

The Greatest “Lean Pull” Game Ever!

When I or one of my colleagues teach a class about “Replenishment Pull and Kanban” most at first cross their arms in disbelief saying “that won’t work in my industry”. When they engage in the game that I am about to explain to you, their defenses break down and the discussion begins.

One of the most Paradigm Shifting methodologies in Lean is “Replenishment Pull and KanBan”. This method is opposite to the way we traditionally produce products, services and transactions.

Because “Pull” is so foreign to us, it makes difficult to get the point across in words.

We as teachers have to use more effective methods. In my experience, I have found that games and simulations are very effective at teaching complex or "paradigm shifting" topics.

I will show you a game that has been very effective at showing the difference between a traditional “Push” process and a “Pull” process.

Material Required:

- 6 -Six Sided Dice
- 200 or more poker chips
 - The poker chips can be varying colors
 - I use 2 packs of "Ace Authentic Poker Chips"
<http://www.shop.com/Ace+Authentic+Poker+Chips+by+Cartamundi-1133346560-p+.xhtml?sourceid=298&CAWELAID=120184370000034244&CAGSPN=pla&gclid=CO-ay5fpnMkCFQaJaQod5iil A>
- A White Board or a Flip Chart (This will be used as the “Score Board”)
 - I use “Post-it® Super Sticky 30" x 25" Self-Stick Easel Pads”
http://www.staples.com/Post-it-Super-Sticky-30-x-25-Self-Stick-Easel-Pads/product_SS506808
- Notepad and Pen or Pencil (Their notepad should be numbered 1 – 30 as shown →)
- 1 Table (at least 6’ in length)

Push	Pull
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10.
-	-
-	-
-	-
30.	30.

Participants Required:

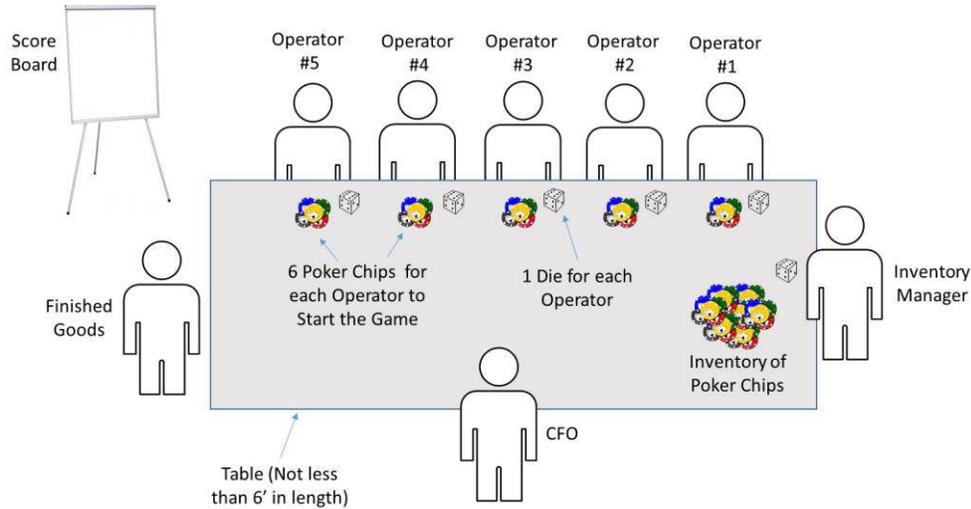
- 5 Operators
- 1 Inventory Manager
- 1 Finished Goods
- 1 CFO (I call him or her the "Bean Counter")

The students will be a part of two different simulations.

1. The first will be the “Push” simulation where the students will participate in a traditional push process. This is the process that most companies exist in every day.
2. The second will be a Lean “Pull” process.

Push Simulation

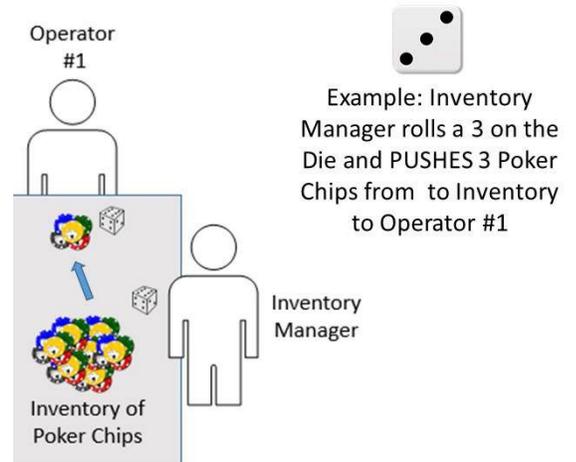
Set up the “Push” simulation according to the diagram below:



Step #1: To start the game, the “Inventory Manager” rolls the Die and pushes the number of Chips that show on the Die to “Operator #1”.

