



Coronavirus Work From Home Process Improvement Project



DEFINE

Problem: working from home spending more time doing non-value-added work



Indications of problem: more time spent working, skipping lunch, chores not getting done, feeling burnt out, procrastination, falling behind in schoolwork

Business Impact

Non-value-add:	VS	Value-add work:
• Transactional		• Tactical
• Task oriented		• Project Oriented

0\$ / hour

6,750\$ / hour

Goal

Reduce time spent doing non-value-added work by **25% per day on average** by March 22nd, 2020.

4.6 Mil / Year!



MEASURE



Data Collection:
daily whiteboard

- Timestamps
- Worklogs
- Tallies

Target Sample Size

$$\text{target sample size} = \frac{z^2 * p * (1-p)}{1 + \left(\frac{z^2 * p * (1-p)}{N * e^2} \right)} \approx 22 \text{ Samples}$$

Confidence	Margin Error	Target Pop
90%	20%	365

Measurement Risk



Unlikely to significantly impact results



Mitigate: Alerts, reminders, reviews

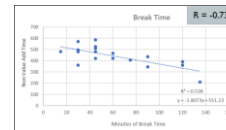
Data Variables

Y = non-value-add time
X = breaks, sleep, coffee, tv, fiancé, emails, meetings, study time, sitting vs standing

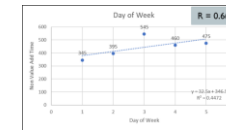
ANALYZE

Correlation Analysis

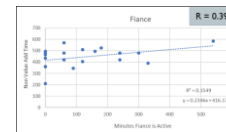
Break Time R = -0.73



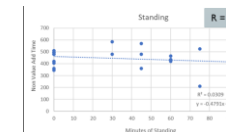
Day of Week R = -0.66



Fiancé Active R = 0.39



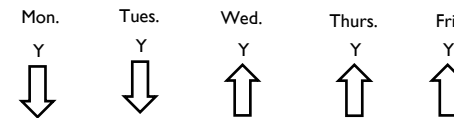
Standing R = -0.18



Chi-Square Test

P value – 0.02

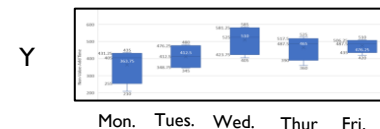
Day of the Week does have a relationship with non-value-add time



Non-value-add time higher on Wed. – Fri.

Measures of Dispersion

Total	Max	Min	Range	St Dev	Average
	585	210	375	86	446



KPI

IMPROVE

- Solution I – Microsoft Outlook Calendar Scheduled Breaks
- Solution II – Use Standing Desk More Often

Results



Missed target by 33.5 minutes

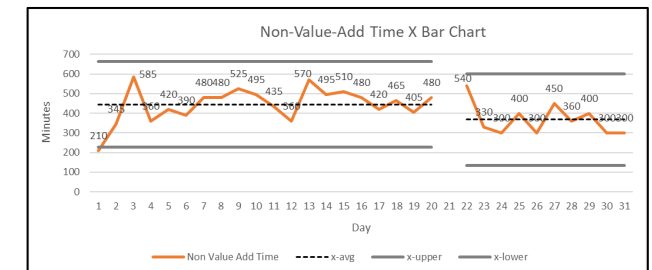
Old SQL 0.8

New SQL 2.0

Improved by 78 minutes!

CONTROL

- Use control chart to identify when process becomes out of control
- Review process if out of control. More improvement may be necessary



Coronavirus Work From Home Process Improvement Project

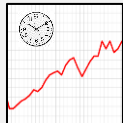
Problem: Reduced Efficiency Working at Home

Problem Statement:

- Due to the coronavirus pandemic, like many others, I have been forced to work from home
- While working from home the lines between personal life and work life have become blurred
- Nothing has changed with my job responsibilities, yet I am **spending more time doing the same non-value-added work**
- As a result, my efficiency at work has become reduced
- Corrective action must be taken before this leads to issues with my work performance and/or personal life

Indications of Problem:

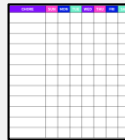
More time spent working



Skipping lunch



Chores not getting done



Feeling burnt out



Procrastination



Falling behind in school



Business Impact / Goal

Non-Value-Added Work vs. Value-Added Work

<p>Non-Value-Added Work = repeated, transactional, task oriented work that must be completed for normal operation but do not necessarily add value for the business.</p> <p>0\$ / hour of business value</p> <p><u>Examples</u></p> <ul style="list-style-type: none">• Daily exceptions review• JDA edits• Sitting in meetings• Email management• Pulling / Refreshing data• Tableau dashboard maintenance• Training a new employee• Waiting for things to load• Ad hoc requests	<p>Value-Added Work = tactical, projected oriented, problem solving type of work, sometimes called discovery work, which directly leads to gains for the business.</p> <p>*6,750\$ / hour of business value</p> <p><u>Examples</u></p> <ul style="list-style-type: none">• Automating processes• Predictive modeling• Building analytical reports• Process improvement• Solution development• Reducing waste
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What is My Goal and How Does this Relate?

- **Opportunity cost** – the cost of spending time on non-value-added work at the expense of time that could be used on value-added work
- By reducing the time I am spending doing non-value-added work, I will be able to use that time to work on value-added work.
- Each hour of value-added-work is worth approximately 6,750\$ of business value, based on estimates of previously documented value-added work.



Goal: Reduce time spent doing non-value-added work by 25% per day on average by March 22nd, 2020.

Sigma Quality Level Definition

What is a defect?

- I am defining a defect as any given day where I did not complete at least 30 minutes of value-add work.
- If my day is consumed by non-value-add work, then that will result in a defect.
- My assumption that there are 8 hours on average in a given workday.
- Assuming that broken into 30 minute chunks, there are 16 opportunities to complete the value-add work per day.

How many defects are possible?

