Stop Jidoka](http://www.strategosinc.com/jidoka_1.htm)

Jidoka, as applied to manned operations, refers to the practice of stopping the entire line or process when something goes amiss. **This has important psychological and practical effects that contribute greatly to "continuous Improvement."**

### The Confusion Over Jidoka

Taiichi Ohno considered Jidoka one of the two pillars of the Toyota Production System (TPS). Yet this aspect of TPS is mostly ignored in the West. When it is discussed, **there is a lot of confusion and misunderstanding.** There are several reasons, among them:

Japanese language (at least in everyday usage) seems less precise than English and the **several meanings of Jidoka do not translate well.**

For historical reasons, **the autonomation concept seems less relevant today** and more like ordinary good sense and practice.

The line-stoppage version of Jidoka requires a **strong stomach and purity of mind** that few managers (Japanese or American) possess.

The original meaning of Jidoka was "Automation" just as in English. It was written in Kanji as shown.

The Kamigo Engine Plant developed many stoppage devices to halt automated machines. This became the word "Autonomation". It was pronounced as Jidoka but the Kanji had a subtle difference-- the addition of a few strokes representing humans or people.

Later, the **idea of stopping everything when something went wrong was transferred to manual assembly** and the "Jidoka" term transferred as well.

### References

MONDEN, YASUHIRO, Toyota Production System, Third Edition, Industrial Engineering & Management Press, Atlanta, Georgia, USA, 1998.

HARRIMAN, FRED, [www.fredharriman.com/services/glossary/jidoka.html](http://www.fredharriman.com/resources/documents/FHcom_Kaizen_Terminology_03.pdf), 2000.

OHNO, TAIICHI, Toyota Production System- Beyond Large Scale Production, Productivity Press, 1988.

<http://www.strategosinc.com/jidoka.htm> 2/2009

**Zone control: Laying the foundation for lean success Dividing the process up and giving control/responsibility to a person**
***Todd Bennett***
***president, United Southern Industries, and Sam McPherson, lean enterprise and public sector consultant, Shingo Prize***
The foundation of the House of the Toyota Production System is “Stability in the 4 Ms (man, machine, methods and materials).” Zone control is Toyota’s little-understood territorial management system that provides machine-intensive operations the same breakthrough performance that cellular manufacturing provides assembly operations. Zone control is a “severe way”, but it was the method for United Southern Industries to achieve basic stability in its machine-intensive custom injection-molding operation. During this session, USI president Todd Bennett and lean enterprise transformation sensei Sam McPherson will share how to: organize your operations for zone control; organize zone control’s “chain of responsibility”; organize the “chain of response” protocols; create zone leader roles and responsibilities; set progressive SMART goals for zones; and develop zone cadence management activities and zone leader standard work in support of zone control.

incorporated daily report outs and the dedication of everyone, including top management

A3

A3 problem solving: simplicity at work Deming’s PDCA Plan do check act cycle or Six sigma’s DMAIC define measure analyze improve control or DMADV define measure analyze design verify on one piece of paper
The A3 problem-solving method and document, in combination with the value stream map (VSM) process flow diagram, a true VSM only lists the value added steps, both borrowed from practices of the Toyota Motor Company,¹ have shown their value in reducing waste and error. The A3 method offers a long-missing standardized approach to solving problems identified in higher-level value stream maps.
Why is the method called A3? In Europe, the nearest metric equivalent to 11" x 17" paper is designated "A3." The method confines a team to what will fit on that size sheet of paper, forcing simplicity and quick communication. This assures the work can be realistically completed within this constraint. It demonstrates successful change and motivates workers to do even more problem solving. High level and then drill down, each activity on an A3 could have another A3
**The A3 is objective and safe**
The VSM gives the user a "10,000-foot level" view of the current steps in a process from the point of request to delivery of what was requested. Data collected in each of the steps or "process boxes" show statistically (thus, objectively) where there is variation. This flags which activities within the step to observe and remove barriers the worker must work around. These work-arounds and rework are what the A3 process helps make visible, improving the value stream as a result.
The A3 is a way to look with "new eyes" at a specific problem identified by direct observation or experience. It offers a structure that always begins by defining the issue from the customer's perspective. Stating the problem this way makes its resolution indisputable. After all, why are we all here if not to produce an ideal service or product for the customer?
Objectivity is further reinforced by creating a deep understanding of the current condition before jumping to a solution. When we observe and diagram the current condition, we visually represent how the current process works. We recognize weakness in the process, not in the people trying to use the broken process. conceptual model will contain this information
Once we construct that first view of the problem and validate it with the people doing the work, we can move on to ask, "What is not ideal about the way this work is happening?" There is so much power in gaining a deep understanding of the way the work is currently done, yet we have not always taken the time to observe and understand a process before fixing it. With a deep understanding, there is a tremendous opportunity to look at work differently and really see the opportunities for improvement. The A3 gives us a new way to look at work.
**Diagrams and simple graphics contribute to a deeper understanding**

|  |
| --- |
| http://www.sme.org/images/press/2006/20061054-2.jpg |
| http://www.sme.org/images/misc_v1/spacer5.gif |