For example, the “Inventory Manager” rolls a 3 and pushes three chips to “Operator #1”.

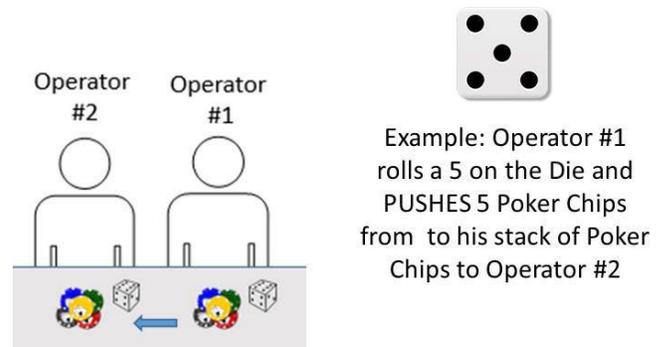
Note: In the “Push” Game each of the players Pushes the number rolled on the Die to the next player versus the next player pulling the number rolled on the die.



Example: Inventory Manager rolls a 3 on the Die and PUSHES 3 Poker Chips from to Inventory to Operator #1

Step #2: “Operator #1” rolls the Die and pushes the number of Chips that show on the Die to “Operator #2”.

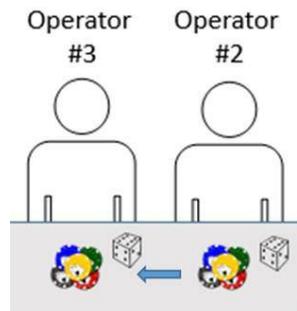
For example, “Operator #1” rolls a 5 and pushes five chips to “Operator #2”.



Example: Operator #1 rolls a 5 on the Die and PUSHES 5 Poker Chips from to his stack of Poker Chips to Operator #2

Step #3: “Operator #2” rolls the Die and pushes the number of Chips that show on the Die to “Operator #3”.

For example, “Operator #2” rolls a 6 and pushes six chips to “Operator #3”.



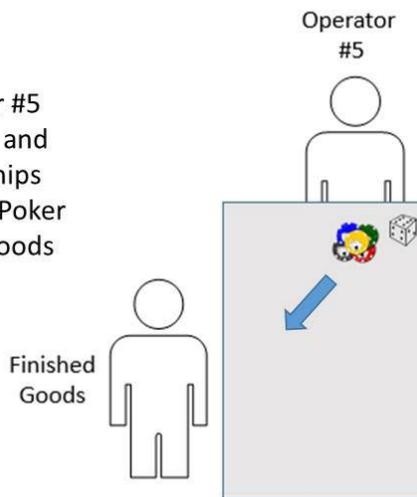
Example: Operator #2 rolls a 6 on the Die and PUSHES 6 Poker Chips from to his stack of Poker Chips to Operator #3

Step #4 and #5: Continue the Push Process from Operator #3 → Operator #4 and Operator #4 → Operator #5.

*** If you have less chips than the number rolled on the die, give all of your chips to the next operator. For Example, if you roll a 6 but you only have three chips, then you push 3 chips to the next operator.**



Example: Operator #5 rolls a 4 on the Die and PUSHES 4 Poker Chips from to his stack of Poker Chips to Finished Goods