- One unit = one day
- Units produced per day = 1
- Total possible defects per day = 16

Definition of the Process / Stakeholders

What is the process I am trying to improve?

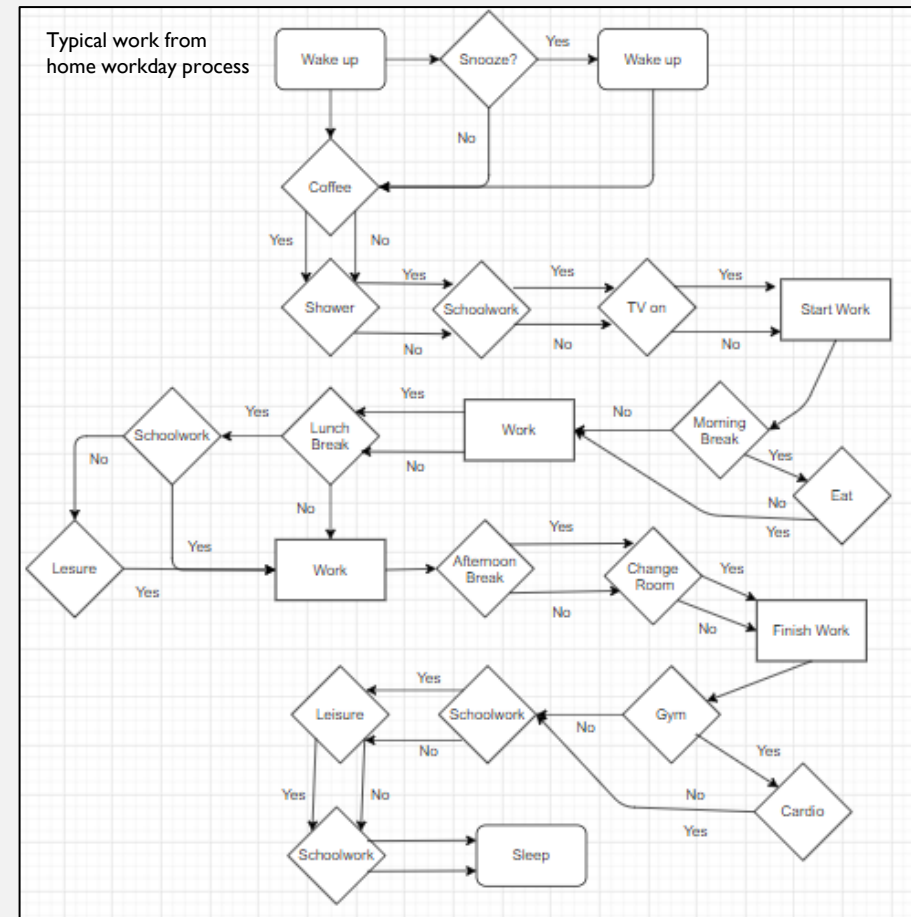
- A typical workday when I am working from home
- The process starts when I wake up in the morning through the time when I go to sleep

Who is the Owner of the Process?

- I am the owner of this process because I have full control over my typical workday process.

What Other Stakeholders are Involved?

- For the duration of the project, I am the only stakeholder that will be directly involved in the project
- I will not be informing my coworkers or fiancé about the project because that could alter their behavior
- If the project is a success, I may be able to share my findings with other people who are working from home
- They might be able to benefit so that they can improve their own work from home processes



Determining Variables

Potential Causal Factors Considered

- Why am I less efficient when I am working from home versus in the office?
- Distractions at home, TV, fiancé, kitchen, phone, etc.
- I don't have to "get ready" for work, can jump right into work
- More laid back work environment
- Easier to hit the snooze button in the morning
- Switching tasks more frequently
- More emails being sent and more meetings scheduled due to working from home
- Not confined to one space, ability to do my work in different places around the house
- Spending more time sitting down, it used to be customary to stand while working in cubicles at the office

X Variables to Measure Per Workday

- Hitting Snooze Button
- Shower / no shower
- Hours of sleep
- Oz of Coffee Consumed
- Minutes of TV on
- Duration of Break Time
- Time Standing vs Sitting
- Time studying / homework
- Time spent in meetings
- # of rooms worked in
- # emails received
- # emails sent
- Time Finance is active

Data Measurement Plan

Performance Measure	Discrete/Continuous	Unit of Measure	Description	Collection Method
Non Value Add Time (y)	Continuous	Minutes	Sum of all non value added time throughout the day	Maintain daily work log with tasks and time spent
Snooze	Discrete	True/False	Did I hit the snooze button yes or no	Write down answer to question before starting work
Shower	Discrete	True/False	Did I take a shower right away yes or no	Write down answer to question before starting work
Amount of Sleep	Continuous	Minutes	Estimated hours of sleep	Write down answer to question before starting work
Oz of Coffee Consumed	Continuous	Ounces	Total coffee consumed throughout the day	Measure by pouring the coffee into a cup with a measuring cup
Minutes of TV On	Continuous	Minutes	How many minutes was the TV on in the background	Jot down a time stamp when the TV is turned on or off
Morning Break Duration	Continuous	Minutes	How long did I take a morning break for	Start times and End times
Lunch Break Duration	Continuous	Minutes	How long did I take a lunch break for	Start times and End times
Afternoon Break Duration	Continuous	Minutes	How long did I take an afternoon break for	Start times and End times
Time Spent Sitting	Continuous	Minutes	How long was I standing throughout the day	(Total duration of work + Total duration of Study) - time spent standing
Time Spent Standing	Continuous	Minutes	How long was I sitting throughout the day	Start and end times of when I am standing
Total duration of Work	Continuous	Minutes	Total duration of time spent working throughout the day	Maintaining daily work log
Total Duration of Study	Continuous	Minutes	Total duration of time spent studying throughout the day	Maintaining daily study log
Total Duration of Leisure	Continuous	Minutes	Total duration of time spent leisure throughout the day	Time in the day minus the amount of time spent studying, working, or working out
Workout Duration	Continuous	Minutes	Total duration of time spent working out	Write down start and stop times for when I am working out.
Time spent in Meetings	Continuous	Minutes	How much time did I spend in meetings throughout the day	At the end of each day, look in outlook and count up how many minutes worth of meetings were scheduled on my calendar, subtracting time if a meeting got done early
Time Fiance is Active	Continuous	Minutes	How long was my fiance up and about the house during the day	Use timestamps. An estimate based on if she is hanging out in the living room / kitchen area which is right outside the office.
# of Rooms Worked In	Discrete	Count	Number of different rooms that I worked in throughout the day	Automatically starts at 1 room (the office), and another room will only be counted I was working in there for 15 minutes or more
# Emails In	Discrete	Count	How many emails were received throughout the day	Maintain a rolling tally sheet marking one tally each time that an email is received
# Emails Out	Discrete	Count	How many emails were sent throughout the day	Maintain a rolling tally sheet marking one tally each time that an email is sent
# Setbacks	Discrete	Count	How many setbacks did I experience throughout the day	Manual data collection via rolling tally sheet.