With the simple graphic representation of a system problem in the current condition, the problem-solver can often see redundant work quickly and clearly, and share the realization with others involved in resolving the issue.
Stick-figure drawings with lines and arrows demonstrate loops in work that create work-arounds and rework. Drawing storm clouds shows where problems reside.
Using pencil makes it safe for a problem-solver to take the drawing to others and say, "Here is my understanding of how this work happens now…did I get it right? Are there steps I may have left out?" All involved can erase, redraw and correct any wrong assumptions that may have been made about the work. Changes can be made immediately, so problem solving is rapid and accurate, and workers can participate in creating the essential understanding.
**The A3 offers a simple and consistent way to achieve and document root cause analysis**
To get to the root cause of the problems flagged with storm clouds, Toyota's "5 Why been around longer than Toyota, however, they have it embedded in their culture?" approach is easy to remember and execute. When the final "Why?" reveals the root cause, we know what must be addressed to move the process closer to the ideal state. The final "Why?" in the analysis of each storm cloud/problem creates a checklist of what to do in the implementation plan not that easy, as many times the final why is a cultural or belief issue held by a high level decision maker.
**Creating the target condition is easy once you get your model validated, then one can move to this stage**
The right side of the page is the creative and fun half of the A3. It is entered into with such a deep understanding of the current work that a better way comes easily. We should see the simpler, cleaner process appear on paper, in pencil again, with fewer rework loops and work-arounds.
Because we did the investigative work on the first half of the A3, it is easy to compare the target condition to the current condition and ask, "Does the proposed way to work move us closer to ideal?" If the answer is yes, we can move forward to defining countermeasures and changes we need to make to move the process from the current to the target condition. In practice many decisions are made with point estimates derived from using deterministic values, thus, the answer is wrong. If there are stochastic variables, their distributions must be included and a CI developed to reflect the underlying risks of the decision.
**Accountability occurs naturally**
By defining what needs to happen, by whom, by when and with what expected outcome, we very clearly and realistically specify the work for the problem-solvers involved. This is our work list -- how the A3 author or team can check progress. Because it specifies the work, everyone involved knows exactly what's expected of him or her. We can refer back to the root causes shown on the left side of the A3 and ask ourselves, "Have we removed the causes keeping us from achieving the target condition?"
**Testing establishes a safe, experimental attitude and environment**
It is important to simulate the process or set up a test environment to challenge and experience the proposed process. The test, with a defined timeline, makes it safe for problem-solvers to be creative and experiment. Although the deep understanding achieved earlier makes risk minimal, testing allows us to tweak the system before implementation. Once the test is done and implementation is authorized, the newly designed work can proceed.
Responsibility for follow-up assessments of the new process on specific dates noted on the A3 is assigned to one or more individuals. The follow-up report becomes the new current condition. If it's not perfect, that's OK! We initiate another A3 and ask again, "What isn't ideal about our new current condition?" The cycle generates ongoing adaptation to the inevitable changes in our work.
This again demonstrates the "safety" of the A3 process; an A3 is deemed successful if the efforts moved us closer to ideal, even if we did not achieve everything we wanted. No one is chastised for not making it perfect on the first round.
**Management and staff learn to see problems the same way**
When staff and management have experienced the A3 process and an issue arises for which the A3 approach is suggested, everyone knows the steps that will be employed, believes that they will be either involved or represented in the work redesign and that there will be a timeline and accountability for completion. They believe that the experimental environment will be safe. They know that when problem solving is reported, it will be consistent and easy to understand. When management says, "I think we should do an A3 on this," everyone knows what that means.
**A3 problem solving occurs as part of everyday work**
Large numbers of staff do not have to be gathered for extended times to do speculative problem solving. Coaches can be recognized and easily trained to help staff validate and participate in the A3 process without leaving the workplace.
**A3 problem solving is intuitive and easy to learn and remember**
Most employees are not engineers or process-improvement specialists. The A3 process is logical thinking based on the scientific method of problem solving. It is easy to learn and teach and requires no technical training.
**A3 thinking means better and fewer meetings**
Conducting a lean meeting using the A3 process can greatly reduce the time and numbers of meetings required. A3s are best done by a group of two to five people representing the affected parties. These people procure validation of the current condition and the target condition from peers.
**The A3 process documents costs and benefits**
The cost of the implementation plan is documented on every A3 and can be compared to the benefit. It can reflect hard or soft dollars saved, or be a measure of quality of service. This creates objective information for leadership to use in authorizing the implementation plan presented on the A3 document.
**The A3 template helps us solve problems and document new processes**
When the A3 document is kept in a three-ring binder, activities can be reviewed by auditors or regulatory groups, senior leaders, and staff from other departments. This promotes cross-departmental sharing of process changes and generates even more problem-solving ideas.
**The A3 process is satisfying to everyone, particularly frontline workers**
The A3 is easy to learn and easy to teach. Staff can use it to remove the frustrations of their daily work created by weak and unsupportive processes. Being involved with creating a better way to work has been exceptionally well received by frontline workers, who Toyota recognizes as the resident experts in any industry. Workers can see and appreciate the changes they participated in creating. In this era of current and impending skilled-worker shortage, satisfaction is essential to retaining good employees.
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¹<http://www.lean.org>

Kanban

**Kanban** (in [kanji](http://en.wikipedia.org/wiki/Kanji) 看板 also in [katakana](http://en.wikipedia.org/wiki/Katakana) カンバン, where *kan,* 看 カン, means "visual," and *ban,* 板 バン, means "card" or "board") is a concept related to [lean](http://en.wikipedia.org/wiki/Lean_manufacturing) and [just-in-time](http://en.wikipedia.org/wiki/Just_In_Time_%28business%29) (JIT) production. The Japanese word *kanban* (pronounced [[kambaɴ]](http://en.wikipedia.org/wiki/Help%3AIPA)) is a common everyday term meaning "[signboard](http://en.wikipedia.org/wiki/Signboard)" or "[billboard](http://en.wikipedia.org/wiki/Billboard_%28advertising%29)" and utterly lacks the specialized meaning that this [loanword](http://en.wikipedia.org/wiki/Loanword) has acquired in English. According to [Taiichi Ohno](http://en.wikipedia.org/wiki/Taiichi_Ohno), the man credited with developing JIT, kanban is a means through which JIT is achieved.[[2]](http://en.wikipedia.org/wiki/Kanban#cite_note-1)

Kanban is a signaling system to trigger action. As its name suggests, kanban historically uses cards to signal the need for an item. However, other devices such as plastic markers (kanban squares) or balls (often golf balls) or an empty part-transport trolley or floor location can also be used to trigger the movement, production, or supply of a unit in a factory.

It was out of a need to maintain the level of improvements that the kanban system was devised by [Toyota](http://en.wikipedia.org/wiki/Toyota). Kanban became an effective tool to support the running of the production system as a whole. In addition, it proved to be an excellent way for promoting improvements because reducing the number of kanban in circulation highlighted problem areas.[[3]](http://en.wikipedia.org/wiki/Kanban#cite_note-2)

5S

**5S** is a reference to a list of five Japanese words which, translated into English, start with the letter S and are the name of a methodology. This list is a mnemonic for a methodology that is often incorrectly characterized as "standardized cleanup", however it is much more than cleanup. 5S is a philosophy and a way of organizing and managing the workspace and work flow with the intent to improve efficiency effectiveness by eliminating [waste](http://en.wikipedia.org/wiki/Muda_%28Japanese_term%29), improving [flow](http://en.wikipedia.org/wiki/Muda_%28Japanese_term%29) and reducing process [unreasonableness](http://en.wikipedia.org/wiki/Muda_%28Japanese_term%29).

[[edit](http://en.wikipedia.org/w/index.php?title=5S_%28methodology%29&action=edit&section=1)] What is 5S? or PACPC or 5C clear out, configure, clean and check, conformity, custom and practice

5S is a method for organizing a workplace, especially a **shared** workplace (like a shop floor or an office space), and keeping it organized. It's sometimes referred to as a housekeeping methodology, however this characterization can be misleading because organizing a workplace goes beyond housekeeping (see discussion of "Seiton" below).

The key targets of 5S are workplace morale and efficiency. The assertion of 5S is, by assigning everything a location, time is not wasted by looking for things. Additionally, it is quickly obvious when something is missing from its designated location. 5S advocates believe the benefits of this methodology come from deciding *what* should be kept, *where* it should be kept, and *how* it should be stored. This decision making process usually comes from a dialog about standardization which builds a clear understanding, between employees, of how work should be done. It also instills ownership of the process in each employee.

In addition to the above, another key distinction between 5S and "standardized cleanup" is Seiton. Seiton is often misunderstood, perhaps due to efforts to translate into an English word beginning with "S" (such as "sort" or "straighten"). The key concept here is to order items or activities in a manner to promote work flow. For example, tools should be kept at the point of use, workers should not have to repetitively bend to access materials, flow paths can be altered to improve efficiency, etc.

The 5S's are:

Phase 1 - **Seiri** (整理)Sorting: Going through all the tools, materials, etc., in the plant and work area and keeping only essential items. Everything else is stored or discarded.
Phase 2 - **Seiton** (整頓)Straighten or Set in Order: Focuses on efficiency. When we translate this to "Straighten or Set in Order", it sounds like more sorting or sweeping, but the intent is to arrange the tools, equipment and parts in a manner that promotes work flow. For example, tools and equipment should be kept where they will be used (i.e. straighten the flow path), and the process should be set in an order that maximizes efficiency.

Phase 3 - **Seisō** (清掃)Sweeping: Systematic Cleaning or the need to keep the workplace clean as well as neat. Daily activity at the end of each shift, the work area is cleaned up and everything is restored to its place, making it easy to know what goes where and to know when everything is where it should be are essential here. The key point is that maintaining cleanliness should be part of the daily work - not an occasional activity initiated when things get too messy.

