Why Lecture on PDSAs When You Can Experience Them?

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Facilitators
(faculty bios can be found at the end of the handouts in Appendix A)

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Quick Quiz

- Stand up if you know what the letters PDSA stand for?
- Keep standing if you have run a PDSA in the past month.
- Keep standing if you have run a PDSA in the past week.
- Bonus Question: How many of you have run 1 or more PDSAs in the same day?

Actually you should ALL be standing! Why?
Because you do PDSAs every day!

The PDSA Challenge!

While you do PDSAs every day, most people (and teams) do not take…

...and then set aside …
In the following case study you will see a number of PDSA cycles.

- How many PDSAs were performed?
- What do you think the theories and predictions for each cycle were?
- What was learned through failure and through success?

PDSA Example
The Case of the Sunken Vehicles

Think you're having a bad day? Check this out!

Car - upside down in the water - see owner standing on it?

Call out the wrecker! This will be a no-brainer and we’ll be at the pub in a few minutes!

“I could have sworn I set the emergency brake!”
Coming back up …
…coming...coming…

Coming up...
almost there!

"I could have sworn I set the brakes on that truck! Did we block the wheels?"
Ok, now that we have the car out, let's get that other crane out of there!

Here comes the crane out of the water. We're looking good.

Just a little bit more and we'll be there. Then it will definitely be time for the pub!
Oh no! Who's going to explain this one to the insurance guys?

Shall we try another PDSA?

So, now it is time to plunge into the PDSA pool and see how good you are at running successful PDSAs!
Hmmmmmmmm... I wonder if these adults can do PDSAs as fast as I can.

The Peg Game

The Peg Exercise: The Game Board
The Peg Exercise: The Set Up

Objective
To run PDSA tests until you end with only one token (piece of candy) on the worksheet.

The Peg Exercise: The Solution!
Exercise: Building Skills with PDSA Cycles

1. Find the worksheet with a triangle on it and 15 circles.
2. Open your bag of candy (don’t eat too many of them yet).
3. Place a piece of candy on 14 of the numbers leaving one of the numbers open (it does not matter what number you leave open but somewhere near the center works best).
4. PDSA Cycle #1: Do this first test by yourself. Write down the procedure you used to jump the candies and count the number of candies left on the worksheet after your first test. What did you learn?
5. Repeat the process and run a series of PDSA cycles BUT remember to record the procedure you used and after each test and the number of candies left on the worksheet.

6. At some point you will want to talk to the others at your table and find out who has the lowest number of candies left and the procedure they used.
7. Have those who can get one piece of candy left on their worksheet share their learning (what is your theory and what is your prediction on how they did it?)
8. Can you replicate this method and document the sequence?
9. How many PDSAs did it take before everyone arrived at ONLY ONE piece of candy left on the worksheet?
10. When the entire table masters the sequence successfully, hold up your hands or standup and shout...“We did it!”
## Peg Game Worksheet

<table>
<thead>
<tr>
<th>PDSA Cycle</th>
<th>Number of Candies left on the board</th>
<th>What was your theory or plan for making jumps?</th>
<th>What did you learn about this plan?</th>
<th>What will you try in the next cycle?</th>
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How Many PDSA Cycles have we run?

What did we learn?
PDSA for the “PEG Exercise”

**PLAN**
- Objective: test another approach to removing pegs.
- Prediction: we will leave fewer pegs the next time.
- Plan: who will remove the pegs, and who will record the moves?

**DO**
- Carry out the plan
- Record the moves
- Note problems or changes in the plan

**STUDY**
- Compare results to the prediction.
- Summarize what was learned
- Was the team’s prediction confirmed?
- If not, why?
- Would other theories work?

**ACT**
- Does our approach (theory) leave only 1 peg?
- What new ideas should we test on the next cycle?

Oh...by the way, here is the solution!
(i.e., if you start with the #5 spot open)

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<th>From</th>
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</table>