Who will Collect the Data?

- I will be collecting the data

When Will Data be Collected?

- On workdays M-F

How Much Data Will be Collected?

- target population size = 365 (one year's worth of days of data collected). I want my sample to be representative of one year.
- confidence level = 90% - the probability that my sample accurately reflects the population. I feel that 90% is a reasonable level of confidence for this project.
- margin of error = 20% - the range that any given day may deviate from the sample that I collect.
- Based on these parameters, my target sample size is approximately 22 samples.

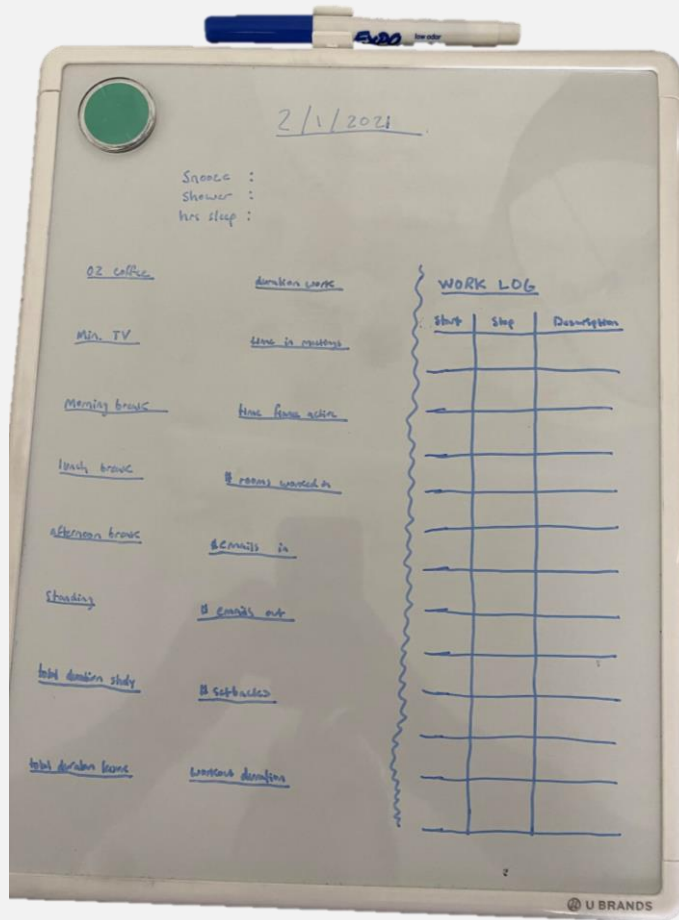
$$\text{target sample size} = \frac{\frac{z^2 * p(1-p)}{e^2}}{1 + \left(\frac{z^2 * p(1-p)}{Ne^2}\right)} \approx 22$$

N = target population size
e = Margin of error
z = z-score

- With a sample size of 22 days of data, the estimate of the population should be within a reasonable range of the actual population according to the assumptions listed above.

DM AIC - Measure

Collecting the Data



Daily Whiteboard for Collecting Data

- Throughout the day, collect data by via whiteboard
- Whiteboard consists of timestamps for each X variable as well as a worklog
- Mark down timestamps and tally's to keep track of the variables
- Worklog keeps track of all of the activities that I did for work during the day
- Work activities are determined to be either non-value-add or value-add
- At the end of the day, review the data and record each x variable and y variable

Measurement Error

Risk for Measurement Error

- There is risk of measurement error – this is mainly due to manually capturing the data.
- Not all variables have the same amount of risk. Some variables have more risk than other variables.
- Variables that have timestamps are at a higher risk of measurement error than other variables.
- Since I am entering the timestamps manually, they could be off if I do not do them right away.
- Binary variables are low risk because they are a simple yes or no.
- Variables that are captured by a system, such as email traffic and time spent in meetings, have a low risk for measurement error.

Low risk variables: snooze, shower, oz. of coffee consumed, emails received and sent, # of rooms worked in, time spent in meetings, hours of sleep, # of setbacks.