Phase 4 - **Seiketsu** (清潔)Standardising: Standardized work practices or operating in a consistent and standardized fashion. Everyone knows exactly what his or her responsibilities are.

Phase 5 - **Shitsuke** (躾)Sustaining: Refers to maintaining and reviewing standards. Once the previous 4S's have been established they become the new way to operate. Maintain the focus on this new way of operating, and do not allow a gradual decline back to the old ways of operating. However, when an issue arises such as a suggested improvement or a new way of working, or a new tool, or a new output requirement then a review of the first 4S's is appropriate.

|  |
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| **5S Housekeeping - to organize the workplace**  |
| **Sort** Put selected things in order (Seiri) | Start by sorting the useful from the unnecessary. The only things that should remain in a work area are the parts, tools, & instructions needed to do the job.  |
| **Straighten** Arrange (Seiton) | Everything has a place; everything is in its place.This is also a good time for your team to create a Visual Scoreboard, Jidoka lights, floor paint, kanbans, and other visual controls described in our our [free Lean & Kaizen PowerPoint presentation](http://systems2win.com/forms/newsletter.htm). |
| **Sweep** **&** **Shine** Clean (Seiso) | Do an initial spring cleaning. Maybe painting, scouring, sweeping, washing, rinsing, scrubbing, and whatever else is needed to make your work place shine. |
| **Standardize** (Seiketsu) Purity of systems so never break down | In the Standardize phase of Lean 5 S, routine cleaning becomes a way of life. Preventative maintenance is routinely performed, perhaps with planning and scheduling and some responsibilities done by your central maintenance department, and as much routine maintenance as possible performed by the people that know that work center better than anyone else. |
| **Sustain** (Shitsuke) Commitment | Shitsuke is when  five S becomes a routine way of life. Root causes are routinely identified and dealt with. The [Systems2win Excel templates](http://systems2win.com/solutions/BPI.htm) known as the 5S Worksheet and the Standard Work Audit are very familiar to everyone - both supervisors and the workers that have come to appreciate the benefits of Five S and Lean methods. |
| **Safety**  | Some companies have taken to calling their program a 6S program - with the inclusion of Safety issues. The Systems2win [5S Scorecard](http://systems2win.com/solutions/5S.htm#5S) template does include a section for safety. |

TPM

**Quick Definition**

TPM (Total Productive Maintenance) is a maintenance philosophy designed to integrate equipment maintenance into the manufacturing process. The goal of any TPM program is to eliminate losses tied to equipment maintenance or, in other words, keep equipment producing only good product, as fast as possible with no unplanned downtime. How does this translate to people (mental and physical preventive maintenance, washing hands and touched surfaces, not coming into work sick……)

**Expanded Definition**

Maintenance has traditionally been viewed as a separate entity outside of the manufacturing process. As companies began to identify the role of maintenance in the production process a gradual shift in thinking occurred. TPM emerged out of the need to integrate maintenance with manufacturing to improve productivity and asset availability. The culmination of change from a reactive/corrective maintenance environment to one that is based on preventative maintenance through predictive maintenance is the process of TPM.

TPM is used to drive waste out of the manufacturing process by reducing or eliminating production time lost to machine failures. The goal of any TPM program is to ensure that machinery and equipment is always available to manufacture products for the end customer. By minimizing rework, slow running equipment and downtime, maximum value is added at the minimum cost.

Successful TPM is a group effort where the entire organization works together to maintain and improve the equipment. One of the first steps in implementing TPM is forming cross functional teams that are empowered to improve the process. Flattening the organizational structure enables teams to address issues when they have the greatest impact - when they occur. As employees join TPM teams, operators are trained to perform routine maintenance items and assume an ownership role. Employees empowered to affect the process will typically be in a position to identify and create process improvements that would have normally been overlooked by management. An on-going refactoring of the process provides a method to implement improvements.

As maintenance issues are addressed and total productive maintenance programs implemented, the true value of TPM begins to emerge. Just as lean manufacturing relies on Kaizen or continuous improvement; continuous re-evaluation of the maintenance cycle allows for kaizen in maintenance programs. Root cause analysis exposes the underlying issues to be addressed. By addressing issues at the root level, problems can be eliminated.

As with any lean initiative it is critical to measure change. OEE (Overall Equipment Effectiveness) is a metric originally developed to measure the success of total productive maintenance programs by associating the Six Big Losses with three measurables: Availability, Performance and Quality. OEE enables organizations to benchmark and monitor their progress with simple, easy to understand metrics. OEE provides both a gauge for the success of TPM and a framework to identify areas that can be improved.

|  |  |  |  |
| --- | --- | --- | --- |
| Six Big Loss Category | OEE Loss Category | Event Examples | Comment |
| Breakdowns | Down Time Loss | Tooling Failures Unplanned Maintenance General Breakdowns Equipment Failure | There is flexibility on where to set the threshold between a Breakdown (Down Time Loss) and a Small Stop (Speed Loss). |
| Setup and Adjustments | Down Time Loss | Setup/ChangeoverMaterial ShortagesOperator ShortagesMajor AdjustmentsWarm-Up Time | This loss is often addressed through setup time reduction programs. |
| Small Stops | Speed Loss | Obstructed Product FlowComponent Jams Misfeeds Sensor Blocked Delivery Blocked Cleaning/Checking | Typically only includes stops that are under five minutes and that do not require maintenance personnel. |
| Reduced Speed | Speed Loss | Rough RunningUnder Nameplate CapacityUnder Design Capacity Equipment Wear Operator Inefficiency | Anything that keeps the process from running at its theoretical maximum speed (a.k.a. Ideal Run Rate or Nameplate Capacity). |
| Startup Rejects | Quality Loss | ScrapRework In-Process Damage In-Process Expiration Incorrect Assembly | Rejects during warm-up, startup or other early production. May be due to improper setup, warm-up period, etc. |
| Production Rejects | Quality Loss | ScrapRework In-Process Damage In-Process Expiration Incorrect Assembly | Rejects during steady-state production |

### Six Big Losses

### Defining the Six Big Losses

### One of the major goals of TPM and OEE programs is to reduce and/or eliminate what are called the Six Big Losses – the most common causes of efficiency loss in manufacturing. The following table lists the Six Big Losses, and shows how they relate to the OEE Loss categories.

|  |  |  |  |
| --- | --- | --- | --- |
| Six Big Loss Category | OEE Loss Category | Event Examples | Comment |
| Breakdowns | Down Time Loss | * + Tooling Failures
	+ Unplanned Maintenance
	+ General Breakdowns
	+ Equipment Failure
 | There is flexibility on where to set the threshold between a Breakdown (Down Time Loss) and a Small Stop (Speed Loss). |
| Setup and Adjustments | Down Time Loss | * + Setup/Changeover
	+ Material Shortages
	+ Operator Shortages
	+ Major Adjustments
	+ Warm-Up Time
 | This loss is often addressed through setup time reduction programs. |
| Small Stops | Speed Loss | * + Obstructed Product Flow
	+ Component Jams
	+ Misfeeds
	+ Sensor Blocked
	+ Delivery Blocked
	+ Cleaning/Checking
 | Typically only includes stops that are under five minutes and that do not require maintenance personnel. |
| Reduced Speed | Speed Loss | * + Rough Running
	+ Under Nameplate Capacity
	+ Under Design Capacity
	+ Equipment Wear
	+ Operator Inefficiency
 | Anything that keeps the process from running at its theoretical maximum speed (a.k.a. Ideal Run Rate or Nameplate Capacity). |
| Startup Rejects | Quality Loss | * + Scrap
	+ Rework
	+ In-Process Damage
	+ In-Process Expiration
	+ Incorrect Assembly
 | Rejects during warm-up, startup or other early production. May be due to improper setup, warm-up period, etc. |
| Production Rejects | Quality Loss | * + Scrap
	+ Rework
	+ In-Process Damage
	+ In-Process Expiration
	+ Incorrect Assembly
 | Rejects during steady-state production. |

#### Addressing the Six Big Losses

Now that we know what the Six Big Losses are and some of the events that contribute to these losses, we can focus on ways to monitor and correct them. Categorizing data makes loss analysis much easier, and a key goal should be fast and efficient data collection workflow solutions that automatically collect data, with data put to use throughout the day and in real-time.