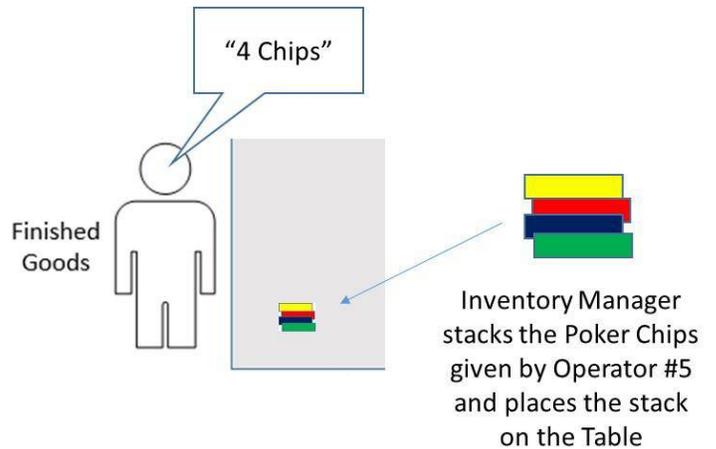


Step #6: “Operator #5” rolls the Die and pushes the number of Chips that show on the Die to “Finished Goods”.

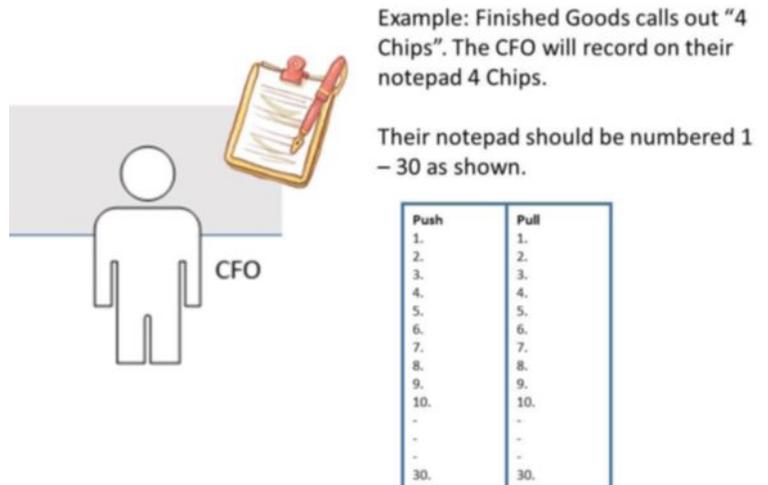
For example, “Operator #5” rolls a 6 and pushes six chips to “Finished Goods”.

Step #7:

1. Finished Goods stacks the Poker Chips given from Operator #5
2. Finish Goods Calls Out the number of Poker Chips in the Stack to the CFO
3. Finished Goods Places the stack of poker chips on the table
 - a. Each stack of Poker Chips is placed individually on the table



Step #8: The CFO will record the number of Poker Chips in the Stack that is called out by Finished Goods



Repeat Steps #1 - #8 thirty (30) times

*** Finished Goods will have a total of thirty stacks of Poker Chips on the table**

For the 1st three rounds (or more) the instructor should be very engaged with the students and the simulation to make sure the simulation process is followed correctly.

After the third round when the students are engaged in the 30 Rounds of the Push Simulation, the Instructor should then move to the "Score Board" and prepare to Record the Score of the "Push" simulation.

The Score Board should resemble the following:

Once the 30 Rounds are completed, have operator #1, #2, #3, #4 and #5 each call out the number of Chips they are in their stack.

Sum the number of chips from all of the Operators and Record on the Score Board next to "Work In Process" under the Push section

Have the CFO add up rows 1-30 on their notepad and Record on the Score Board next to "Finished Goods" under the Pull Section