Low

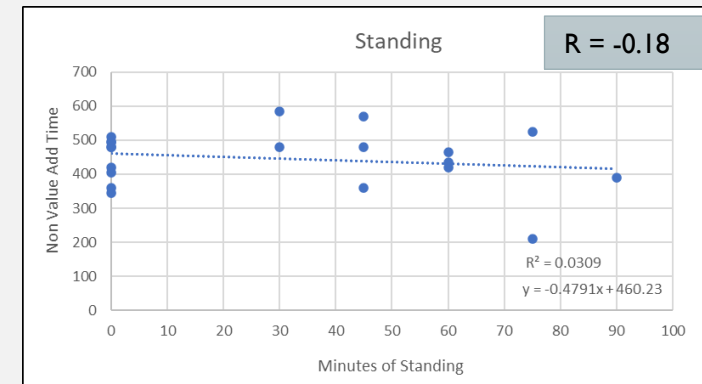
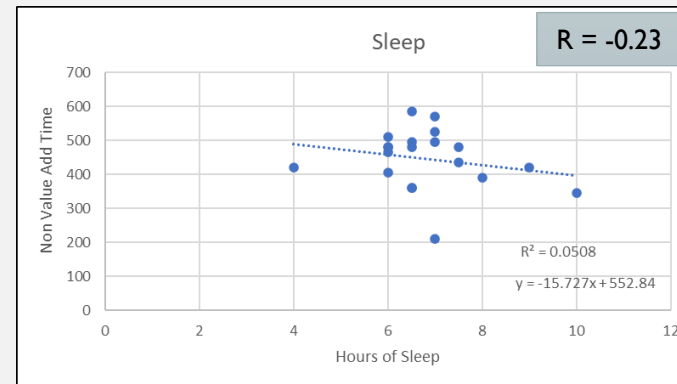
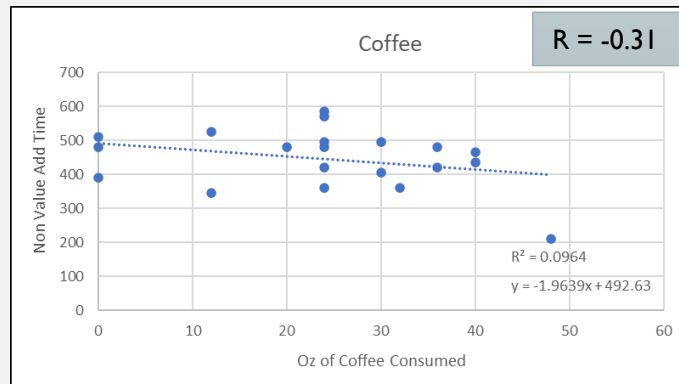
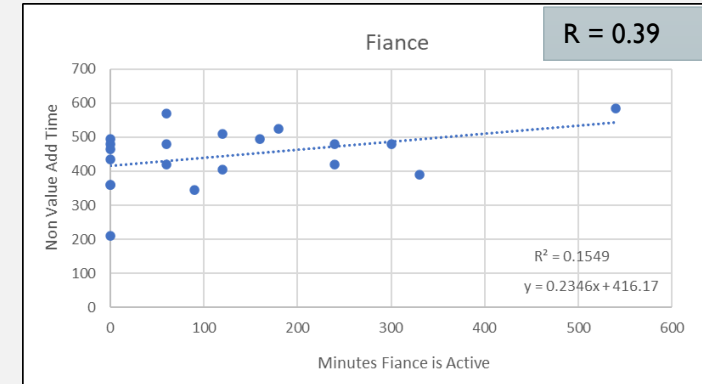
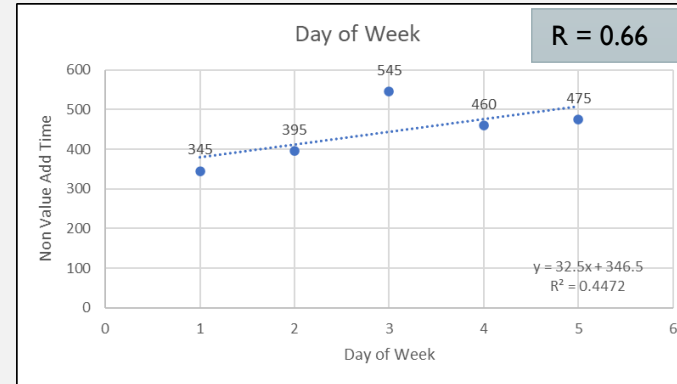
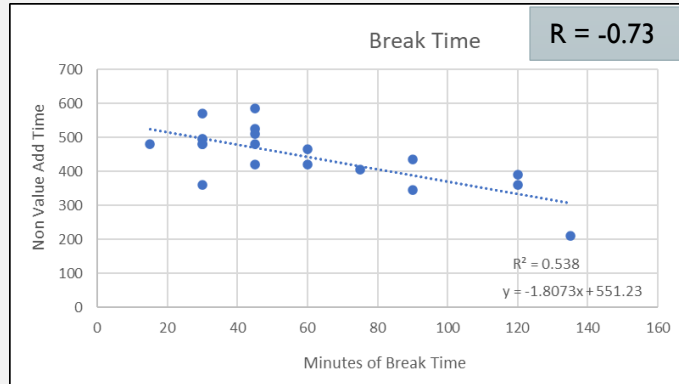
Risk Mitigation Strategy

- Low risk variables: It is unlikely that the measurement error, if any, will significantly skew the results.
- High risk variables: Implement a structured methodology for recording data.
- Set phone alarms at a frequency of every 30 minutes as a reminder to record data. This will prevent me from getting caught up in my work and forgetting to record data
- Keep whiteboard in front of me at all times on my desk. This is a constant reminder to record the data.
- Daily mid day and end of day data reviews. Look over the data that was collected through the day so far and make any adjustments as needed.