**Breakdowns**

Eliminating unplanned **Down Time** is critical to improving OEE. Other [OEE Factors](http://www.oee.com/oee_factors.html) cannot be addressed if the process is down. It is not only important to know how much Down Time your process is experiencing (and when) but also to be able to attribute the lost time to the specific source or reason for the loss (tabulated through **Reason Codes**). With Down Time and Reason Code data tabulated, **Root Cause Analysis** is applied starting with the most severe loss categories.

**Setup and Adjustments**

Setup and Adjustment time is generally measured as the time between the last good part produced before Setup to the first consistent good parts produced after Setup. This often includes substantial adjustment and/or warm-up time in order to consistently produce parts that meet quality standards. Pre-control after each set up is often necessary
Tracking **Setup Time** is critical to reducing this loss, together with an active program to reduce this time (such as an [SMED - Single Minute Exchange of Dies](http://www.oee.com/overall-equipment-effectiveness-glossary.html#SMED) program).
Many companies use creative methods of reducing Setup Time including assembling changeover carts with all tools and supplies necessary for the changeover in one place, pinned or marked settings so that coarse adjustments are no longer necessary, and use of prefabricated setup gauges.

**Small Stops and Reduced Speed**

Small Stops and Reduced Speed are the most difficult of the Six Big Losses to monitor and record. **Cycle Time Analysis** should be utilized to pinpoint these loss types. In most processes recording data for Cycle Time Analysis needs to be automated since cycles are quick and repetitive events that do not leave adequate time for manual data-logging.

By comparing all completed cycles to the [Ideal Cycle Time](http://www.oee.com/overall-equipment-effectiveness-glossary.html#Ideal Cycle Time) and filtering the data through a [Small Stop Threshold](http://www.oee.com/overall-equipment-effectiveness-glossary.html#Small Stop Threshold) and [Reduced Speed Threshold](http://www.oee.com/overall-equipment-effectiveness-glossary.html#Reduced Speed Threshold) the errant cycles can be automatically categorized for analysis. The reason for analyzing Small Stops separately from Reduced Speed is that the root causes are typically very different, as can be seen from the Event Examples in the previous table.

**Startup Rejects and Production Rejects**

Startup Rejects  and Production Rejects are differentiated, since often the root causes are different between startup and steady-state production. Parts that require rework of any kind should be considered rejects. Tracking when rejects occur during a shift and/or job run can help pinpoint potential causes, and in many cases patterns will be discovered.
Often a **Six Sigma** program, where a common metric is achieving a defect rate of less than 3.4 defects per million 3.4 million is accounting for a continuous 1.5 standard deviation shift from desired target, if the target and mean were the same it would be 2/billion opportunities "opportunities", is used to focus attention on a goal of achieving "near perfect" quality.

<http://www.oee.com/oee_six_big_losses.html>

Kaizen

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| [Other Kaizen Magazine Articles](http://www.graphicproducts.com/tutorials/magazine-articles/magazine-article.php)Getting Back to Basics**Find your mistakes and learn from them.**

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| By Tom DossenbachThis article first appeared in Wood & Wood ProductsIn response to recent reader inquiries about Continuous Improvement, I feel many manufacturers need encouragement to stop looking at this as some sophisticated management system for the rich and famous. It matters not that you are a small shop making kitchen cabinets, a supplier of parts to the industry, a millwork company or a Fortune 500 company. Continuous improvement is for everyone.**You have heard a lot about Kaizen** (“Good Change” or “Continuous Improvement”) over the past decade. The Japanese have been given the credit for this movement, but actually Dr. W. Edwards Demming initiated much of the philosophy while assisting the rebuilding of Japanese industry following World War II. But regardless of what you call it, there are two important axioms to bear in mind:1. Continuous Improvement efforts, applied diligently, will generate positive results -- certain!2. Defiance of Continuous Improvement Pursuit will result in company doom -- certain!**Some of us have forgotten what we learned** many years ago when we had suggestion boxes in our plants. We learned that those on the production floor knew better than anyone what needed to be done to improve productivity and quality. The problem was that we really did not have a program in place to follow up. Now it is time to get those suggestions out of the box and empower employees and groups of employees to participate in their own change initiatives for the good of the company.Continuous Improvement: What Is It?What is continuous improvement and why is it important? The answers are found in the following simple example:I did some consulting for a case goods manufacturer last year. During a tour of the factory I noticed that there was a lady on the assembly line working very diligently scraping and hand sanding every one of the veneered tops to remove defects. I had just seen an excellent sanding department with up-to-date equipment so I asked Albert, the supervisor, why they were having to do so much re-work?He replied, *“We always have to because of the scratches and marks on the tops.”**“Where do the marks come from?”* I asked.*“Well, they just happen.”**“Have you tried to find out why?”**“We can’t. It’s always something -- first one thing and then another”.*I replied, *“Well, why don’t you try to fix the one thing’ first and then the other’?”*Sure enough, we took a quick look and found the drawer fitter was using the top as a workbench for his tools; the top-out station dragged one top across the other as they drew from stock; and a wet sponge was set on another top. I suggested to Albert that we take two minutes, right then, and explain the problem to the entire line and point out some of our observations asking them to see if they could find ways to avoid the extra work.The assemblers began being more careful when applying glue so there was no reason to use a wet sponge on the tops to remove the glue. The top-out station started lifting the tops instead of dragging them. The drawer fitters started placing their tools on a convenient shelf they made. (These are woodworkers, after all.) Other ideas on how to avoid dents and scratches were discussed.**By the end of the next day, the lady who had been sanding the tops had been moved to another department. That’s a $30,000 cost avoidance!**The norm in industry today is to repair the damage or to remove the symptom. That’s what they were doing. The Kaizen way is to get to the cause and remove it, permanently. Putting it another way, we often are satisfied to say: “If it’s broken, fix it.” In a plant practicing continuous improvement, the question is: “Why did it break?” This is how all of you must think about your processes when deciding what to implement as improvementsI have said it before and I will say it again. You have to believe that your company can and must improve to meet the challenges of tomorrow. Furthermore, you need to believe in the ability of your people to recognize opportunities and make improvements in an ongoing manner.

