

# Sherlock Holmes, Zombie Hunter



DMAIC Project Story Board

**Define**

**Measure**

**Analyze**

**Improve**

**Control**

Let's start by reviewing the generic critical questions for the Define Phase of our DMAIC project...

## Define Phase Critical Questions:

- What is the problem to be solved?
- Are the right people on the team?
- Who is the customer?
- What are the customer requirements?
- How does the process flow?

Define

Measure

Analyze

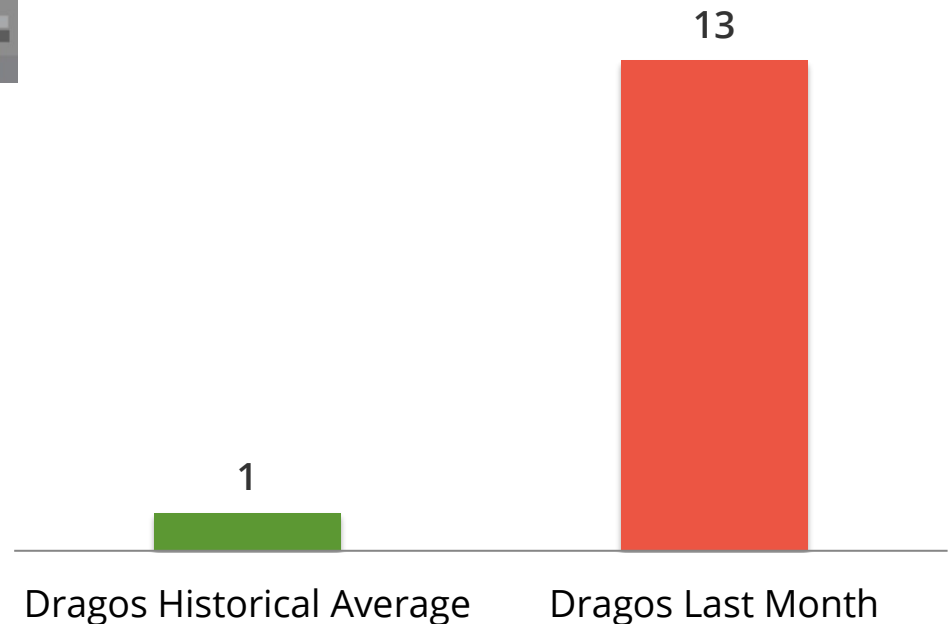
Improve

Control



The town of Dragos in Variansa (Eastern Europe) has experienced a recent surge in Zombie attacks.

Zombie Attacks Per Month



Define

Measure

Analyze

Improve

Control

Luckily, nobody has been injured (yet). In addition to the obvious safety concerns, the town is also at risk to be de-selected as the host site for a summer folk festival. The economic value of that festival is estimated at 17.5 million euros.



#1: Public  
Safety

#2: Economic  
Impact  
17.5 MM Euros



A contributing problem: data from police reports has not been available in a timely fashion.



Define

Measure

Analyze

Improve

Control

Team formed representing all key functions...



Sherlock and Watson, and representatives from the Economic Development Council and Police