High risk variables: TV, breaks, standing, work, study, leisure, workout, fiancé

High

Correlation Analysis

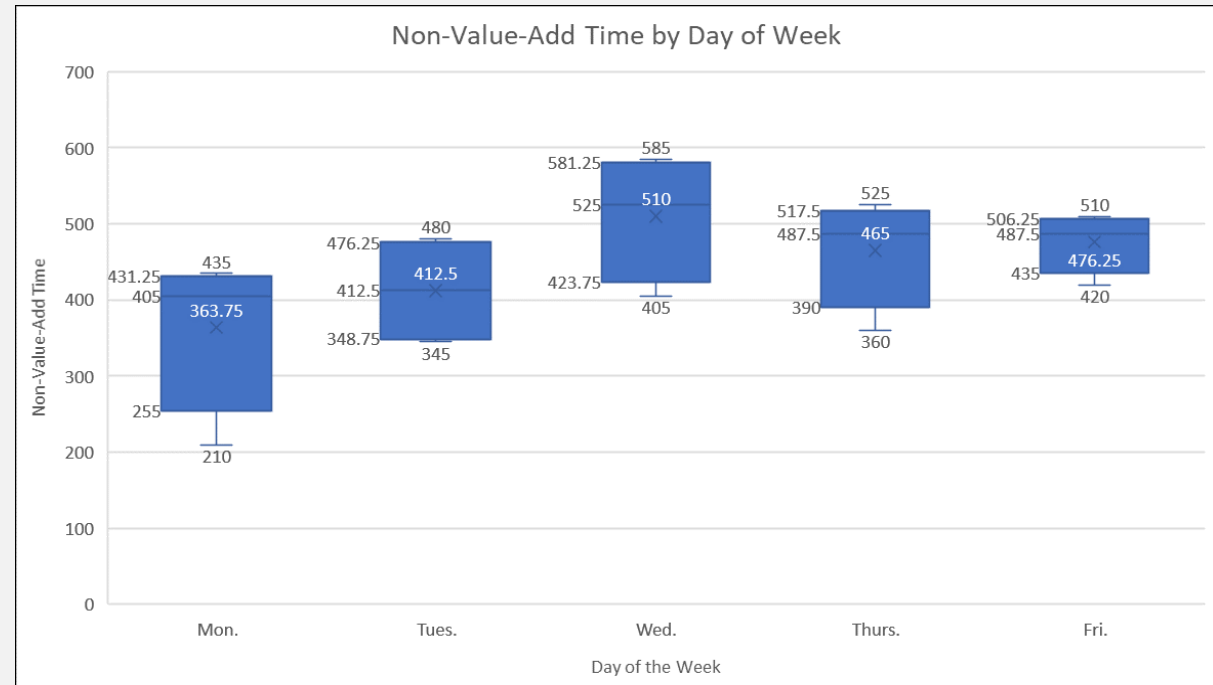


Measures of Dispersion

Non-Value-Add Time Measures of Dispersion

Total	Max	Min	Range	St Dev	Average
	585	210	375	86	446
Mon	Max	Min	Range	St Dev	Average
	435	210	225	104	364
Tues	Max	Min	Range	St Dev	Average
	480	345	135	70	413
Wed	Max	Min	Range	St Dev	Average
	585	405	180	84	510
Thu	Max	Min	Range	St Dev	Average
	525	360	165	72	465
Fri	Max	Min	Range	St Dev	Average
	510	420	90	39	476

Non-Value-Add Time Box and Whisker Plot



Chi-Square-Test

Chi-Square Data for Day of Week

Day of Week	y < 50th Percentile	y > 50th Percentile	Totals
Mon.	4	0	4
Tues.	3	1	4
Wed.	1	3	4
Thurs.	1	3	4
Fri.	1	3	4
Totals	10	10	20

df	4
alpha	0.10
P=value	0.02

	f (observed)	F (expected)	(f-F)^2 / F
Mon < 50th	4	0.40	32.40
Tues < 50th	3	0.40	16.90
Wed < 50th	1	0.40	0.90
Thurs < 50th	1	0.40	0.90
Fri < 50th	1	0.40	0.90
Mon > 50th	0	0.40	0.40
Tues > 50th	1	0.40	0.90
Wed > 50th	3	0.40	16.90
Thurs > 50th	3	0.40	16.90
Fri > 50th	3	0.40	16.90
Totals	10	4	24.00

Discoveries

Correlation Analysis

- Break time has a moderate/strong negative correlation with non-value-add time
- Day of the week has a moderate/strong positive correlation with non-value-add time
- When my fiancé is active there is a slight positive correlation with non-value-add time
- Coffee/sleep/standing each have a slight negative correlation with non-value-add time

Measures of Dispersion

- The average non-value-add time for a given day of work is about 446 minutes or 7.5 hours.
- This means that on an average 8 hour workday, about 0.5 hours of that is value-add time.
- To reach my goal of a 25% reduction of non-value-add time per day, I will need to get the average down to 334 minutes.
- For the most part, the non-value-add time stays relatively consistent (COV of 0.19)
- Sometimes there can be larger fluctuations in either direction (range of 375)
- There seems to be a relationship between the day of the week and the non-value-add time.



Chi Square Test

- There is in fact a relationship between the day of the week and non-value-add time
- The null hypothesis, which states that there is no relationship, is rejected at an alpha of 0.10 and a p-value of 0.02
- Wed-Fri tend to have higher amounts of non-value-add time than Mon-Tues

Solution I

Solution I – Microsoft Outlook Calendar Scheduled Breaks

- Because there is a moderate/strong relationship between the amount of break time that I am taking and the amount of non-value-add time, I will be implementing a change to my process that enforces taking a more structured break routine.
- I will be scheduling out blocks of time in my outlook calendar for morning, lunch, and afternoon breaks. This will serve two purposes. It will remind me that I need to take a break, and it will prevent coworkers from scheduling meetings during that time.
- Based on a simple linear regression of break time and non-value-add time, the slope coefficient is -1.8073. That means for every minute of break time that I can add into my routine, I am able to salvage about 108 seconds worth of non-value-added time in my day.
- On average, my break time was 58.5 minutes per day. Based on the data that I collected, I am confident that if I increase this, I can add reduce the non-value-add time per day. I am going to increase my target break time to 90 minutes per day.
- Based on a target break time increase of 31.5 minutes, that will translate to an average reduction of about 57 minutes of non-value-add time per day. This will account for approximately half of the reduction that I need in order to reach my goal (a total of 112 minutes / day reduction needed to reach my goal).
- On my outlook calendar, I will be blocking off the time slots of 10:00 AM – 10:15 AM, 12:00 PM – 1:00 PM, and 2:00 PM – 2:15 PM. This will add up to a total of 90 minutes per day of break time.