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| How to Fail at Kaizen• Go around telling everyone you have a great program to save the company — “right now.”• Believe that you know all the questions and have all of the answers to make Continuous Improvement work in your company.• Begin before discussing with your key people to decide what you want to accomplish.• Use your own personal vision to lead the effort instead of developing a set of long range goals for your company.• Believe in changing processes and systems alone without any attention to the company culture.• Expect and tolerate no failures or set-backs. |

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If you still want a fancy definition of Kaizen, it is the metaphysics of positive change. If you prefer, it is a philosophy, an attitude, a way of thinking, and a way of acting all in one. It can include Kaizen Circles, Quality Circles, Total Quality Management, Participative Management, Kan Ban, JIT, and many other useful tools. However, it can be as simple as your dedication to get people involved in cutting costs through positive change.Pilot ProgramDo not start out making your Continuous Improvement Program too complicated. Go slowly. Be willing to take a step or two backwards from time to time. Expect mistakes. Don’t freak out when they occur. Learn from them. If you wish, do as I have done and begin with a pilot program after you have decided on a vision of where your company needs to go. Identify a critical area in which you would like to see progress made. Select a group of capable individuals to make up a team. Maybe it is a manufacturing department, such as packing. Get the supervisor in the team leadership mode. Let them begin to work on their challenges. With your leadership from the top and their initiatives from the bottom you will have a winning effort.I would caution you not to let an atmosphere of elitism surface. I have seen this turn the rest of the plant against the idea.This is just a pilot program to find out what works and what doesn't in your organization. It can also serve to generate interest throughout your organization. Look at it as a primer.Reprinted, with permission from Wood & Wood Products, copyright 2005 - VANCE PUBLISHING, ALL RIGHTS RESERVED  |

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**quality circles and kaizen teams**

**Business studies students often come across the concept of quality circles, or "Kaizen". What does this mean and what are the practicalities of using Kaizen in a quality management system?**

We saw in our [revision note on total quality management](http://tutor2u.net/business/production/quality_tqm.htm) that a key principle of quality management is that of "continuous improvement".

Continuous improvement means just what it says. It is a philosophy that encourages all employees in an organization so that they perform their tasks a little better every day. It starts from the assumption that business processes (e.g. production methods, purchasing, recruitment) can **always** be improved.

So why the use of the term **Kaizen**? Kaizen is a system for **generating and implementing employee ideas** popularized developed in Japan. The Kaizen suggestion scheme helped many Japanese companies improve **quality** and **productivity**, which allowed them to offer better products at lower prices and therefore increase their market share.

Much of the success of Kaizen came about because the system encouraged many small-scale suggestions that were cheap and quick to implement. They also came from shop-floor employees - who had a detailed appreciation of the benefit each change might make to the process concerned. By implementing many small improvements, the overall effect was substantial.

One of the most publicized aspects of the Japanese approach to quality management is the idea of Quality Circles or Kaizen teams.

Professor John Oakland (a leading authority on quality) defines a Quality Circle/Kaizen Team as a group of workers who do similar work and who meet:

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| - | Voluntarily |
| - | Regularly |
| - | In normal working time |
| - | Under the leadership of their supervisor |
| - | To identify, analyze and solve "work-related" problems |
| - | To recommend solutions to management |

Evidence of successful Quality Circles suggests that there are no formal rules about how to organize them. However, the following guidelines are often suggested:

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| - | The circle should not get too large - otherwise it becomes difficult for some circle team members to contribute effectively |
| - | Meetings should be help away from the work area - so that team members are free from distraction |
| - | The length and frequency of quality circle meetings will vary - but when a new circle is formed, it is advised to meet for about one hour, once per week. Thereafter, the nature of the quality problems to be solved should determine how often the circle needs to meet |
| - | Quality circles should make sure that each meeting has a clear agenda and objective |
| - | The circle should not be afraid to call on outside or expert help if needed |

# 7. Lean Manufacturing Glossary, Definitions and Terms

| 1 | 2 | 3 | 4 | [5](http://www.gembutsu.com/articles/leanmanufacturingglossary.html#5) | 6 | 7 | 8 | 9 |

| [A](http://www.gembutsu.com/articles/leanmanufacturingglossary.html#a) | [B](http://www.gembutsu.com/articles/leanmanufacturingglossary.html#b) | [C](http://www.gembutsu.com/articles/leanmanufacturingglossary.html#c) | [D](http://www.gembutsu.com/articles/leanmanufacturingglossary.html#d) | [E](http://www.gembutsu.com/articles/leanmanufacturingglossary.html#e) | [F](http://www.gembutsu.com/articles/leanmanufacturingglossary.html#f) | [G](http://www.gembutsu.com/articles/leanmanufacturingglossary.html#g) | [H](http://www.gembutsu.com/articles/leanmanufacturingglossary.html#h) | [I](http://www.gembutsu.com/articles/leanmanufacturingglossary.html#i) | [J](http://www.gembutsu.com/articles/leanmanufacturingglossary.html#j) | [K](http://www.gembutsu.com/articles/leanmanufacturingglossary.html#k) | [L](http://www.gembutsu.com/articles/leanmanufacturingglossary.html#l) | [M](http://www.gembutsu.com/articles/leanmanufacturingglossary.html#m) | [N](http://www.gembutsu.com/articles/leanmanufacturingglossary.html#n) | [O](http://www.gembutsu.com/articles/leanmanufacturingglossary.html#o) | [P](http://www.gembutsu.com/articles/leanmanufacturingglossary.html#p) | [Q](http://www.gembutsu.com/articles/leanmanufacturingglossary.html#q) | [R](http://www.gembutsu.com/articles/leanmanufacturingglossary.html#r) | [S](http://www.gembutsu.com/articles/leanmanufacturingglossary.html#s) | [T](http://www.gembutsu.com/articles/leanmanufacturingglossary.html#t) | [U](http://www.gembutsu.com/articles/leanmanufacturingglossary.html#u) | [V](http://www.gembutsu.com/articles/leanmanufacturingglossary.html#v) | [W](http://www.gembutsu.com/articles/leanmanufacturingglossary.html#w) | [X](http://www.gembutsu.com/articles/leanmanufacturingglossary.html#x) | [Y](http://www.gembutsu.com/articles/leanmanufacturingglossary.html#y) | [Z](http://www.gembutsu.com/articles/leanmanufacturingglossary.html#z) |

 <http://www.gembutsu.com/articles/leanmanufacturingglossary.html> 9/03/09

**5S:** 5S is a housekeeping methodology for the shop floor. There are five rules of housekeeping for a lean environment and they help to expose waste and support the discipline needed to implement the Toyota Production System.

The five S’s are described below:

**1. Seiri (Organization):** Keep just what is needed, clearly distinguish between what is needed and kept and what is unneeded and thrown away.

**2. Seiton (Orderliness):** Have a place for everything and implement a system whereby everything is in its place. Organize in a way that ensures that necessary things are kept close at hand. Tools and other objects should be easier to find and returned to their proper location.

**3. Seiso (Cleanliness):** This can be viewed as systematic clearing where everything is cleaned, inspected and maintained on a regular basis.

**4. Seiketsu (Standardization):** Establish methods within the company that will ensure the effective continuation of steps 1 thought 3.

**5. Shitsuke (Discipline):** Set us systems that sustain the five S process. Ensure that all 4 steps are maintained.

If a company does not have the discipline to execute the five S’s, it will not have the discipline to complete standard work, pull systems, and other lean techniques. 5S is the very first step on a company’s learn journey.

