KAIZEN EVENTS and LEAN $6\sigma$

- KAIZEN EVENTS are a very effective, proven way to make rapid improvement
- SIX SIGMA is a deliberate, structured, effective way to develop solutions for sustained improvement.
- Barrier: belief that $6\sigma$ is too rigorous, too methodical, too rigid, and will slow you down.
- You can have the best of both worlds.
  - The speed and energy of Kaizen
  - The discipline and sustainability of $6\sigma$
AGENDA

- DuPont history with Lean, 6σ, and Kaizen
- The meaning of KAIZEN
- The Kaizen event process
- DMAIC – the Six Sigma process
- Kaizen events as Six Sigma projects - exploit the parallels!
- Case study – sheet extrusion process
- Benefits of doing Kaizen following a 6σ process
- Questions
The DuPont Company began to practice Lean in 1989
- As Continuous Flow Manufacturing (CFM)
- Began as individual plant pilots
- Benefits were dramatic – but not always sustained

Six Sigma became the corporate process for problem solving in 1998
- Brought a higher level of sustainability to Lean

Kaizen Events were adopted circa 2004.
- Soon evolved to being done as 6σ projects
- Brought discipline & sustainability, maintained speed & energy
The Japanese terms KAI and ZEN literally mean “to change” and “for the better”, and it has come to symbolize continuous improvement. Kaizen can be defined on several levels:

- A *philosophy* of on-going, incremental continuous improvement
- The *process* of making small incremental improvements on a daily basis
- An *attitude* within the workforce, that they have the responsibility to identify and participate in potential improvements
- A *mind-set* that is always striving for perfection
Although Kaizen should be practiced every day to achieve incremental improvement…

It is often helpful to conduct an event to attack a more significant problem or opportunity

Kaizen Events:

- Are very focused
- Have a well defined purpose and scope
- Are team based
- Have a short, fixed time duration
- Include piloting, implementing, and standardizing the improvement
Kaizen Events are sometimes called ....

- Kaizen Bursts
- Kaizen Blitzes
The typical Kaizen event is 3 – 5 days in length
Can be shorter (< 1 day), depending on scope
Must be long enough to allow implementation and demonstration of results
A complex problem (e.g., implementation of a Pull System) may be broken into several Kaizens
   Each must have a defined, demonstrable end point
In addition to the event itself, there is event planning
   A few days, spread over a few weeks
   ….. and follow-up
**KAIZEN EVENT BENEFITS**

*Things get done!*

- Improvements get made.
- Waste gets eliminated.
- Results are seen very quickly.
- Participants learn skills – and get experience.
- Cross-functional teams provide better understanding of end-to-end process.
- The solution has strong user ownership.
- Employee motivation is enhanced.
- A successful event builds energy for the next steps.

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KAIZEN EVENT SPECIFICS

- PLAN THE EVENT
- CONDUCT THE EVENT
- EVENT FOLLOW-UP
PLANNING A KAIZEN EVENT

1. Define the Scope
2. Set the Objective
3. Select the Team
4. Select the Event Leader
5. Decide on Event Length
6. Schedule the Event
7. Arrange Participant Availability
8. Arrange Management Availability
9. Define the Pre-work
10. Schedule & do the Pre-work
11. Arrange Meeting Facilities
12. Arrange for Production Interruptions
CONDUCTING A KAIZEN EVENT

1. Kick-off, Purpose, Scope
2. Set the Improvement Target
3. Training: Process, Tools
4. Analyze the Problem
5. Propose a Solution
6. Implement the Solution
7. Improve the Solution
8. Document the Solution
9. Define a Control Plan
10. Present Results to management
11. Celebrate Success!!
KAIZEN EVENT FOLLOW-UP

Follow-up is very important!
– without good follow-up, the Kaizen effort may be wasted

1. Publicize the new Process

2. Audit Performance (on-going)

3. Leverage to Similar Situations
TYPICAL KAIZEN EVENT TOPICS

- 5S an area
- SMED a changeover
- Pilot TPM in a manufacturing area
- Develop the Value Stream Map for a process
- Design and implement a Takt Board in an area
- Identify the bottleneck and apply Theory of Constraints
- Implement Cellular flow
- Implement or improve a Product Wheel
- Design and implement a Pull Replenishment System**