 Scheduled Break
 Regular Meeting

Pros	Cons
Free, no cost solution, can be done with existing resources	Appears as though I am less available to coworkers
Simple solution, not a complicated solution	Not fool proof, there could still be noncompliance
Relatively low risk, makes a lot of sense based on the data collected	
Reproduceable, this could be done by anybody else as well	

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
Feb 28	Mar 1 9:30am touch base; Microsoft Teams Meeting; ... 10:30am Production attai... 2:00pm Alert tool ideas; Microsoft...	2 10:00am Alert Tool Development M... 1:00pm Revised GIMBO Meeting... 1:30pm Team Touch base; Mic...	3 11:00am Allocation Revi... 11:30am HCY Cannibalization ... 3:00pm Staff Me... 8:00pm SCM 651...	4 11:00am Mongo... Tool 11:00am 2021 Vi... 1:00pm Austin T... 2:00pm Alert To... 8:00pm MBC 638...	5 9:00am Alert Tool Development Meeting 3; Teams; Gigot, Tyler 12:30pm Team Touch base; Microsoft Teams...	6
7	8 8:00am Tableau ... 9:30am touch b... 10:00am Schedu... 12:00pm Schedu... 12:15pm Schedu... 12:00pm Interna...	9 9:30am Producti... 10:00am Schedu... 12:00pm Schedu... 12:15pm Ledges... 1:00pm Revised ...	10 9:30am EMEA Re... 10:00am Schedu... 11:00am Allocati... 12:00pm Schedu... 2:00pm Schedu...	11 10:00am Schedu... 11:00am 2021 Vi... 12:00pm Schedu... 1:30pm Team To... 2:00pm Fluid M...	12 10:00am Scheduled Brea... 11:00am ENT US Demand Review... 12:00pm Schedu... 2:00pm Schedu...	13
14	15 10:00am Mecha... 10:00am Schedu... 11:00am touch ... 12:00pm Schedu... 1:00pm Catch U...	16 9:00am Coblatio... 10:00am Schedu... 12:00pm Schedu... 1:00pm Revised ... 1:30pm Team To...	17 St. Patrick's Day;... 9:00am Video Gl... 10:00am Mecha... 10:00am Schedu... 11:00am Allocati...	18 10:00am Schedu... 11:00am 2021 Vi... 12:00pm Schedu... 1:00pm Learnin... 1:30pm Team To...	19 9:30am Hip/Extr... 10:00am Schedu... 11:00am Produc... 11:30am Autom... 12:00pm Schedu...	20
21	22 10:00am Schedu... 11:00am touch ... 12:00pm Schedu... 1:30pm Updates... 2:00pm Schedu...	23 10:00am Schedu... 12:00pm Schedu... 1:00pm Revised ... 1:30pm Team To... 2:00pm Coblatio...	24 10:00am Schedu... 11:00am Allocati... 11:30am US De... 12:00pm Schedu... 2:00pm Schedu...	25 8:30am Demand... 10:00am Schedu... 11:00am 2021 Vi... 12:00pm Schedu...	26 8:00am Check Tolls From Color... 10:00am Scheduled Brea... 12:00pm Schedu... 2:00pm Schedu...	27
28	29 9:30am touch base; Microsoft ... 10:00am Scheduled Brea... 12:00pm Schedu... 2:00pm Schedu...	30 10:00am Schedu... 12:00pm Schedu... 1:00pm Revised ... 1:00pm Taxes M... 1:30pm Team To...	31 10:00am Schedu... 11:00am Allocati... 12:00pm Schedu... 2:00pm Schedu... 3:00pm Staff Me...	Apr 1 10:00am Schedu... 11:00am 2021 Vi... 12:00pm Schedu... 1:30pm Team To... 2:00pm Schedu...	2 10:00am Scheduled Break; Gigot, Tyler 12:00pm Scheduled Brea... 2:00pm Scheduled Brea...	3

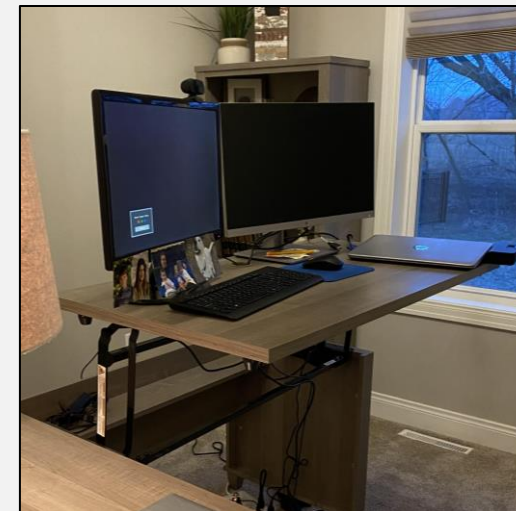
Solution II

Solution II – Use Standing Desk More Often

- Given that when (I) my fiancé is active, and (II) the day of the week is Wed.-Fri. that the non-value-add time increases, I will be implementing a method to hope to offset some of this.
- Based on the data, when I am standing versus sitting there is a negative correlation with non-value-add time. Therefore, when my fiancé is active, I will be standing at all times. Also, if the day of the week is Wed.-Fri., I will be standing more often than not.
- Based on a simple linear regression of when I am standing, for each minute that I am standing, the non-value-add time reduces by about -0.4791 minutes. That means for every additional minute that I am standing, I can reduce the non-value-add time by about 0.5 minute.
- On average, my fiancé is active an average of 125 minutes per day. My average standing time was 30.75 minutes per day. The difference between these two values is the additional amount of time that I will spend standing which is about 94.25 minutes per day. This equates to a reduction of about 45 minutes per day of non-value-add time.
- I need another 10 minutes per day reduction of non-value-add time to reach my goal of 25% reduction. This means that I need to add about another 100 minutes of standing time per week. I will look to increase my standing time on Wednesdays, Thursdays, and Fridays by about 33 minutes for each of those days.