**| A |**

**Andon:** Simply means “light” in Japanese. However, in a TPS environment, an andon is any visual indicator signaling that a team member has encountered an abnormal situation which can not be resolved without preventing a stoppage (as defined by takt time). Poor quality, lack of a parts, paperwork, information or tools may cause an abnormal condition. The key to effective andons is that they be visual and support “management by sight”.

**Andon Board:** A visual control device in a work area, typically a lighted overhead display giving the current status (green, yellow, red) of each step in the production system and alerting team leaders and supervisors to existing or emerging production problems.

**Automation:** Employing machines to do the work of people. The steam engine and the automation that it enabled was the backbone of the Industrial Revolution.

**Autonomation (Jikoka):** Transferring human intelligence to automated or semi-automated machinery so that machines and not people are able to detect production defects and immediately stop themselves. Usually, such a stop is signaled via an [andon](http://www.gembutsu.com/articles/leanmanufacturingglossary.html#andon) signal. This notion of built-in-quality was pioneered by Sakichi Toyoda when he invented automatic textile looms that stopped the instant a thread was broken. In Japanese, this concept is called Jidoka and it is a critical element of the TPS House.

**Automatic Time:** The time when a machine is running on an automatic cycle and a person is not needed to operate the equipment.  Automatic Time is also called Machine Time and it is one of three measures on a Standard Work Combination Sheet.

NB: If an operator is required to watch a machine work, this is to be considered not automatic time, but operator time.

**| B |**

**Batch Production:** In contrast to one-piece-flow (or flow), batch production is a mass-production practice developed by Henry Ford. It is the practice of making large lots of a particular item to gain economic efficiencies of equipment and machine changeover time. TPS teaches that such a practice is inefficient in the long-term because it results in overproducing unwanted product. [*See the seven wastes.*](http://www.gembutsu.com/articles/leanmanufacturingglossary.html#7wastes)

**Breakthrough Improvement (Kaikaku):** A major, significant improvement that occurs after many small, incremental improvements (kaizen). Kaikaku should come naturally after completing many (sometimes hundreds) kaizens; it is not something that is forced.

**| C |**

**Chaku-Chaku:** A Japanese word meaning load-load, it refers to a single-piece flow cell where the only thing that an operator does is load each machine in sequence. The operator only loads material because all other operations have been automated and do not require human supervision. This is an advanced lean technique and may takes years of hard work to develop in a single cell. However, the benefits are significant (elimination of WIP, defect free production and very high utilization of labor and space).

**Changeover Time:** The time required for a machine to produce a different part (for example, a new stamping, a new color in a paint system, a new mold in an injection molding machine, etc...). Changeover time is measured from the last good part of the previous process to the first good part of the subsequent process.  Reducing changeover time is a key component of implementing a pull production system which operates with as little inventory as possible.

**Continuous Flow:** Flow of products in a manner through the production operation. The ideal situation is one-piece flow at and between the processes. The intent of flow production is to increase the velocity of products and make the production cycle predictable.

**Concrete Head:** A Japanese term for someone who resists and will not accept change.  Concrete heads do not accept that businesses must be focused on waste elimination and customer satisfaction and other concpets inherent to a lean production system.

**Cycle Time:** Cycle time is measured, usually with a stop watch. The actual time it takes to complete a process from start to finish to produce one unit (one cycle of an operation). An employee’s cycle time, must meet [takt time](http://www.gembutsu.com/articles/leanmanufacturingglossary.html#takttime) (with an appropriate buffer of safety time). If cycle time is higher than takt time, the customer’s needs will not be met. If it is lower, there will be overproduction / excess inventory or operator idle time, each of which is a waste and costs money. Keeping cycle time equal to takt time will prevent waste from creeping back in the process.

Only when cycle time for every operation in a complete process is reduced to equal takt time can products be made in a single-piece flow process.

**| E |**

**Elimination of Waste:** A philosophy which states that all activities undertaken need to be evaluated to determine if they are necessary or unnecessary as defined by the customer. The philosophy of waste elimination is the backbone of the Toyota Production System.

**Employee Involvement:** A crucial aspect of Continuous Improvement based on two facts:

Fact 1: Those who do the job every day have vital information for eliminating waste and adding value and solving real problems.

Fact 2: To get commitment from those who will implement the plans developed, they need to be involved in the decision making process.

**Error Proofing:** See Poka-Yoke (Mistake Proofing).

**| F |**

**Five Why’s:** Method of evaluating a problem or question by asking “why” five times. The purpose is to get to the root cause of the problems instead of addressing the symptoms. By asking and answering why five (or more) times, the root cause becomes evident and the proper corrective action can be taken.

**Flow Production:** Same as single-piece-flow or one-piece-flow. Describes how goods, services and information are processed. That is, once piece at a time. This can be a part, a document, invoice or customer order. It rejects the concept of batch, large lot or mass processing. Flow vertically integrates all operations and functions as operationally or sequentially performed. It also encompasses pull or demand processing. Goods are not pushed through the process, but pulled or demanded by succeeding operations from preceding operations.

**| G |**

**Gemba\*: “**Actual place” or the place where real action occurs, that is where products or services are performed. In a manufacturing environment, the gemba often refers to the shop floor, because it is there that product is being transformed.

**Gembutsu\*:** In Japanese, it refers the actual product. These are a companies parts, tools, jigs, fixtures, machines, equipment and materials all used to manufacture quality products.

**Genjitsu\*:** In Japanese, it refers to the “actual facts” or reliable and observed data required to understand what the actual situation/problem is.

**\*Three Gen Principle:** When solving a problem, the combination of going to the gemba, to observe the Gembutsu in order to obtain genjitsu. With these three “gen’s” a problem can be properly solved.

**| H |**

**Hanedashi:** A device or means for automatic unloading of a work piece from one operation or process. This same device will provide proper orientation of the next work piece for the next operation or process. Crucial for a “Chaku-Chaku” line.

**Hoshin Kanri:** A strategic decision-making tool for a firm’s executive team that focuses on resources on the critical initiatives necessary to accomplish the business objectives of the firm. By using visual matrix diagrams similar to those employed for quality function deployment, three to six key objectives are selected while all others are clearly deselected. The selected objectives are translated into specific strategies and deployed down to the implementation level in the firm. Hoshin Kanri unifies and aligns resources and established clearly measurable targets against which progress toward the key objectives is measured on a regular basis.

**| J |**

**Just In Time (JIT):** A strategy that exposes waste, makes continuous improvement a reality, and relies on total employee involvement. It concentrates on delivering what the customer wants, when they want it, in the quantity they want. The key elements of JIT are flow, pull, standard work (with standard in-process inventories), and takt time.

**| K |**

**Kaizen (Continuous Improvement):** An organizational attitude, approach and philosophy to doing business. It is the key thrust to maintaining or achieving competitive advantage through a well managed, dynamic change process. It is customer focused, ever changing, and maximized when all associates use kaizen to achieve the primary quality, cost , delivery, safety, and morale goals. The key to kaizen is to use it as a tool to accomplish the policy deployment breakthrough objectives.

**Kanban (signboard):** Designates a pull production means of communicating need for product or service. Originally developed as a means to communicate between operations in different locations, it was intended to communicate a change in demand or supply. In application, it is generally used to trigger the movement of material to or though a process.

**| L |**

**Level Scheduling (Heijunka):** The creation of a level schedule by sequencing orders in a repetitive pattern and smoothing the day to day variations in total orders to correspond to longer-term demand. In other words, crating a production schedule based on a constant volume needed within a given time and variety of product called “mixed lot” production. The goal is to average both the volume and the mix of products.