** (may take more than one Kaizen Event)
KAIZEN EVENT TOPICS

- It’s best to start with straightforward problems
  - To introduce the concept
  - To achieve initial successes
  - To build momentum for more challenging problems

- More complex problems may be better managed as projects, with Kaizen events to complete specific pieces of the plan
  - May be much more than can be done in a week
  - May require too many participants at one time

- Example - Develop a Pull Replenishment System
  1) Analyze all demand and variability data, decide if MTO or FTO is an option
  2) Decide on Pull concept, and where supermarkets are needed, design supermarket levels
  3) Design visual pull management tools, Takt boards
Kaizens aren’t just for manufacturing anymore!

- Legal patent application filing process
- Accounts receivable process
- HR interviewing process
- Production planning process
WHAT’S IT REALLY LIKE?
KAIZEN EVENT ANALOGY ~ REAL LIFE

TIGERS   QTR.   GUEST
14    0    4    20

DOWN   YDS. TO GO   BALL ON
7    10    33

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HOW IS THIS LIKE A KAIZEN EVENT?

- The objective is very clear
- Short, fixed, time frame
- All data has been gathered
- The process has been mapped
- It has been well planned
  The “two-minute drill”

- The best team is on the field
- The team leader has been selected
- Results must achieved within the time
- Adrenaline flows!
- Success builds excitement and energy!
SIX SIGMA

- An improvement methodology
- Aimed at elimination of all defects
- Aims for a defect rate < 3.4 per 1,000,000 opportunities
- 99.9996% perfect
- Is based on statistical quality tools
  - Pareto diagrams, run charts, histograms, regression analysis, etc.
- And a disciplined, structured process
  - D – M – A – I - C

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Six Sigma is based on:

\[ Y = f (x_1, x_2, x_3 \ldots) \]

- Where Y is a key performance parameter to be improved
- And X’s are the controllable variables that may affect Y
D M A I C

- **D = Define**
  - Clearly define the problem being addressed
  - Know who the customer is
  - Map the current process

- **M = Measure**
  - Identify the project “Y”
  - Measure current process performance

- **A = Analyze**
  - Identify the “Xs” with most effect on “Y”
SIX SIGMA

- **I = Improve**
  - Propose a solution
  - Pilot the solution

- **C = Control**
  - Document the solution
  - Put an audit & control plan in place
Kaizen Events and Six Sigma map onto each other very well
PLANNING A KAIZEN EVENT

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KAIZEN EVENT FOLLOW-UP

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CONTROL
The key is to follow the 6σ methodology, but not get carried away with it

Should be viewed as a guide, not a requirement

Examine the 17 Deliverables

Steps that aren’t helpful should be bypassed
  - MSA (Measurement System Accuracy)

But should be a conscious decision, not an oversight
KAIZEN EVENTS AS SIX SIGMA PROJECTS

- IF a plant has embraced Six Sigma ....
  Kaizen events should be $6\sigma$ projects

- The D-M-A-I-C framework will increase the likelihood of success
  - Design and Measure will help insure that all factors are considered in Kaizen planning
  - Creation of a Control plan will make it much more likely that the success will be sustained

- There should be a Black belt or Green Belt on the event team
  - To be the $6\sigma$ conscience – to insure that the methodology is being appropriately followed
  - To document the work in the $6\sigma$ format
CASE STUDY ~ KAIZEN EVENT AS A SIX SIGMA PROJECT

- Sheet extrusion process
- 3 day Kaizen Event
- Six Sigma Black Belt project
PROCESS VS ASSEMBLY

Parts Manufacturing and Assembly
- Automobiles
- Cell phones
- Computers
- Power tools
- Appliances
- Aircraft
- Medical instruments
- Consumer electronics
- Lawn mowers

Process Operations
- Chemical reactions
- Physical transformations
- Mixing, blending
- Extrusion
- Sheet forming

Process Products
- Automotive and house paints
- Glass and ceramics
- Foods and beverages
- Personal care products
- Synthetic fibers
- Sheet goods
- Films
**PROCESS PLANT KAIZEN REQUIREMENTS**