- When you start with hole #5 it ends with the final peg standing in hole #13.
- With practice, solving this "hard one" is really just remembering that there are only 2 possible first moves and this solution starts from the right.
- The next couple moves are filling the pegs just jumped over or from
- The #4th position is opening the middle hole on the right side of the triangle.
- From there, this challenge pretty much solves itself!
<table>
<thead>
<tr>
<th>Exercise Name</th>
<th>Est. time to run the exercise</th>
<th>Materials Required (per team or table unless stated otherwise)</th>
<th>Number of participants</th>
<th>Number of facilitators required</th>
</tr>
</thead>
</table>
| Peg Game            | ~30 min or less depending on the number of PDSA cycles run | • Copy of peg board (triangle) for each person  
• Markers for each person (M&Ms work nicely plus they get to eat them!)  
• Peg Game worksheet  
• Timing device | 4 or more  
Note: you can do this as an individual exercise or combine people into dyads or teams | None (but if there are more than 50 people it is useful to have a few people to walk amongst the tables to provide guidance and directions) |
| Marshmallow Exercise | ~45-60 min | • 1 marshmallow  
• 20 pieces of Spaghetti  
• 1 yard of string  
• 1 yard of tape  
• Scissors  
• Tape measure  
• Timing device | Minimum: 8 (2 teams of 4 people)  
Maximum: limited only by size of room | 1 lead facilitator  
Support facilitators help but are not required |
| Card Game           | 45-60 min | • Card Game slide set  
• Team Tracking Grid for each team  
• Results of Card Technology Summary Table (put on a couple flipchart pages by facilitators)  
• 2 flipcharts for facilitators | This is a team based exercise.  
Teams should have minimum of 4 people | 1 lead facilitator  
1-2 support facilitators to record results on flipcharts |
| Tennis Balls        | ~30-45 min | • 1 can of tennis balls for each team (3 balls per can)  
• Timing device for facilitator  
• Flipchart for recording results and markers (facilitators) | 5-7 people on a team  
Preferably sitting around a table but they could be standing in a circle. | 1 lead facilitator  
Each table selects a “quality control officer” |
| Paper Airplane Exercise | ~40-4 min | • Standard paper (8.5 x 11”)  
• Each team should have about 10 pieces of paper  
• You will need an area big enough for the teams to "launch" their planes to see how far they fly | This is best done in teams of 4-6 people  
A group of 40-50 participants is a preferred size.  
If you get large groups (>50) you may need additional facilitators to help manage the process. | One faculty member can run this exercise with 50 participants (they would be in teams of 4-6 people)  
When you get more participants than 50 you will definitely need more facilitators. |
## PDSA Exercise Summary Table

<table>
<thead>
<tr>
<th>Exercise Name</th>
<th>Est. time to run the exercise</th>
<th>Materials Required (per team or table unless stated otherwise)</th>
<th>Number of participants</th>
<th>Number of facilitators required</th>
</tr>
</thead>
</table>
| Airplane Factory      | ~60-75 min                    | • 50 – 60 sheets of blank printer paper for each team  
• 1 ruler  
• 1 box of small paper clips  
• Red and blue pens  
• 1 pair of scissors  
• A package of Post-it notes  
• 1 order sheet per person  
• 4 model airplanes  
• Laptop & Airplane Factory slides  
• A recycle bin for all the paper  
• Timing device  | • This is a team activity  
• 4-8 people per team and no more than 10 people per team  | • 1 lead facilitator  
• One “customer” at each table  
• NOTE: the customers must be trained since they have to accept or reject the planes that are produced |
| Mr. Potato Head        | ~60-90 min                    | • 1 Mr. Potato Head for each team  
• Timing device for facilitator  
• Mr. Potato head worksheets to record results of each PDSA and plot the run charts on time and accuracy  | • 4-8 people on a team  
• Each table selects people to be: Pilot Tester, Time Keeper, Quality Assurance, & Data Collector  | • 1 lead facilitator  
• If you have more than 10 teams having “floor supervisors” is helpful |
| Sequence Exercise      | ~30-60 min                    | • 1 flip chart & markers (for facilitators)  
• 2-4-6 worksheet for each person  | • Minimum: 6 people  
• Maximum: limited only by the size of the room  | 1 main facilitator and 1 reviewer per 5 participants                                      |
PDSA Exercises*

1. Peg Game
2. Marshmallow Challenge
3. Card Game
4. Tennis Ball Exercise
5. Paper Airplane Exercise
6. Airplane Factory
7. Mr. Potato Head
8. Sequence Exercise

*NOTE: Exercises 1, 3, 5 and 7 will be done in class. The other exercises and games will be explained but not done.

Let’s take a closer look at …

…the Model for Improvement!
When you combine the 3 questions with the...

PDSA cycle, you get...

...the Model for Improvement.

Our focus today is on the PDSA part of the MFI and tests of change.

Langley, et al., The Improvement Guide, 2009
The scientific method provides the foundation for the PDSA cycle

Deductive Phase
(general to specific)

Theoretical Concepts
(ideas & hypotheses)

Select & Define Indicators

Inductive Phase
(specific to general)

Data Collection
(plans & methods)

Data Analysis and Output

Interpretation of the Results
(asking why?)

Information for Decision Making

Theory and Prediction


Development of the Shewhart Cycle
Materials courtesy of Ron Moen and Cliff Norman, API

1. Design the product (with appropriate tests).
2. Make it; test it in the production line and in the laboratory.
3. Put it on the market.
4. Test it in service, through market research, find out what the user thinks of it, and why the non-user has not bought it.
5. Re-design the product, in the light of consumer reactions to quality and price. *Continue around and around the cycle.*
The Inductive-Deductive Nature of a PDSA Cycle

**FIGURE 4.4. THE ITERATIVE NATURE OF LEARNING AND IMPROVEMENT.**

Prediction (Based on a Hypothesis, Conjecture, Model, Theory)

Real world: Observation, carry out test, look for anomalies

PDSA Cycle 1

PDSA Cycle 2

PDSA Cycle 3

PDSA Cycle 4


Deming’s Sketch of the Shewhart Cycle - 1985

Walter Shewhart (1891 – 1967)

**THE SHEWHART CYCLE**

1. **Plan**
2. **Do**
3. **Study**
4. **Act**

*Act: Adopt the change, or abandon it.*

- Plan a change or a test aimed at improvement
- Carry it out (probably on a small scale)
- Study the results; what did we learn?
- Run through the cycle again, possibly under different environmental conditions.
The PDSA Cycle for Learning and Improvement

Plan
• Objective
• Questions & predictions
• Plan to carry out: Who? When? How? Where?