**| M |**

**Make It Ugly:** Kaizen and TPS does not fix everything right now. Instead, it exposes problems that need to be fixed. Instead of covering up the problems, make it “ugly” as possible so it gets attention. What gets our attention gets resolved. This is a very difficult concept for Western managers to embrace.

**Milk Run:** A routing of a supply or delivery vehicle to make multiple pickups or drop-offs at different locations on a regularly scheduled basis.

**Mistake Proofing (Poke-Yoke):** Developing a system so that it is impossible to make a mistake or produce a defect.

**Monument:** Any design, scheduling, or production technology with scale requirements necessitating that designs, order and products be brought to a machine to wait in a queue for processing. Contrast with right-sized tool. A piece of equipment (usually large and expensive) that cannot easily/inexpensively be moved, even if it would be good to so do in terms of TPS principles. Also, continuous improvement requires continuous re-arrangement; therefore monuments are waste.

**Muda and the 7 wastes:** Waste. Any activity that consumes resources but creates no value.
Seven types of waste have been identified for the shop floor. They are waste from (1) over production, (2) waiting or idle time, (3) transportation, (4) inefficiency of the process itself, (5) inventory, (6) unnecessary motion and effort and (7) defects.

**Mura:** Overloading an area or asking for otherwise unreasonable work.

**Muri:** Uneven flow of parts.

**| N |**

**Nichijo Kanri:** Daily fundamental management. This is the opposite of Hoshin Kanii or Policy Deployment, which is the direction setting management or strategic planning function.

**| P |**

**Pull System:** A production method in which the production of an item starts only when there is actual demand from a customer (as opposed to anticipated from a forecast). The demand of that customer starts (pulls) the next downstream operation into the production process, etc. The opposite of pull production is push production.

**Push Production:** The typical method of “pushing” large lots of material through the system, usually managed by a complicated (often computerized) process to track where items are and how to connect these items into a customer satisfaction unit. Inevitability this leads to other wasteful processes, such as expediting. The production of items based on a predetermined schedule or forecast. The result is inventory – manufactured items for which there is not yet a customer. A push system is the exact opposite of a pull system.

**| Q |**

**Q,C,S,D,M:** These are the basic drivers of every business and are Quality, Cost, Delivery, Safety and Morale.

**| R |**

**Right Sized Tool:** A design, scheduling, or production device/tool that can be fitted directly into the flow of products within a product family so that production no longer requires unnecessary transport and waiting. Contrast with monument.

**| S |**

**Spaghetti Chart:** A map (floor plan) of the path taken by a specific product/part/material/person as it or they travel through the value stream in a mass-production organization, so-called because the product’s route typically looks as disorganized as a plate of spaghetti.

**Standard Work:** Standard work lists the normal tasks done with the least amount of waste possible at the current time (of course, it will continually be improved.) Standard work includes the amount of time needed for each task. Standard work focuses on the employee, not the equipment or the materials. Standard work is completed by the actual operator performing the task since they know best the details of the process. Standard work is often confused with work standards and/or work instructions. They are not the same thing. Standard work reduces variation an increases consistency that is necessary for first-time quality.

**Standard Work Combination Sheet:** A form that visually charts the information from a time sheet observation form in terms of an employees activity, machine time and moving time. It separates time between: man, machine and movement (walking).

**Standard Work Sheet:** A form to visually describe the standard operation, including inspection steps, safety issues, and standard work in process. It is a layout of the cell area with all the movement/steps in process noted like a [spaghetti diagram](http://www.gembutsu.com/articles/leanmanufacturingglossary.html#spaghettidiagram).

**| T |**

**Takt Time:** Takt time is a calculated value. The formula for takt time is AVAILABLE PRODUCTION TIME / CUSTOMER DEMAND. Since takt time is defined by the customer (denominator), it becomes a very important number in a lean environment and drives all shop floor decisions.

**Throughput Time:** The time required for a product to go thought a process. Usually, throughput time is measured from the receipt of raw material until that raw material is shipped to the customer. Some companies begin the process with the receipt of a customer’s order.

**Total Productive Maintenance (TPM):** Preventative maintenance carried out by all employees. It is equipment maintenance performed on a company wide basis. TPS has five goals:

1. Maximize equipment effectiveness.
2. Develop a system of productive maintenance for the life of the equipment,
3. Involve all departments that plan, design, use, or maintain equipment in implementing TPM.
4. Actively involve all employees.
5. Promote TPM through motivational management.

**| V |**

**Value Steam Mapping:** Identification of all the specific activities occurring along a value stream for a product or product family. This is part of creating a lean enterprise. The output should be a list of action items to be done to improve the process.

**| W, X, Y and Z |**

**Waterstrider (Mizusumashi):** Water-beetle or Water-spider. A term used to describe the activities of the person responsible for maintaining correct inventories on the production line.