Pros and Cons

Pros	Cons
Free, no cost solution, can be done with existing resources	Appears as though I am less available to coworkers
Simple solution, not a complicated solution	Not fool proof, there could still be noncompliance
Added benefit of standing being better for health than sitting	Higher risk because the correlations are not as strong
	Not everybody has the ability to stand at their desks, not as reproduceable



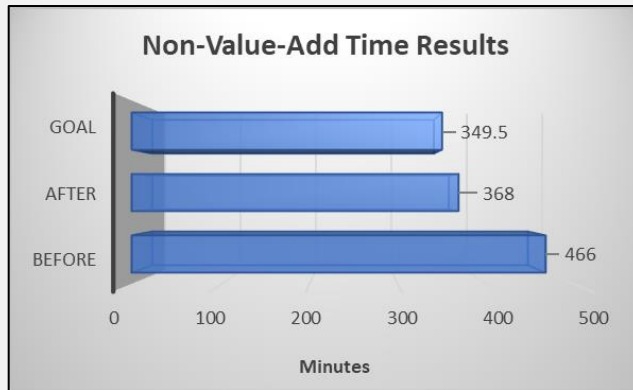
Standing desk setup at home

DMAIC - Improve

Results

Average non-value-add time per day (y)

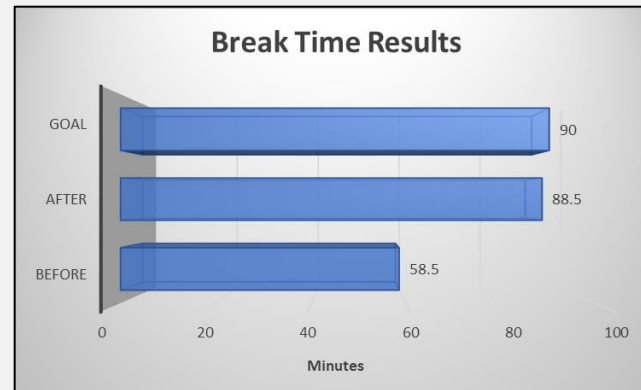
Before: 446 minutes
After: 368 minutes
Reduction: 21% reduction
Target: 25% reduction



Missed target by 33.5 minutes

Average break time per day (Solution I)

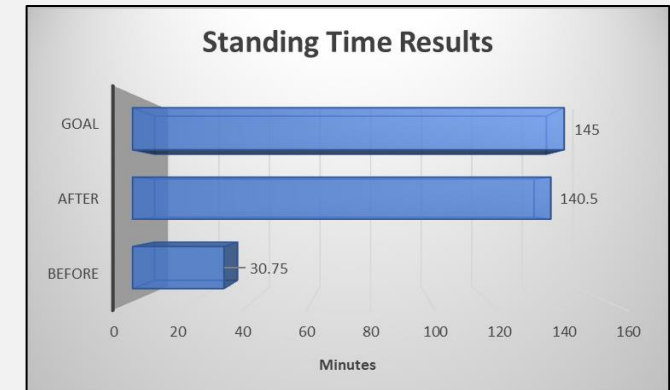
Before: 58.50 minutes
After: 88.50 minutes
Increase: 30.00 minutes
Target: 31.50 minutes



Missed target by 1.5 minutes

Average time standing per day (Solution II)

Before: 30.75 minutes
After: 140.50 minutes
Increase: 109.75 minutes
Target: 114.25 minutes



Missed target by 4.5 minutes

Sigma Quality Level Before Process Improvement

- Total actual defects = 240
- Total possible defects = 320
- Defect-per-opportunity rate = 75%
- Defects per million opportunities = 750,000
- Sigma Quality Level = 0.8

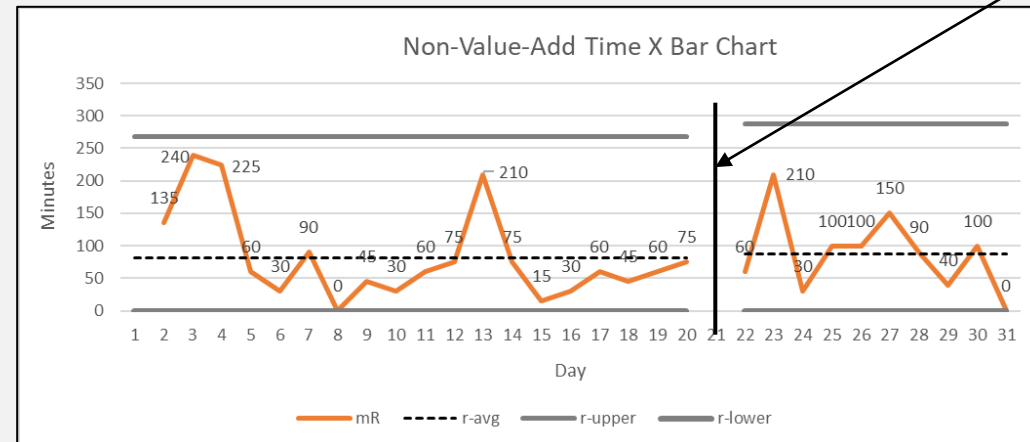
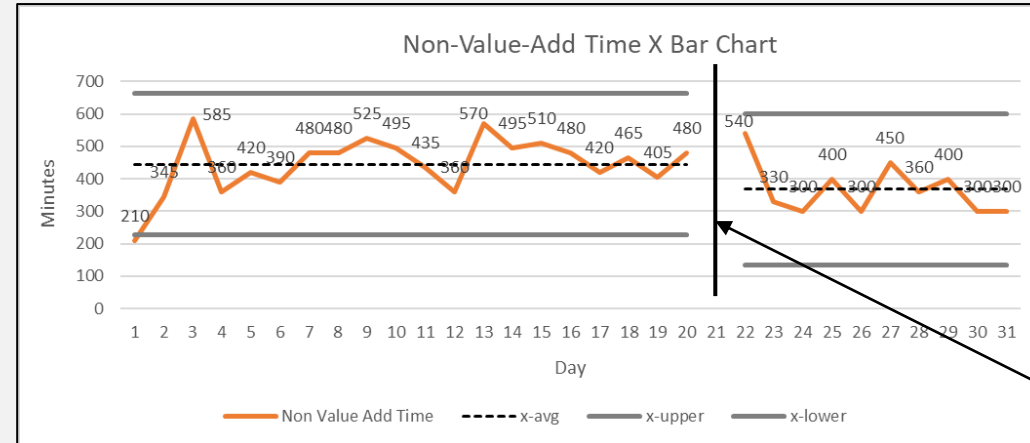
Sigma Quality Level After Process Improvement