Do
• Carry out plan
• Document problems
• Begin data analysis

Study
• Complete data analysis
• Compare to predictions
• Summarize

Act
• Ready to implement?
• Try something else?
• Next cycle

What will happen if we try something different?

Did it work?

Let’s try it!

What’s next?

Now the real learning begins!
The Marshmallow Challenge

Objectives

- Generate and test fresh ideas
- Incorporate prototyping
- Build teamwork and consensus
- Run multiple PDSA tests

The Challenge in 18 Minutes

Teams must build the tallest free-standing structure out of

- 20 sticks of spaghetti
- one meter/yard of tape
- one meter/yard of string
- one marshmallow

The marshmallow needs to be on top and remain intact.
Directions

• Build the Tallest Freestanding Structure
• Use as Much or as Little of the Kit as you like (but you can’t use the paper bag!)
• Break up the Spaghetti, String or Tape
• The Challenge Lasts 18 minutes

QUESTIONS?

What did we learn?

• When did you start learning here?
• What did you learn about collecting data, testing, implementing?
• Would we have been as successful with one large test?
• Any value in ideas that did not work?
• Did we take time for teambuilding?

How does this exercise relate to your improvement project?
Links for further information
http://www.marshmallowchallenge.com/Instructions.html

Conclusions

Kids do better than Business Students!

On virtually every measure of innovation, kindergarteners create taller and more interesting structures.
Proto-Typing Matters

- The reason kids do better than business school students is that kids spend more time testing (playing) and prototyping.

- They naturally start with the marshmallow and stick in the sticks.

- The Business School students spend a vast amount of time planning, then implementing the plan, with almost no time to test or fix the design once they put the marshmallow on top.

Test Early and Often!

- The lesson in the marshmallow challenge is that we need to identify the theories and assumptions in our project and test them early and often.

- That’s the mechanism that leads to effective innovation and better results!
The Sequence of Improvement

The Sequence
Testing/Implementation/Spread

- **Pre-Testing:** Collecting data or developing a change. At this point you don’t have an idea (theory) to test yet. In this stage we are learning about the system, looking for ideas to test and understanding the variation in the system.

- **Testing:** Trying and adapting existing knowledge on a small scale and under different conditions. Learning what works in the system.

- **Implementing:** Making a tested change a part of the day-to-day operation of the system in your pilot population.

- **Spreading:** adapting change to areas or populations other than your pilot population(s).
The Sequence of Improvement

As we said, you actually do PDSAs every day
# PDSA Example

## A Tale of Two Bikes!

**1970 Raleigh Record**

**1988 TREX 400**

---

## PDSAs for Two Bikes!

### TREX 400

<table>
<thead>
<tr>
<th>PDSA 1</th>
<th>conduct initial test to determine current status of the bike</th>
</tr>
</thead>
<tbody>
<tr>
<td>PDSA 2</td>
<td>Take bike to bike shop and review findings from PDSA 1</td>
</tr>
<tr>
<td>PDSA 3</td>
<td>Complete tune-up</td>
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<tr>
<td>PDSA 4</td>
<td>Road test at bike shop</td>
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<tr>
<td>PDSA 5</td>
<td>Hit the road for a long ride!</td>
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</tbody>
</table>
To Be Considered a PDSA Test

- The test or observation was **planned** (including a plan for collecting data).
- The plan was attempted (**do** the plan).
- Time was set aside to analyze the data and **study** the results.
- **Action** was rationally based on what was learned.

Source: Improvement Guide pp.60-61

Guidance for Testing a Change

- A test of change should answer a specific question!
- A test of change requires a **theory** and a **prediction**!
- Test on a small scale and collect **data over time**.
- Build knowledge **sequentially** with multiple PDSA cycles for each change idea.
- Include a **wide range of conditions** in the sequence of tests.
- Don’t confuse a **task** with a **test**!
Activity ≠ Change

Is NOT a change: (but may be a necessary preliminary task)
- Planning
- Having a meeting
- Educating staff
- Creating a protocol
- Assigning responsibility

Is a change:
- Include ASC culture in admission pack
- Create a standing order
- Provide staff with protocol compliance feedback
- Test placement of alcohol rub dispensers

For each change idea, you should have an explicit prediction of how it will impact the outcome.

Smaller Scale Tests: Oneness

Conduct the next test
- in 1 facility
- in 1 office or ward
- with 1 nurse
- with 1 physician
- with 1 patient

Start Small ~ 1:3:5:All
Shrink the Timeframe!

- Years
- Quarters
- Months
- Weeks
- Days
- Hours

Determine if you can drop down “two levels” to plan test cycle!