- Process equipment tends to be more complex – thus problems can be more complex
  - Designing a Product Wheel for a process making sheet goods of various widths, thicknesses, tensile strengths, and densities is more complex than developing a mixed-model schedule for a process making gear pumps
  - A SMED Kaizen may have to address decontamination issues or getting properties back within spec in addition to mechanical tasks

- More planning and data gathering is often required
  - You can’t always get what you need simply by going into the area and observing.
  - In some processes, not much can actually be seen
  - Sometimes you need weeks of data
PROCESS PLANT KAIZEN REQUIREMENTS

- Number of participants may be greater
  - More groups or functions may be needed
- Rath & Strong recommend a maximum of 8 participants
- *Kaizen for the Shopfloor* recommends 6 – 12
- *The Toyota Way* suggests a maximum of 15
- Process plant Kaizens may require more than that
- In the following case study:
  
  (4) Shift operators  
  (2) Mechanics  
  (1) First line supervisor  
  (1) Repair shop operator  
  (1) Area manager  
  (1) Master scheduler  
  (1) HR representative  
  (2) Mechanical development engineers  
  (1) Product development chemist  
  (1) Six Sigma Black Belt  
  (1) Lean coach  

  Total of 16
THE EXTRUSION PROCESS

POLYMERIZATION REACTOR

EXTRUSION DIE (SPIN PACK)

BONDING

WINDUP
The Problem

- The die can become clogged at any time
- Once clogged – it must be removed and cleaned
- Average die life = 5 days
- Cleaning time averages 9 hours
- Polymer continues to flow during cleaning cycle
- 9 hours of material is wasted every 5 days
- Yield loss = several millions dollars
LINE DOWNTIME

LINE DOWNTIME AVERAGED ALMOST 9 HOURS!
THE KAIZEN EVENT

- Four weeks of planning and data gathering
- Three day event
- Participants:

  (4) Shift operators
  (2) Mechanics
  (1) First line supervisor
  (1) Repair shop operator
  (1) Area manager
  (1) Master scheduler

  (1) HR representative
  (2) Mechanical development engineers
  (1) Product development chemist
  (1) Six Sigma Black Belt
  (1) Lean coach

  Total of 16
THE KAIZEN EVENT

The event process:

- SMED (Single Minute Exchange of Dies)

Additional tools employed:

- Discrete event simulation modeling
- To understand the effect of several proposals on shared resources
  - Extrusion die cleaning area
  - Die removal – installation mechanics
The improvement:

1. Schedule the die changes – to coordinate use of shared resources
   - Frequency < 5 day failure rate – to catch 98% of failures
   - Only 2% of repairs would be unscheduled

2. Purchase a 2nd die – to be ready to install
   - Expensive – but yield savings well justified it
THE RESULT

AVERAGE DOWNTIME WENT FROM 9 HOURS TO 45 MINUTES
Using Six Sigma to manage the Kaizen Event was very beneficial

- Helped insure that all required planning activities were completed
- The 6σ Black Belt served as the team “conscience”
- He insisted that a control plan be created during the event
- He also helped us make conscious decisions about what steps to skip

6σ didn’t slow us down at all

- The things that took time were very necessary steps
  - Four weeks of data gathering & event planning
KAIZEN FAILURES

Not all Kaizen events are effective

- Poor planning, not enough planning
  - Lack of needed data

- “Drive-by Kaizens”
  - A Kaizen done to satisfy a quota
  - Selecting the scope for some arbitrary reason
  - A scope not tied to a clear operational goal
  - A scope not part of the future state VSM

- Lack of sustained improvement
  - The event may be very successful
  - But, the aftermath ……. 
The term “Kaizen” represents Continuous Improvement, in all of the ways it can be achieved.

It is often very powerful to dedicate a small team to solving a specific problem within a very short time frame.

Kaizen events:
- Are quick - 5 days or less
- Are focused - the scope is specific and clear
- Are focused - the team is dedicated full-time
- Get results - the improvement happens during the event
- Place the responsibility in the hands of the users

Six Sigma brings a structure that helps to insure that all relevant steps are being taken.
Summary

- The Six Sigma C step (Control) puts on-going processes in place to enhance sustaining the gains
  - Auditing processes
  - Control plans
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Questions?

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