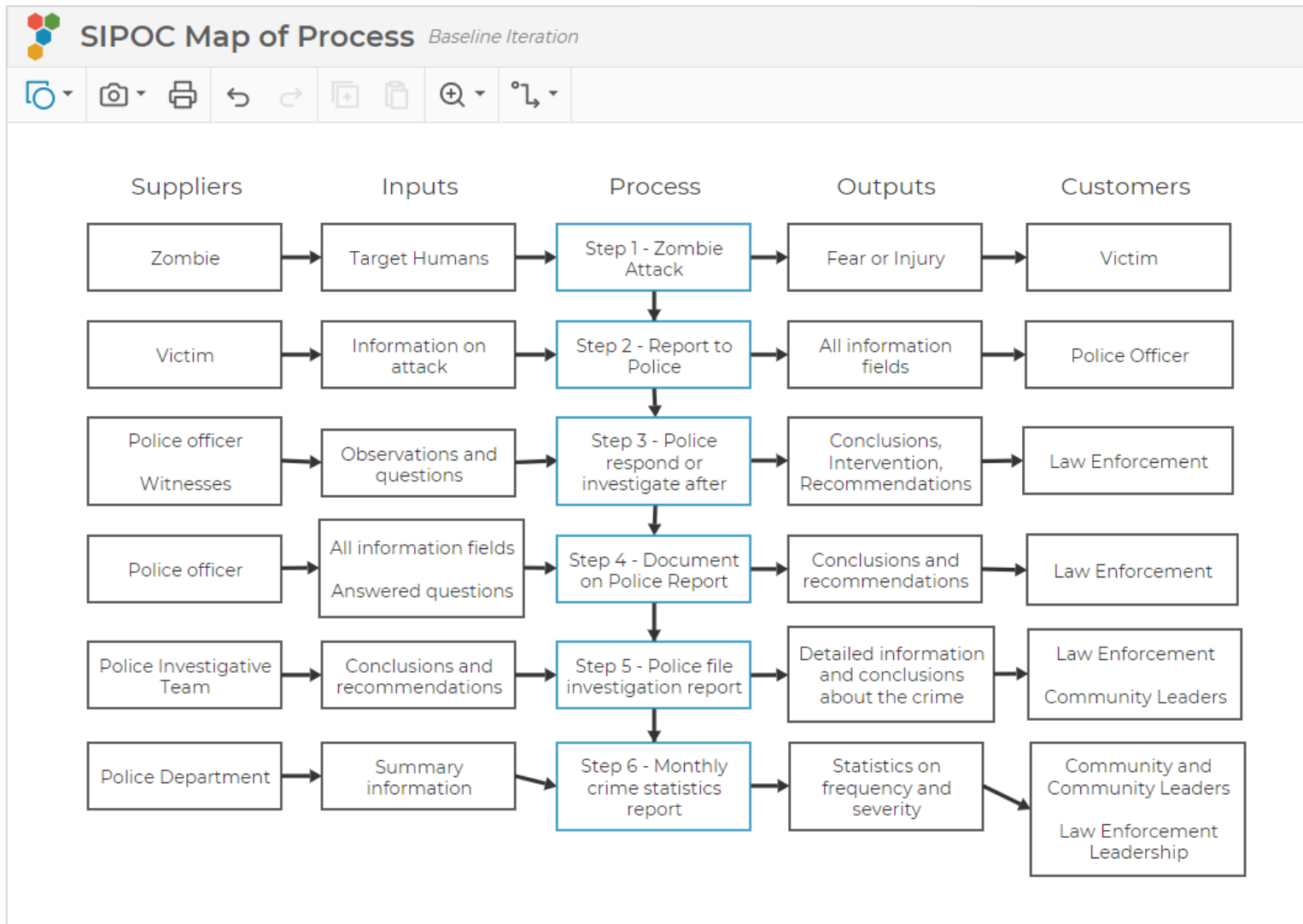
# Define

# Measure

# Analyze

# Improve

# Control



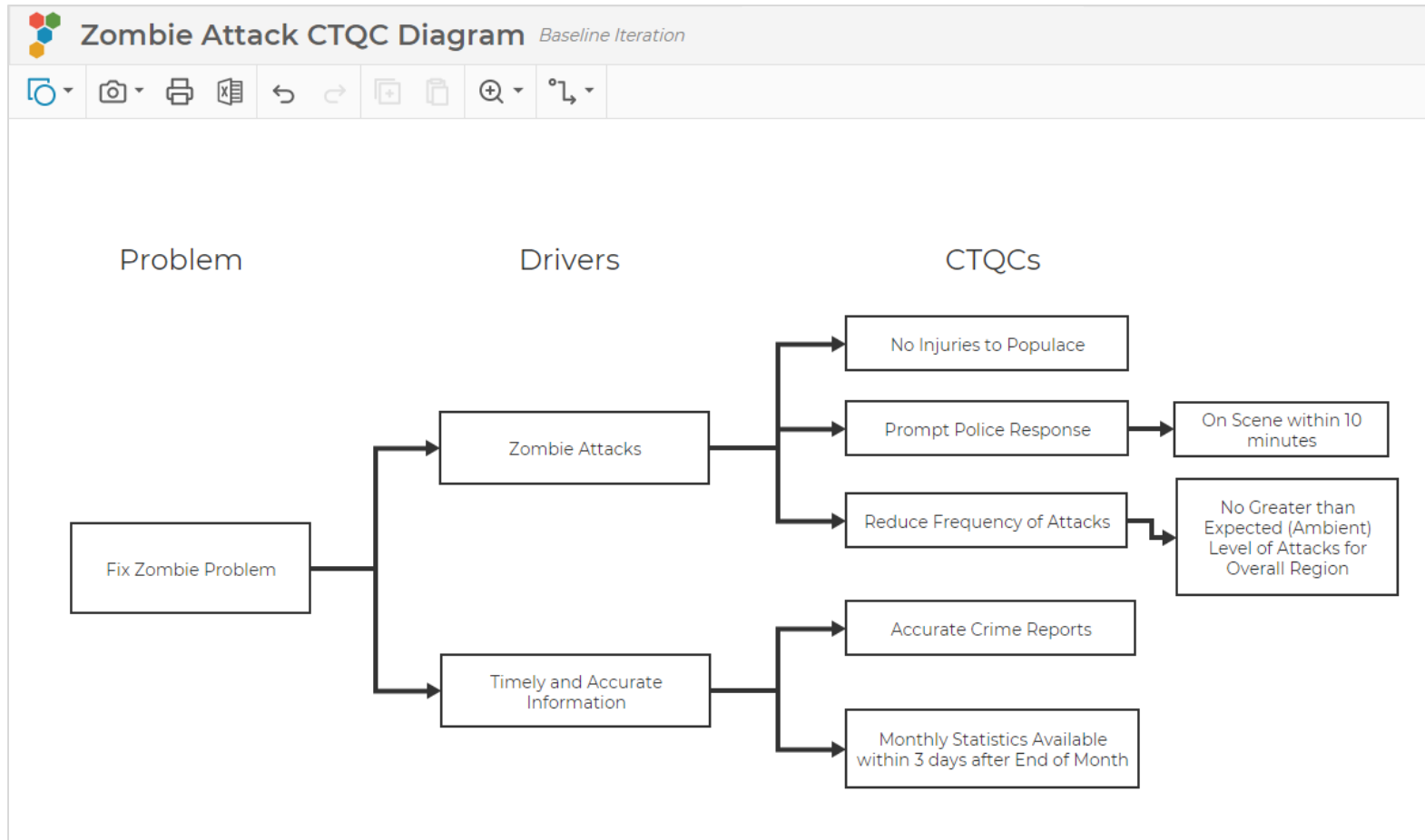
# Define

# Measure

# Analyze

# Improve

# Control



Define

Measure

Analyze

Improve

Control

## Requirements:

CTQC #1: "Prevent injury from zombie attacks".

CTQC #2: "Police on scene within 10 minutes".

CTQC #3: "Reduce frequency of zombie attacks to normal expected (ambient) level".

CTQC #4: "Accurate Police Reports".

CTQC #5: "Monthly crime statistics report should be available within 3 days after the end of the month".

Define



Measure

Analyze

Improve

Control

Before we start this phase, let's start by reviewing the generic critical questions for the Measure Phase of our DMAIC project...

## Measure Phase Critical Questions:

- How do we measure the problem ?
- Are the measurements reliable?
- How does the process vary over time?
- What process inputs might be significant?