Repeated Use of the PDSA Cycle is Essential for Improvement

<table>
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<tr>
<th>Model for Improvement</th>
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<tr>
<td>What are we trying to accomplish?</td>
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<td>How will we know that a change is an improvement?</td>
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<tr>
<td>What change can we make that will result in improvement?</td>
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</table>

Hunches
Theories
Ideas

Very Small Scale Test

Follow-up Tests

DATA

Changes That Result in Improvement

Spreading
Sustaining the gains
Implementation of Change
Wide-Scale Tests of Change

Sequential building of knowledge under a wide range of conditions
PDSA Example:
Change Idea: Standardize Intra-operative Temperature Control

Organizing the OR team & equipment will achieve reliable temp control

Mini-measure tracks improvement cycles

Learning from data

99% Reliability
Cycle 6: Educate staff on new standards
Cycle 5: Standardize and document devices and protocol
Cycle 4: Analyze failures, test variation for selected surgical type
Cycle 3: Day 3: 1st OR is reliable; test with 3 ORs and surgery types
Cycle 2: Day 2: Checklist and stocking process for warming devices in OR
Cycle 1: Day 1: With 1 OR team, assign responsibility for temp monitoring

Linking multiple PDSAs related to one project

Monitor Temp
Stock supplies
Control Ambient Temp
Recovery Transfer

These could be done by 1 or more teams
A Few Final Tips on Testing

- Test with volunteers
- Use simulation (you don’t need a computer!)
- Do not worry about getting buy-in, consensus, committee approval, etc.
- Be innovative to make test feasible
- Collect useful data during each test
- As cycles proceed, test over a wider range of conditions
- Conduct rapid tests in short periods of time

Improving Using the CARD-DECK Technology

What are we trying to accomplish?

We have a deck of cards which incorporates a new technology. The technology (represented by numbers on the cards) gives potentially valuable information for increasing the overall results achieved on your improvement projects.

Each team should develop a method to predict the numbers on the cards and then implement the technology on all future Improvement projects.
How will we know that a change is an improvement?

1. Correct predictions of numbers on each card.
2. A theory for the predictions of the numbers.
3. An increase in overall improvement achieved on improvement projects.

What changes can we make that will result in improvement?

Each time a card is available (i.e. each Improvement project begun), your team has three choices:

A. Collect data only: Increase in Improvement = -10%

B. Use card in a small-scale test (i.e. on one part of the project, with one team, one physician, for one shift, etc.):
   - Improvement, if prediction for card is correct = +10%
   - Improvement, if prediction for card is incorrect:
     - miss by <2 = -20%
     - miss by 2-4 = -30%
     - miss by >4 = -40%

C. Implement: Make the use of the card a standard part of all projects:
   - Improvement, if prediction for next card is correct = +30%
   - Improvement, if prediction for next card is incorrect = -80%
PDSA Cycles for Card Deck

**PLAN**
- Predict # on the next card.
- What is the # on the next card?
  - Prediction? _______
- Record prediction and choose option A, B, or C ___________

**DO**
- Turn the next card.
- Record # on data sheet.

**STUDY**
- Compare # to prediction.
- Compare to # from previous cards.
- Is team’s theory still useful?
- Would other theories work?

**ACT**
- Are we ready to test or implement the new technology?
- What should we do for the next cycle?

Team Tracking Grid for the Card-Deck Technology

<table>
<thead>
<tr>
<th>Cycle</th>
<th># on Card</th>
<th>Option A, B or C?</th>
<th>Gain or Loss?</th>
<th>Result of this Cycle</th>
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<td>Cycle</td>
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NOTE: Fill out this table to show (1) the kind of PDSA conducted and (2) the cumulative +/- score (e.g., A (collect data only)/-10 or T/-40
What is the next card?

201?
What did we learn?

- When did you start learning here?
- What did you learn about collecting data, testing, implementing?
- Would we have been as successful with one large test?
- Any value in failed tests?
- Did we take time for teambuilding?

How does this exercise relate to improvement?

Lessons from the Card Game

- Planning requires prediction
- Prediction requires a theory
- A single observation may require us to modify our theory (i.e., learning)
- Testing under different conditions is critical to success and reliability!
Tennis Ball Exercise

**Aim**
Teams of 5-9 people attempt to pass/touch a tennis ball in a specified sequence in the shortest time possible.

**Set Up**
- Assign a time keeper. This person will not participate directly in the exercise but will time each PDSA and keep a running record of the time to complete each test.
- Count the number of remaining people at your table.
- Assign a number to each of these individuals starting with the number 1 and continuing until you run out of people.
Your current process involves passing or tossing a tennis ball (a patient?) from person to person, following the sequence provided on the next slide.

The initial sequence as provided must be followed during each PDSA test.

The same person starts and finishes each test.

Each person passes the ball and remembers who they passed it to.

You may only test one change idea at a time.

You can run as many tests as you like to achieve the aim.

**Rules**

- If you drop the ball, begin the test again!

- Document Plan, Do, Study, Act cycles on flip chart paper.

- Each PDSA test must follow the same sequence.
What did you learn from the Tennis Ball Exercise?

What's next?
- Ready to implement?
- Try something else?
- Next cycle

Plan
- Objective
- Questions & predictions
- Plan to carry out: Who? When? How? Where?

Study
- Complete data analysis
- Compare to predictions
- Summarize

Do
- Carry out plan
- Document problems
- Begin data analysis

Did it work?

Act

Let's try it!

What will happen if we try something different?

Sequence for the number of people at a table.