Score Board

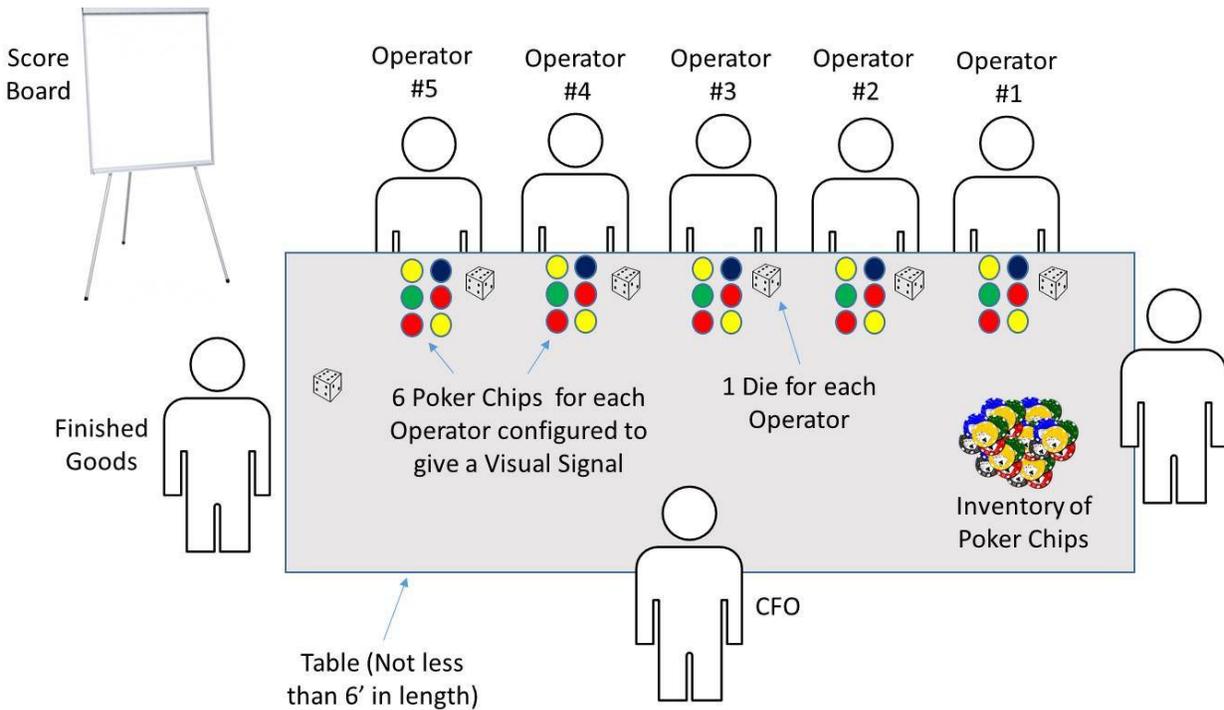


Push	Pull
Operator #1:	Operator #1:
Operator #2:	Operator #2:
Operator #3:	Operator #3:
Operator #4:	Operator #4:
Operator #5:	Operator #5:
Finished Goods:	Finished Goods:
Work In Process:	Work In Process:

Now it's time for the Pull Simulation

Pull Simulation

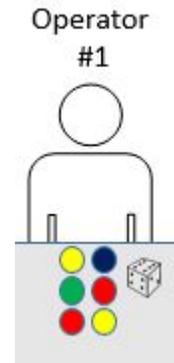
Set up the "Pull" simulation according to the diagram below:



In the Pull Simulation you will see that the six chips have been laid out in front of each operator in 2 columns of 3 poker chips.

This is a Visual Signal (or Kanban) that let's all Operator's understand the number of poker chips that an Operator has.

The Kanban limit of this Simulation is 6. An Operator should never have more than 6 poker chips.



Step #1A: Finished Goods rolls the Die and PULLS the number rolled on the Die from Operator #5 to Finished Goods.

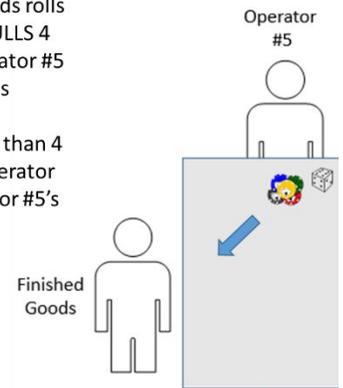
For Example, Finished Goods rolls a 4 on the Die and PULLS 4 Poker Chips from Operator #5 to Finished Goods.

If Operator #5 has less than 6 Poker Chips , then Finished Goods PULLS all of Operator #5's Poker Chips to Finished Goods (making sure not exceed 6 in Finished Good's stack)