- Total actual defects = 48
- Total possible defects = 160
- Defect-per-opportunity rate = 30%
- Defects per million opportunities = 300,000
- Sigma Quality Level = 2

DMAIC - Control

Control Chart

- I chose to use a control chart (XmR) to continue to monitor the non-value-add time.
- With this tool, I understand what I should expect in terms of non-value-add time per day with the new process.
- This will allow me to identify if my process becomes out of control.
- As long as the non-value-add time does not fall outside of the upper and lower limits, either on the X chart or mR chart, the process is in control.
- If the non-value-add time falls consistently on above or below the mean for seven consecutive days, that also indicates a signal has occurred.
- In the event that a signal occurs, I would proceed to investigate what the root cause of the signal was.
- This will help me determine whether another change to the system is necessary to bring the process back into control.



System changed
– process
improvement

Reflection

Criticisms About the Project

- I would have changed a few things about my project to enhance it. I believe that my results were somewhat limited due to the data collection method chosen. I would have tried to use less manual data collection methods. I believe that this may have caused some measurement error along the way.
- My risk mitigation plan for measurement error did not work as well as I thought it would. I found that it was difficult to manage my work and record the data accurately at the same time. In addition, the whiteboard got cluttered at times.
- One key variable that I overlooked that I think would have been a good addition would be screen time on my phone. There is a setting that I could have adjusted on my iPhone so that it tracks my amount of screen time and which apps I am looking at.
- Another variable I wanted to use but couldn't figure out how was if I could capture how long my status was either set to busy, away, or available on Microsoft teams. That may have been another interesting variable to add. There is also Microsoft analytics, a new service that they provide, but I was not able to implement this in my project in time.
- One more variable that I think would have been interesting would be sleep quality. I could have used an apple watch to track my quality of sleep of night. I think that would have been better than just putting down many hours I got.
- Some of the variables that I picked were subjective, and it would have been nice to add a few more objective variables into the mix. Unfortunately, by the time that I thought of this I was already halfway through the measurement phase. It was too late to go back and add in the variables because the new sample size would have been too small.
- Lastly, I would have liked to have gotten at least one more week of data prior to process improvement, as well as an additional week of data after the process improvement. Due to time constraints, I was not able to collect as much data as I would have liked.

Learnings From the Project

- The project helped me to think differently about what I am doing on a day to day. Working from home is a lot of different than working in the office. I already knew that but what I did not know was how much of a difference changing my behavior could make. Before the project, I was not sure if changing anything would matter; or if it did, how much it would matter. What I found out was that the actions that I take, such as taking breaks, not sitting for too long, and managing my time are important.
- This was the first project I have ever done where I had to come up with my own data to collect. I found this to be a challenge because there are so many things to consider. When doing any kind of project in the future, I want to make sure I spend plenty of time figuring out what I want to collect and how I want to collect it. It was a disappointing feeling to realize after it was too late that there were some variables I missed out on that could have enhanced my project.

Appendix / Calculations

Value-added work = 6,750\$ per hour (slide 3)

- dollar estimate based on documented instances of value-added work over the first 2.5 years in my role

target sample size (slide 6)

- <https://www.qualtrics.com/blog/calculating-sample-size>

Chi-Square Formula in Excel (slide 11)

- =CHISQ.DIST.RT(24,4)

Non-Value-Add Time COV (Coefficient of Variance) (slide 12)

- s / \bar{x}

Target break time effect on non-value-add time (slide 13)

- $31.5000 * 1.8073 \approx 57$ minutes

Target standing time effect on non-value-add time (slide 14)

- $((125.00 - 30.75) + (100.00 / 5.00)) * 0.4791 \approx 55$ minutes

Annual Savings from Process Improvement (Slide 1)

- 112 minute target reduction / 60 minutes = 1.86 hours per day
- 1.86 hours * 6,750 dollars per hour = 12,600 dollars per day
- 365 days per year * 12,600 dollars per day = 4,600,000\$ per year

Goal non-value-add time per day (slide 12)

- $446 * 0.75 = 334$
- $446 - 334 = 112$ minute reduction

Total effect on non-value-add time from process improvement (slide 13-14)

- Solution I effect + solution II effect = 57 + 55 = 112 minutes

Five tools (Multiple slides)

- Process map, correlation, measures of dispersion, chi-square, control chart

Value-Add time in one day (slide 9)

- Total time spent working – total non-value-add time = value-add time

Sigma Quality Level Opportunities per day (Slide 9)

- 8 hours per day / 30 minute blocks = 16 opportunities per day

Sigma Quality Level Total Possible Defects (Slide 16)

- Before process improvement = 16 opportunities per day * 20 days = 320 possible defects
- After process improvement = 16 opportunities per day * 10 days = 160 possible defects