- 9 people
  - 1
  - 5
  - 9
  - 3
  - 7
  - 2
  - 6
  - 4
  - 8
  - 1

- 8 people
  - 1
  - 4
  - 8
  - 3
  - 7
  - 2
  - 6
  - 5
  - 1

- 7 people
  - 1
  - 4
  - 7
  - 3
  - 6
  - 2
  - 5
  - 1

- 6 people
  - 1
  - 4
  - 7
  - 6
  - 3
  - 5
  - 2
  - 1

- 5 people
  - 1
  - 4
  - 7
  - 6
  - 5
  - 2
  - 1

- 1
  - 2
  - 3
  - 4
  - 5
  - 6
  - 7
  - 8
  - 9

1
2
3
4
5
6
7
8
9
“What we gain from academic studies is knowledge.
What we gain from experience is wisdom.”

Mohandas Gandhi

Failed Test…Now What?

Be sure to distinguish the reason:

- Change was not executed
- Change was executed, but not effective

If the prediction was wrong – not a failure!

- Change was executed but did not result in improvement
- Local improvement did not impact the secondary driver or outcome
- In either case, we’ve improved our understanding of the system!
Learning from Failure!

The Value of “Failed” Tests

“I did not fail one thousand times; I found one thousand ways how not to make a light bulb.”

Thomas A. Edison
It took 40 attempts to create WD-40

The 40th time was the charm for the blue canister that boasts more than 2,000 uses. In 1953, chemist Norm Larsen finally created on his 40th try, a formula to stop corrosion by displacing moisture (hence the name “Water Displacement, 40th attempt).

PDSA Exercise
Paper Plane Exercise

- **Aim** – To design a paper plane that will fly the **furthest distance**.
  - Assign a design team
  - Assign someone to assemble the plane
  - Assign someone to launch the plane
  - Assign a measurement person to measure or mark the distance flown
- Run PDSA tests as many times as you like
- Make predictions about the expected distance
- What did you learning from each test?
- Did you use the learning to design the next test?
- Did your new plan result in improvement?
- Are you ready to implement and spread your design?
Report Out

• How did your team approach the task?
• What were your hunches and why?
• Did anyone have any prior experience?
• How many tests did you run?
• What did you learn?
• How did you factor that learning into subsequent tests?
• Did you use measurement to guide improvement?
• What would you do differently?

Lessons Learned

• Use all available data sources
• Build on prior knowledge and experience within the team
• Work as a team
• Keep the aim front and centre
• Predict, predict, predict- what’s your theory?
• Measure, measure measure…
• Factors to consider when making paper planes
• Size of plane
• Shape of plane
• Person throwing the plane
• Add-ons (weights, paper clips)
Welcome to the Paper Airplane Factory!

When everything seems to be going against you...

...remember that the airplane takes off against the wind, not with it.
—Henry Ford
The Paper Airplane Factory Rules

- Your customer has ordered 18 planes, which are listed on the order sheet in front of you.
- You have five (5) minutes to produce and deliver all of them.
- You must deliver/ship the planes in the order listed on the order sheet to the customer by handing each completed plane to the customer at your table.
- The customer (who always knows best) will accept or reject the planes based on whether they meet the order specifications (e.g., large or small plane, angled or straight wings, correct number of seats and proper symbol on the wings).
- You will get credit only for planes that are delivered within the timeframe and that meet all the customer’s specification.
The Paper Airplane Factory
Design Round

• You will have five (5) minutes to work together as a team to design your system to produce the 18 paper planes requested by the customer.

• The first step is to review each plane so that you know what the specifications are and their related symbols on the customer order form.

• Inspect the four prototype planes on your table and study the design for each plane.

Plane 1: This is a large, angled wing plane with 1 seat for the red circle customer.

Plane 2: This is a large, straight wing plane with 2 seats for the blue square customer.

Plane 3: This is a small, straight wing plane with 1 seat for the blue square customer.

Plane 4: This is a small, angled wing plane with 2 seats for the red circle customer.
The Paper Airplane Factory
Design Round (continued)

• You will have five (5) minutes to work together as a team to design your system to produce the 18 paper planes requested by the customer.

• The first step is to review each plane so that you know what the specifications are and their related symbols on the customer order form.

• Inspect the four prototype planes on your table and study the design for each plane.

• You can use the model planes at your table as a reference and examples. **They cannot be submitted as completed planes!**

• Once you have designed your production system we’ll clear the table of your Design Round planes and run your factory for five (5) minutes and see how many planes you can construct and ship.

• Based on your team’s ability to meet the customer’s order you’ll have a chance to redesign your system and try again. That is, if you need another chance.
The Paper Airplane Factory

Design Round

5 minutes for the Design Round.

Start Designing!

The Paper Airplane Factory

Production Round #1

Again, you are allowed to keep the 4 models at your table as a reference.

Don’t recycle them.

Now you have five (5) minutes to fill the customer’s request for 18 planes that meet all the specifications.

Read, set…Goooo!
The Paper Airplane Factory
Production Results

<table>
<thead>
<tr>
<th>Team</th>
<th>Production Round 1</th>
<th>Production Round 2</th>
<th>Production Round 3</th>
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</thead>
<tbody>
<tr>
<td>1</td>
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<td>12</td>
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</table>

**Outcome**
The number of planes produced that meet **ALL** the customer specifications!

The Paper Airplane Factory
Production Round #2

- Before we start Production Round #2 we’re going to construct a plane together so that you can understand what the customer expects and how to meet these expectations.