Define

Measure

Analyze

Improve

Control



## Attacks by Month

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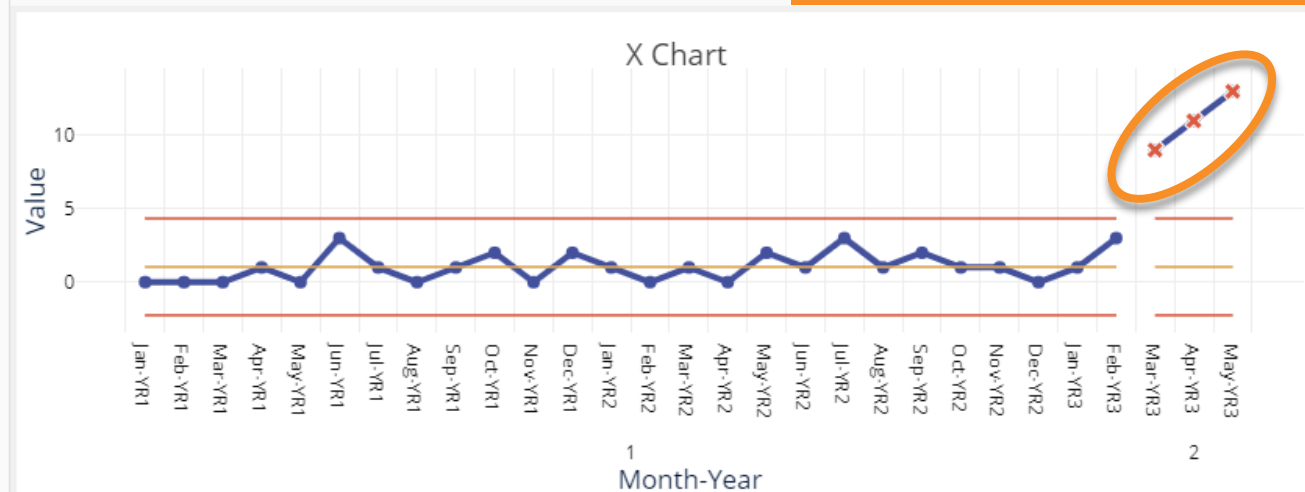
### X Chart Statistics

|         | Stage 1 | Stage 2 |
|---------|---------|---------|
| UCL     | 4.336   | 16.32   |
| Average | 1.038   | 11      |
| LCL     | -2.259  | 5.681   |

### Moving Range Chart Statistics

|         | Stage 1 | Stage 2 |
|---------|---------|---------|
| UCL     | 4.051   | 6.535   |
| Average | 1.24    | 2       |
| LCL     | 0       | 0       |

### Charts of Number of Attacks





Define



Measure

Analyze

Improve

Control

Most attacks have low severity:  
"Chased" or only "Sighted"

SEVERITY KEY:

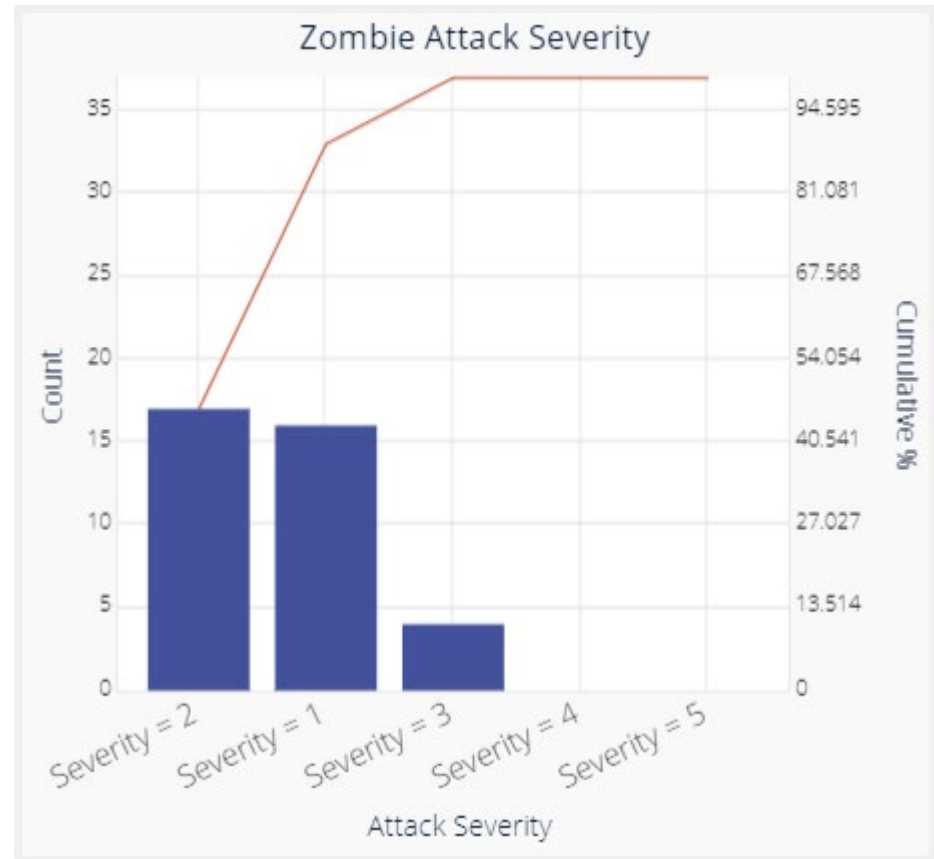
Severity Level 1 = Sighted

Severity Level 2 = Chased

Severity Level 3 = Touched

Severity Level 4 = Injured

Severity Level 5 = Killed



Define



Measure

Analyze

Improve

Control

## Calculate DPMO, Adjusting for Affected Population Size

|                             |                                   |         |
|-----------------------------|-----------------------------------|---------|
| Total Population of Dragos  |                                   | 25,478  |
| Population in City Center   |                                   | 3,134   |
| Tourists & Visitors - Daily | +                                 | 150     |
| Total                       |                                   | 3,284   |
| Ave. Trips Outside/Day      | x                                 | 3.5     |
| Opportunities Per Day       |                                   | 11,494  |
| Number of Days              | x                                 | 92      |
| Total Opportunities         |                                   | 1057448 |
| Attacks                     | March                             | 9       |
|                             | April                             | 11      |
|                             | May                               | 13      |
|                             |                                   | 33      |
| DPMO                        | $33 / 1,057,488 \times 1,000,000$ | 31      |



### Sigma Level

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[Instructions](#)

| Discrete Data                           | Product A |
|-----------------------------------------|-----------|
| Enter number of defects:                | 33        |
| Enter number of units:                  | 1057448   |
| Enter number of opportunities per unit: | 1         |
| Or Enter DPMO directly:                 |           |
| Calculated DPMO:                        | 31        |
| Short term sigma level (Z + 1.5)        | 5.5       |
| Long term sigma level (Z)               | 4.0       |