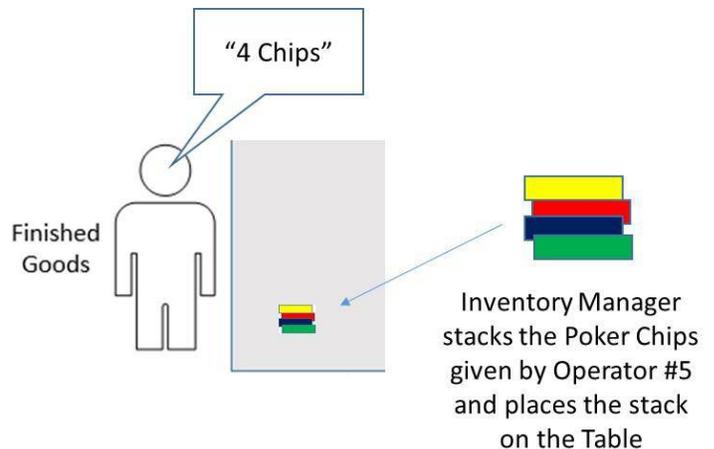
Example: Finished Goods rolls a 4 on the Die and PULLS 4 Poker Chips from Operator #5 to Finished Goods

If Operator #5 has less than 4 Poker Chips , then Operator #5 PULLS all of Operator #5's Poker Chips

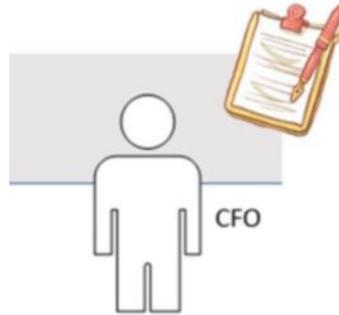


Step 1B:

1. Finished Goods stacks the Poker Chips PULLED from Operator #5
2. Finish Goods Calls Out the number of Poker Chips in the Stack to the CFO
3. Finished Goods Places the stack of poker chips on the table
 - a. Each stack of Poker Chips is placed individually on the table



Step #1C: The CFO will record the number of Poker Chips in the Stack that is called out by Finished Goods



Example: Finished Goods calls out "4 Chips". The CFO will record on their notepad 4 Chips.

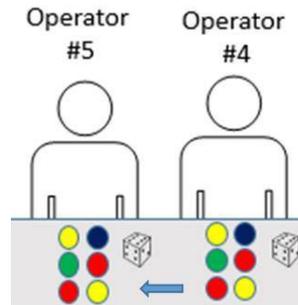
Their notepad should be numbered 1 – 30 as shown.

Push	Pull
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10.
-	-
-	-
-	-
30.	30.

Step #2: Operator #5 rolls the Die and PULLS the number rolled on the Die from Operator #4 to Operator #5

For Example, Operator #5 rolls a 6 on the Die and PULLS 6 Poker Chips from Operator #4 to Operator #5

If Operator #4 has less than 6 Poker Chips , then Operator #5 PULLS all of Operator #4's Poker Chips to Operator #5 (making sure not exceed 6 in Operator #5's stack)



Example: Operator #5 rolls a 6 on the Die and PULLS 6 Poker Chips from Operator #4 to Operator #5

If Operator #4 has less than 6 Poker Chips , then Operator #5 PULLS all of Operator #4's Poker Chips

Step #3 through #6: Continue the Pull Process from Operator #4 → Operator #3; Operator #3 → Operator #2; Operator #2 → Operator #1 and Operator #1 → Finished Goods.

Repeat Steps #1 - #6 thirty (30) times

*** Finished Goods will have a total of thirty stacks of Poker Chips on the table**

For the 1st three rounds (or more) the instructor should be very engaged with the students and the simulation to make sure the simulation process is followed correctly.

Enforce the KanBan limit of 6 at each Operator. Each Operator should have no more than 6 Poker Chips at any time during the Pull Simulation.

Example, if an Operator has 5 Poker Chips and rolls 4 on the Die, then they will want to Pull 4 but this would give them a total of 9 Poker Chips which exceeds the KanBan limit of 6 Poker Chips.