- One person at each table should write down each step on a sticky note and the rest of the team will follow along making a plane with me. Remember to keep the sticky notes in the correct order.

- You will end up with 13 sticky notes (steps).

- First we will make an *angled wing plane* then a *straight wing plane.*
How to Construct a Paper Airplane
(in 12 easy steps)
Small Plane: Tear

Fold to center line
Small Plane: Tear

Fold to center line

Open

Defect free: Fold to center line

Small Plane: Tear

Fold to center line

Open

Right Corner
Fold to center line

Small Plane: Tear
Fold to center line
Open Right Corner Left Corner

Defect free: Fold to center line

Small Plane: Tear
Fold to center line
Open Right Corner Left Corner Right Side

Defect free: Fold to center line
Defect free: Fold to center line

Small Plane: Tear
Fold to center line
Open
Right Corner
Left Corner
Right Side
Left Side

Defect free: Folds inside plane body, not outside.
Angled Wings:

Defect free: Edge of wing meets edge of plane

Small Plane: Tear
Fold to center line
Open
Right Corner
Left Corner
Right Side
Left Side

Close
Right Wing: ANGLED/STRAIGHT
Left Wing: ANGLED/STRAIGHT

Angled Wings:
Defect free:
Mark on top of wing.

Small Plane: Tear
Close
Defect free:
PAPER CLIPS ON BOTTOM.

Fold to center line
Open
Right Corner
Left Corner
Right Side
Left Side

Right Wing: ANGLED/STRAIGHT
Left Wing: ANGLED/STRAIGHT
“Mark” Add Symbols
Add clips/ seats

Defect free:
MARK ADD SYMBOLS.
The Paper Airplane Factory
Production Round #2

- OK, what did we just do?
- We determined what the customer wants, needs and expects from us.
- We also broke down the work process into the relevant sequence of steps required to meet the customer’s specifications.
- We can assign responsibility for the selected tasks and start to build a production system.
- Take the 13 sticky notes and give at least 1 to each team member. Most team members will have more than 1 sticky note.
- Now, put one plane through the system to ensure it works. Everyone has to pay attention to what the person is doing when putting the plane through the system so everyone understands each step of the process.
- Make a perfect large, angled wing plane with 1 seat for the red circle customer.

The Paper Airplane Factory
Production Round #2

You have 5 minutes to complete the customer’s order for 18 planes as laid out on the customer request form.

Set the production process in motion and make some planes!
The Paper Airplane Factory
Production Round #3

Now, for Round 3, you need to come up with a simple way to never have to talk about which plane is going through the production system.

Use a sticky note to number each plane from the order sheet. More specifically, have the first person in the workflow add a sticky note to each plane with its assigned number so that the rest of the group knows which plane they are working on when it reaches them. Additionally, if you’d like to reassign tasks in your process, take a minute and do that now.

TEST RUN: Run a plane through the system to confirm you don’t have to talk to accomplish this task. Once made, recycle this plane.

You now have five minutes to construct all 18 planes for the customer. Ready, set, go!

The Paper Airplane Factory
Conclusions and Observations

Generally by the end of Round #3 we see each team produce 15-18 planes that meet the customer's specifications.

We expect no rejects at this point irrespective of how many planes were produced.

Not every team meets the target of 18 acceptable planes. But the planes produced are usually meeting specifications.

The production system itself is reliable enough that the team does not need to speak. Note that speaking caused delays and slow-downs in Round #2.

What factors kept the team from making 18 that meet specification?
The Paper Airplane Factory
Conclusions and Observations

Discussion Questions

1. What changes did we make from Round 1 to Round 2?
   • We made it very clear what the work was (aim clarification)
   • We broke the process down into the relevant steps and tasks (S + P = O)
   • We assigned specific tasks to each individual (process owners)
   • We made sure everyone understood how their work fit into a chain of events. No one person or task was more important than another.

2. What changes did we make from Round 2 to Round 3?
   • We made it clear what you were supposed to do when each plane came to you.
   • We took steps to reduce the amount of talking (i.e., alternative or conflicting theories) and increased the productivity of the team, not one individual.

A Challenge for you
If possible, go to a workplace (a clinic, a pharmacy, a restaurant with an open kitchen, a hotel) and see how the processes flows. What's the output? What's the flow? What are the handoffs? What are the bottle necks? Are all of these well-defined? How would you improve the process?

PDSA SIMULATION WITH MR. POTATO HEAD

Set Up

Please organize & decide now…

- 4 “Voluntolds”
- Pilot Tester, Time Keeper, Assurance, Data Collector

Your Simulator
# PDSA Simulation

## Plan, Do, Study, Act Cycle

### Plan
- **Aim**: Complete the process and capture the data.
- **Test Cycle Measures/Learning Questions**: Time and accuracy.
- **Predicted Cycle Outcomes**: Time will improve, accuracy will improve.
- **Capture Relevant Data**: Test cycle.
- **Observations Expected/Unexpected**: Time will improve, accuracy will improve.