**Six Sigma**

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| **5 Ms and a P** | An expression identifying the six major factors most likely to be the source of problems. These factors are machines, materials, methods, Mother Nature, measurement, and people. |
| [attribute data](http://www.toolingu.com/definition-900170-13850-attribute-data.html) | Data that represents an individual characteristic or a count. Also known as discrete data, attribute data cannot be added to or subtracted from other attribute data. |
| [bell-shaped curve](http://www.toolingu.com/definition-900170-13844-bell-shaped-curve.html) | A graph of variable data characterized by a high center, tapered sides, and bell-flared edges. A bell-shaped curve reflects conditions that exhibit natural variation.  |
| [black belt](http://www.toolingu.com/definition-900170-13826-black-belt.html) | A Six Sigma practitioner with the most training who acts as the project leader. Black belts work full time on projects and coach lower-level team members. |
| [champion](http://www.toolingu.com/definition-900170-13824-champion.html) | A Six Sigma designation for an executive or manager within a company who can get things done for the team. Champions make sure that the team has necessary resources. |
| [charter](http://www.toolingu.com/definition-900170-13847-charter.html) | A document that serves as a problem statement defining the Six Sigma project target. |
| [common cause variation](http://www.toolingu.com/definition-900170-13836-common-cause-variation.html) | A source of variation that is normal and expected. Common cause variation is predictable and cannot be traced back to a single source. |
| [continuous data](http://www.toolingu.com/definition-900170-13839-continuous-data.html) | Data that can be measured on a scale and compared with other data. Also known as variable data, it can be added to or subtracted from other continuous data. |
| [continuous improvement](http://www.toolingu.com/definition-900170-13819-continuous-improvement.html) | The belief that an organization must constantly measure the effectiveness of its processes and strive to meet more difficult objectives to satisfy customers.  |
| [critical to quality](http://www.toolingu.com/definition-900170-13820-critical-to-quality.html) | Specific, measurable characteristics of a product or process that are identified by customers as necessary for their satisfaction.  |
| [cycle time](http://www.toolingu.com/definition-900170-13823-cycle-time.html) | The actual time it takes to perform a task and forward it to the next step.  |
| [data](http://www.toolingu.com/definition-900170-13812-data.html) | Factual information, usually in the form of numbers, that is used for analysis and problem solving. |
| [discrete data](http://www.toolingu.com/definition-900170-13838-discrete-data.html) | Data that represents an individual characteristic or a count. Also known as attribute data, discrete data cannot be added to or subtracted from other discrete data. |
| [DMAIC](http://www.toolingu.com/definition-900170-13846-dmaic.html) | Six Sigma's five steps for process improvement. DMAIC stands for define, measure, analyze, improve, and control. |
| [external customer](http://www.toolingu.com/definition-900170-13821-external-customer.html) | An outside organization or individual that receives a product or service from the company.  |
| [finish grinding](http://www.toolingu.com/definition-900170-13834-finish-grinding.html) | An abrasive process that improves the surface of the part. |
| [frequency distribution](http://www.toolingu.com/definition-900170-13843-frequency-distribution.html) | A systematic method of showing the number of occurrences of observational data in order from least to greatest. Frequency distributions best represent continuous data. |
| [go-no go gage](http://www.toolingu.com/definition-900170-13840-go-no-go-gage.html) | A measuring instrument that determines whether a part feature simply fits or does not fit and therefore passes or fails inspection. No effort is made to determine the exact degree of error. |
| [green belt](http://www.toolingu.com/definition-900170-13827-green-belt.html) | A team member trained in Six Sigma who spends about 20% of his or her time on Six Sigma projects and about 80% on regular duties. |
| [internal customer](http://www.toolingu.com/definition-900170-13822-internal-customer.html) | A department or individual within the company that relies on others to satisfy the external customer. In a multi-step process, the next step in the process is always the internal customer.  |
| [ISO 9000](http://www.toolingu.com/definition-900170-13816-iso-9000.html) | A standard published by the International Organization for Standardization that lists requirements for the creation and implementation of an effective quality management system. |
| [just-in-time manufacturing](http://www.toolingu.com/definition-900170-13815-just-in-time-manufacturing.html) | An approach to production and distribution that emphasizes flexible processes and reduced inventories to decrease costs and improve responsiveness.  |
| [lean manufacturing](http://www.toolingu.com/definition-900170-13818-lean-manufacturing.html) | An approach to manufacturing that seeks to improve product quality and productivity, reduce cost, and eliminate waste.  |
| [master black belt](http://www.toolingu.com/definition-900170-13825-master-black-belt.html) | A hands-on Six-Sigma practitioner who works closely with other members to set and carry out project goals. Master black belts work full time on projects and coach lower-level team members. |
| [non-value added](http://www.toolingu.com/definition-900170-13832-non-value-added.html) | Activities that do not contribute to the product or the process and should therefore be eliminated. Non-value added steps are waste.  |
| [Pareto chart](http://www.toolingu.com/definition-900170-13842-pareto-chart.html) | A bar chart that shows the order of the most frequently occurring errors or sources of errors. Pareto charts best represent discrete data. |
| [Pie chart](http://www.toolingu.com/definition-900170-13841-pie-chart.html) | A circular chart that is cut into slices that represent the frequency of the collected data. The bigger the slice, the higher the number or percentage. Pie charts best represent discrete data. |
| [process mapping](http://www.toolingu.com/definition-900170-13848-process-mapping.html) | A graphical method of capturing the steps of a process. Process mapping can be performed before and after a process is improved.  |
| [process owner](http://www.toolingu.com/definition-900170-13828-process-owner.html) | A temporary designation for the person responsible for process design and performance. Green belts are sometimes considered process owners. |
| [quality management](http://www.toolingu.com/definition-900170-13813-quality-management.html) | A process improvement method that focuses on increasing customer satisfaction at a reasonable cost to the company. |
| [root cause analysis](http://www.toolingu.com/definition-900170-13831-root-cause-analysis.html) | A study undertaken to find the first or underlying cause of a problem. Root cause analysis involves the collection and study of data to determine a true cause to a problem. |
| [run chart](http://www.toolingu.com/definition-900170-13845-run-chart.html) | A graphic representation of process performance data tracked over time. Run charts best represent continuous data. |
| [Six Sigma](http://www.toolingu.com/definition-900170-13811-six-sigma.html) | A management philosophy and process improvement method that uses data to identify problems and point to improvements. Six Sigma's goal is to reduce the number of defects to less than 3.4 defects per million opportunities, which is near perfection.  |
| [special cause variation](http://www.toolingu.com/definition-900170-13837-special-cause-variation.html) | A source of variation that causes a fundamental change in a process. Special cause variation signals a change in a process and can be traced back to a single source. |
| [statistical process control](http://www.toolingu.com/definition-900170-13849-statistical-process-control.html) | The use of statistics and control charts to measure key quality characteristics and control how the related process behaves. SPC separates special causes of variation from common causes.  |
| [total quality management](http://www.toolingu.com/definition-900170-13814-total-quality-management.html) | A management method popular in the 1980s and 1990s that was based on a list of improvement philosophies. The purpose was to bring about company-wide change and continuous improvement. |
| [value-added](http://www.toolingu.com/definition-900170-13833-value-added.html) | Any part of the production process that improves the product for the customer.  |
| [variable data](http://www.toolingu.com/definition-900170-13851-variable-data.html) | Data that can be measured on a scale and compared with other data. Also known as continuous data, it can be added to or subtracted from other variable data. |
| [variation](http://www.toolingu.com/definition-900170-13835-variation.html) | A difference between two or more similar things.  |
| [waste](http://www.toolingu.com/definition-900170-13817-waste.html) | Any thing or process that does not add value to a product. Waste is often tied to special causes of variation.  |
| [yellow belt](http://www.toolingu.com/definition-900170-13829-yellow-belt.html) | A designation for other staff members who help with Six Sigma projects.  |

**BPMM**



BPM meets Six Sigma Lake & Wolstenhome (2005)

**Be sure to read: (Favaron, 2006) Even more on What BPM is AND (Lombarti) More on What BPM is**

[**http://webpages.uidaho.edu/~metlen/BUS439History/resources.html**](http://webpages.uidaho.edu/~metlen/BUS439History/resources.html)

What is Bootstrapping and why is it used???

Information

Technology

Process Design & Modeling

Process Implementation & Execution

Process Control & Measurement

Process Improvement & Innovation

Process Project & Program Mgt

Process Project & Program Mgt

Process Improvement & Innovation

Process Control & Measurement

Process Implementation & Execution

Process Design & Modeling

Methods

Process Management Leaders

Process Knowledge

Process Collaboration & Communication

Process Education & Learning

Process Skills & Expertise

People

Process Metrics & Performance

BPM Standards & Controls

Decision Making Processes

Process Roles and Responsibilities

Governance

Strategic

Alignment

**Process improvement Plan**

Strategy & Process Capability Linkage

Process Architecture

Process Output Measurement

Process Customers & Other Stakeholders

Michael Rosemann, 2005 Lenonardo Consulting

Business Process Management Maturity Model

Culture

Process Values & Beliefs

Process Attitudes & Behaviors

Responsiveness to Process Change

Leadership Attention to Process

Process Social Networks

Define

Measure (simulate & perform stats)

Model As-Is processes at appropriate level of detail

Analyze to-be models and select best

Compare To-Be and as-is models

Develop to-be models

Look at existing models of related processes in ‘BPM software’ repository

Capture issues – maintain as attributes (or link to model/objects)

Communicate models to business for verification

Analyze models via ‘BPM software’ reports

Define process scope using ‘BPM modeler’

Investigate (simulate)

Utilize Change Management functionality

Use model analysis to develop associated change requirements: Job descriptions & competencies

Use model to support training

Communicate roll-out via model

Solution sign off based on model

Implement

Gather feedback via web-published models

Evaluate

Store process/owner information in attributes

Provide model to process owner

Share common model via ‘BPM software’

repository

Standardize