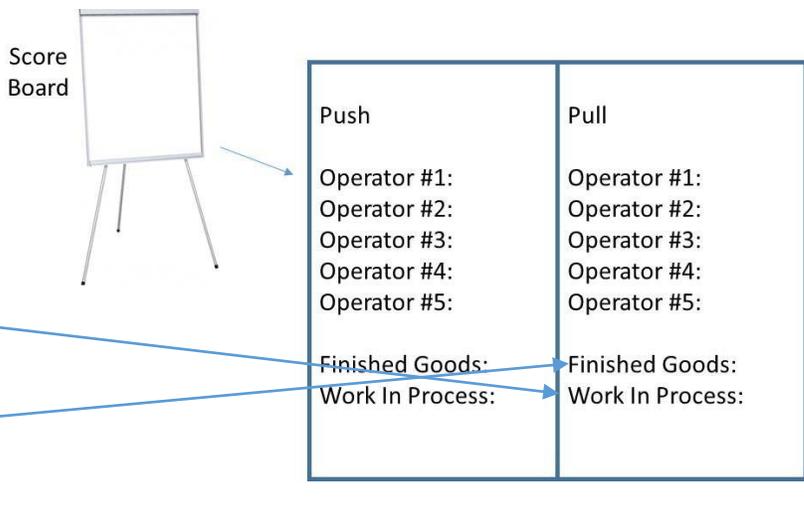
After the third round when the students are engaged in the 30 Rounds of the Pull Simulation, the Instructor should then move to the “Score Board” and prepare to Record the Score of the “Pull” simulation.

The Score Board should resemble the following:

Once the 30 Rounds are completed, have operator #1, #2, #3, #4 and #5 each call out the number of Chips the are in their stack.

Sum the number of chips from all of the Operators and Record on the Score Board next to “Work In Process” under the Push section

Have the CFO add up rows 1-30 on their notepad and Record on the Score Board next to “Finished Goods” under the Pull Section



Push	Pull
Operator #1:	Operator #1:
Operator #2:	Operator #2:
Operator #3:	Operator #3:
Operator #4:	Operator #4:
Operator #5:	Operator #5:
Finished Goods:	Finished Goods:
Work In Process:	Work In Process:

Now it’s time to discuss what the Class Learned from the Two Simulations!

Have the Class gather in front of the Score Board.

I normally start off by asking “What differences did you see between the Push and the Pull process?”

Typical comments:

- “The Pull Process was more difficult to get used to”
 - The class will want to break the rule of the KanBan limit of 6 (thus creating inventory)
- The Pull Process did not create as much work in process (WIP)
 - With 5 operators and a KanBan limit of 6 there should never be more than 30 in WIP
 - There is no limit on WIP in the Push process

These comments come from existing in a Push process

- “Finished Goods in the Push process is greater than the Pull process”
 - If you were to divide the amount of WIP by Finished Goods of both the Push and Pull process, you would get a proportion of WIP to Finished Goods.
 - In the Pull process, the more times that you run the simulation (for example, from 30 times to 1000 times) the proportion of WIP to Finished Goods decreases
 - In the Push process, the more times that you run the simulation (for example, from 30 times to 1000 times) the proportion of WIP to Finished Goods increases
- “The customer (each operator and finished goods) was shorted for many of the die rolls”
 - There will be times when an operator will roll the die and roll a number greater than the amount of chips that the upstream operator has available.
 - For Example, Operator #4 rolls a 5. Operator #3 only has 1 chip so Operator #4 can only pull 1 Chip.
 - In this case Operator #4 has more capacity to produce than Operator #3 can supply (which means that Operator #3 experience a process problem because he should have the capacity to supply 6 for each roll).

One of the most Paradigm Shifting discussions from this simulation should be “Inventory Hides Problems!”

First, let’s establish that in these simulations, the dice is the uncontrolled variable. The roll of the dice equals the uncertainty in production.

- A roll of 6 means that production had no problems and was able to meet demand.
- A roll of 1 means that major problems were experienced (maintenance issues, time delays, defects needing rework).

In the Push simulation, there will be a varied amount of WIP at each station. As the simulation progresses through the thirty rounds, WIP will build up at one or more stations.

Let’s say that Operator #3 has 25 poker chips in WIP and Operator #2 rolls a 1. In the Push process, no one feels the “Pain” of the 1 that is rolled. The amount of WIP at Operator #3 (25 poker chips) buffers the 1 rolled on the die.

What does this mean, “**Inventory Hides Problems!**”. Operator #2’s Die roll of 1 is a problem. Operator #3’s 25 Poker Chips hide the problem. Because of the buffer of 25 poker chips, Operator #4, and #5 do not feel the pain of Operator #2’s die roll of 1.

This should start or reinforce the discussion of the use of “Visual Signals” and “Visual Data” that are so important in the Lean Methodology.

If you need more information or clarification on the simulation explained above, please contact me (Kevin Clay) at 241-731-3176 or at kclay@sixsigmads.com.