### Do
- **Alternative Pathways Uncovered**: Yes/No
- **Test Cycle Completed**: Yes/No
- **If No, Reason**: None

### Study
- **Test Cycle Learning**: Yes/No
- **Action Taken**: None

### Act
- **Test Cycle Results**: None
<table>
<thead>
<tr>
<th></th>
<th>Plan</th>
<th>Do</th>
<th>Study</th>
<th>Act</th>
</tr>
</thead>
<tbody>
<tr>
<td>PD</td>
<td>Test Cycle Aim</td>
<td>Test Cycle Measures/Learning Questions</td>
<td>Predicted Cycle Outcomes</td>
<td>Capture Relevant Data</td>
</tr>
<tr>
<td>1</td>
<td>Start with feet and work to top</td>
<td>Will time and accuracy improve with improved flow?</td>
<td>Time will improve.</td>
<td>Time: 2.37</td>
</tr>
<tr>
<td>2</td>
<td>Struggled to get pieces organized in order.</td>
<td></td>
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<tr>
<td>2</td>
<td>Time improved by 20 sec.</td>
<td>Accuracy improved from 2 to 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Organization of parts helps time &amp; accuracy.</td>
<td>Yes</td>
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</table>
### PD Cycle
<table>
<thead>
<tr>
<th>Cycle</th>
<th>Test Cycle Aim</th>
<th>Test Cycle Measures/Learning Questions</th>
<th>Predicted Cycle Outcomes</th>
<th>Capture Relevant Data</th>
<th>Observations expected/unexpected</th>
<th>Results</th>
<th>Test Cycle Success</th>
<th>Action Taken</th>
<th>Alternate Pathways Discovered</th>
<th>Test Cycle Completed</th>
<th>If No, Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Start with feet and work to top</td>
<td>Will time and accuracy improve with improved flow?</td>
<td>Time will improve. Accuracy will improve.</td>
<td>Time: 2.37 / Accuracy 3</td>
<td>Struggled to get pieces organized in order.</td>
<td>Time improved by 20 sec. Accuracy improved from 2 to 3</td>
<td>Organization of parts helps time &amp; accuracy.</td>
<td>Yes</td>
<td>None</td>
<td>Yes</td>
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</table>

### PDSA Measures

#### Accuracy
- **3** – All pieces on Sam & positioned correctly
- **2** – All pieces on Sam, but one or more is out of place
- **1** – One or more pieces are not on Sam.

#### Time
- **Start**: When timekeeper says go.
- **Stop**: When clinician indicates last piece is in place AND removes hand.
3 – All pieces on Sam & positioned correctly
2 – All pieces on Sam, but one or more is out of place
1 – One or more pieces are not on Sam.

PDSA Simulation
PDSA Simulation • **Accuracy**
- **3** – All pieces on Sam & positioned correctly
- **2** – All pieces on Sam, but one or more is out of place
- **1** – One or more pieces are not on Sam.

**Time**
- **Start**: When time keeper says go.
- **Stop**: When teacher indicates last piece is in place AND removes hand.

---

**Run Charts from Potato Head**

![Chart 1: PDSA Time in Sec](chart1)

![Chart 2: Accuracy Score](chart2)
1. What are we trying to accomplish?

We have found a new technology represented by a sequence that can help our organization improve patient safety. We want to discover the rule (or theory) that generated this sequence.

Each table is an improvement team and should run a series of tests to determine the rule. When you are sure that you have the rule (based on enough trials), then implement the technology in your organization.

2. How will we know that a change is an improvement?

- Correct predictions of the results of tests
- A statement of the correct rule upon implementation
Exercise:
Learning the Sequence

3. What changes can we make that will result in improvement?

1. Each team can test one sequence on each cycle. Write down the specific sequence (example) being tested. The faculty will classify your sequence as either conforming or not conforming to the rule.

2. Run as many cycles (tests) as required until you are sure you know the rule. Keep track of the number of cycles, and whether the example test sequence was conforming or not conforming to the rule you have established.

3. When testing cycles are complete, wait until all teams are done to report the implementation cycle (state the rule to the faculty).

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Sequence Technology Results

<table>
<thead>
<tr>
<th>Cycle</th>
<th>Theory for Sequence</th>
<th>Sequence</th>
<th>Correct</th>
<th>Incorrect</th>
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</thead>
<tbody>
<tr>
<td>1</td>
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In Summary…
A Framework for Improvement

- Establish appropriate measures
- Set an aim and goal for each measure
- Develop theories and predictions on how you plan on achieving the aim and an appropriate time frame for testing
- Test your theory, implement the change concepts, follow the measures over time and analyze the results
- Revise the strategy as needed

Applying PDSAs to your project

- What cycles can we complete by next Tuesday?
- Be willing to compromise on scope, size, rigor, and sophistication, but the tests must be completed by next Tuesday!
PDSA Worksheet

• Use this to document individual tests.

• Remember. It's not a test if you don't actually change the process!

See Appendix B for a completed PDSA.

MODEL FOR IMPROVEMENT

Objective for this PDSA Cycle

DO: CARRY OUT THE CHANGE OR TEST; COLLECT DATA AND BEGIN ANALYSIS.

STUDY: COMPLETE ANALYSIS OF DATA; SUMMARIZE WHAT WAS LEARNED.

ACT: ARE WE READY TO MAKE A CHANGE? PLAN FOR THE NEXT CYCLE.

Project Planning Form

Goal(s): ____________________________

Measures: ____________________________

<table>
<thead>
<tr>
<th>Cycle No.</th>
<th>Change (test or implement)</th>
<th>Who is responsible?</th>
<th>Month 1 Wk1 Wk2 Wk3 Wk4</th>
<th>Month 1 Wk1 Wk2 Wk3 Wk4</th>
<th>Month 1 Wk1 Wk2 Wk3 Wk4</th>
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The Sequence of Improvement

Reflections & Questions

PDSA
Practical Improvement Science in Healthcare: A Roadmap for Getting Results

- IHI and HarvardX have created a **free**, 6-week MOOC that starts on **January 20, 2016**
- Expert faculty: Don Goldmann, Dave Williams, Don Berwick, Karen Baldoza, and Amy Reid
- Learners have the option to earn 6 CEUs for $99 upon course completion

[www.ihi.org/ph556x](http://www.ihi.org/ph556x)

Appendices

**Appendix A: Faculty Bios**

**Appendix B: Example of a completed PDSA Form**

**Appendix C: National Quality Center The Game Guide**
Appendix A Faculty Bio: Robert Lloyd

Robert Lloyd, PhD., Vice President, Institute for Healthcare Improvement provides leadership in the areas of performance improvement strategies, statistical process control methods, development of strategic dashboards and capacity and capability building for quality improvement. He also serves as faculty for the IHI Improvement Advisor (IA) Professional Development programme and various IHI initiatives and demonstration projects in the US, Canada, the UK, Sweden, Denmark, Africa, the Middle East and New Zealand. Dr. Lloyd an internationally recognized speaker on quality improvement concepts, methods and tools. He also advises senior leadership teams on how to create the structures and processes that will make quality thinking part of daily work. He is the author of two leading books on measuring quality improvement in healthcare settings and numerous articles and chapters on quality measurement and improvement. He lives in Chicago, Illinois with his wife Gwenn, daughter Devon and their ever entertaining dog Cricket.

Appendix A Faculty Bio: Dave Williams

David M. Williams, PhD, Executive Director, Institute for Healthcare improvement (IHI), is co-lead of the Improvement Capability Focus Area. He has served as the Improvement Advisor for large Collaboratives in the United States and Europe, including Impacting Cost + Quality in the US, the NHS South West Patient Quality and Safety Programme in England, and the Scottish Government Early Years Collaborative. Dr. Williams is faculty for the IHI Open School and the Massive Open Online Course (MOOC) being developed with HarvardX and the Harvard T.H. Chan School of Public Health. He created the Mr. Potato Head exercise used worldwide to teach PDSA testing and measurement. A paramedic by background, Dr. Williams practiced in urban EMS systems for many years and is internationally known as an expert on paramedic care and emergency medical services systems. Prior to joining IHI, he led a consulting practice focused on improvement science and expert consulting in education, public safety, and health care.
**PDSA Worksheet for Rapid Cycle Testing**

**Team Name:** Falls Group  
**Date:** 11th March

**Project Aim:** To reduce the number of falls on the ward by 10% as compared with the baseline data from the same time period the previous year.

**Cycle 1 Aim:** To reduce the number of falls on X ward in bay 4 by 10% over a 3 month period (as compared to the corresponding previous 3 month period) by using Intentional Rounding (IR) as a process tool in that bay. IR may spread organically on the ward to the other bays but Bay 4 will remain the measure.

**Plan for the Test of Change:** Introduce the concept of IR to the staff on the ward via the lead Staff Nurse through Safety Briefings, notices and 1-1 sessions in which the theory and documentation will be shown and explained. The process will be supported by the Ward Manager, Falls Nurse and Safety Lead.

The Trusts definition of Intentional Rounding (IR) is to go to each patient in the given bay/area and ask is 'everything alright' and can the nurse assist in any way with nutrition, comfort, toileting etc. This will be done every two hours during the day and at night except when the patient is asleep or when a risk assessment indicates a different time period is needed.

---

**Appendix B**

**PDSA Example**

**What is the test or change to be tried?**
The first change is to introduce IR to the bay and record its frequency over a 24 hour time period.

**What is your prediction about what will happen when this test is completed?**
For compliance over a 24 hour period to be at 40%

**What exactly will be done to test the change?**
IR tool to be completed every two hours and recorded including why it was not offered.

**When will it be conducted?** Week commencing 16th March

**Where will it take place?** X ward Bay 4

**What is the plan for data collection? (Who, what, when, where?)**
Information recorded by Nurses allocated to that bay, data to be checked at every handover time by Ward Manager or Senior Nurse on Duty.

**How will the data be sampled?** Record Sheet as attached
DO: (Carry out the test, collect data. Display data on chart)
Results will be presented as a Run Chart highlighting Total Compliance Definition: Opportunities to IR and IR completed by bay for 1 day expressed as a percentage and IRs completed by hour over a 24 hour period.

STUDY: (Complete the analysis of the data, summarize what was learned.)

- Were the results as you predicted?
- How does the data compare to baseline?

ACT: (What is the plan for the next cycle? Is this change ready to be spread?)