Opportunities = Affected Population x No. of Days x Ave. Daily Trips Outside

Define



Measure

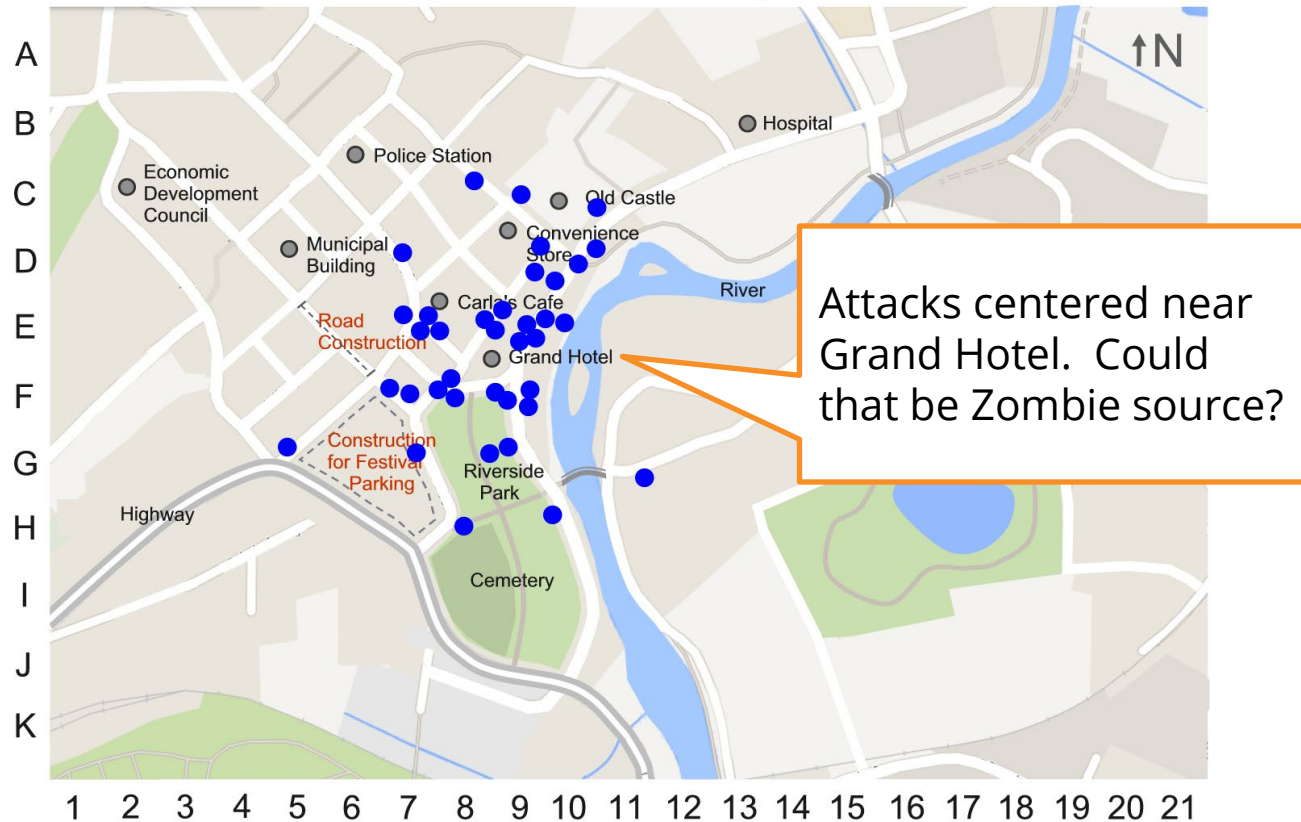
Analyze

Improve

Control

Where did the attacks take place? - Plot location data from police reports

Map of Central Dragos



Define ✓

Measure ✓

Analyze

Improve

Control

Before we start this phase, let's review the generic critical questions for the Analyze Phase of our DMAIC project...

## Analyze Phase Critical Questions:

- What is the root cause of the problem?
- How do the process inputs affect the output of interest?
- How do we know?

Define ✓

Measure ✓

Analyze

Improve

Control

Where can we get more information?

- Review Police Reports
- Interview Victims
- Interview Witnesses

Define ✓

Measure ✓

Analyze

Improve

Control

Reviewed last few months of Police Report data. Something seems odd... multiple descriptions of zombies resembling various celebrities.



*"I could swear it looked like Richard Nixon, which is pretty scary."*

*"... but had a face like Justin Bieber."*

*"...it kept smiling at me. It looked like Bill Clinton, which is pretty strange."*

Define ✓

Measure ✓

Analyze

Improve

Control

Follow up by interviewing victims and witnesses...



Define ✓

Measure ✓

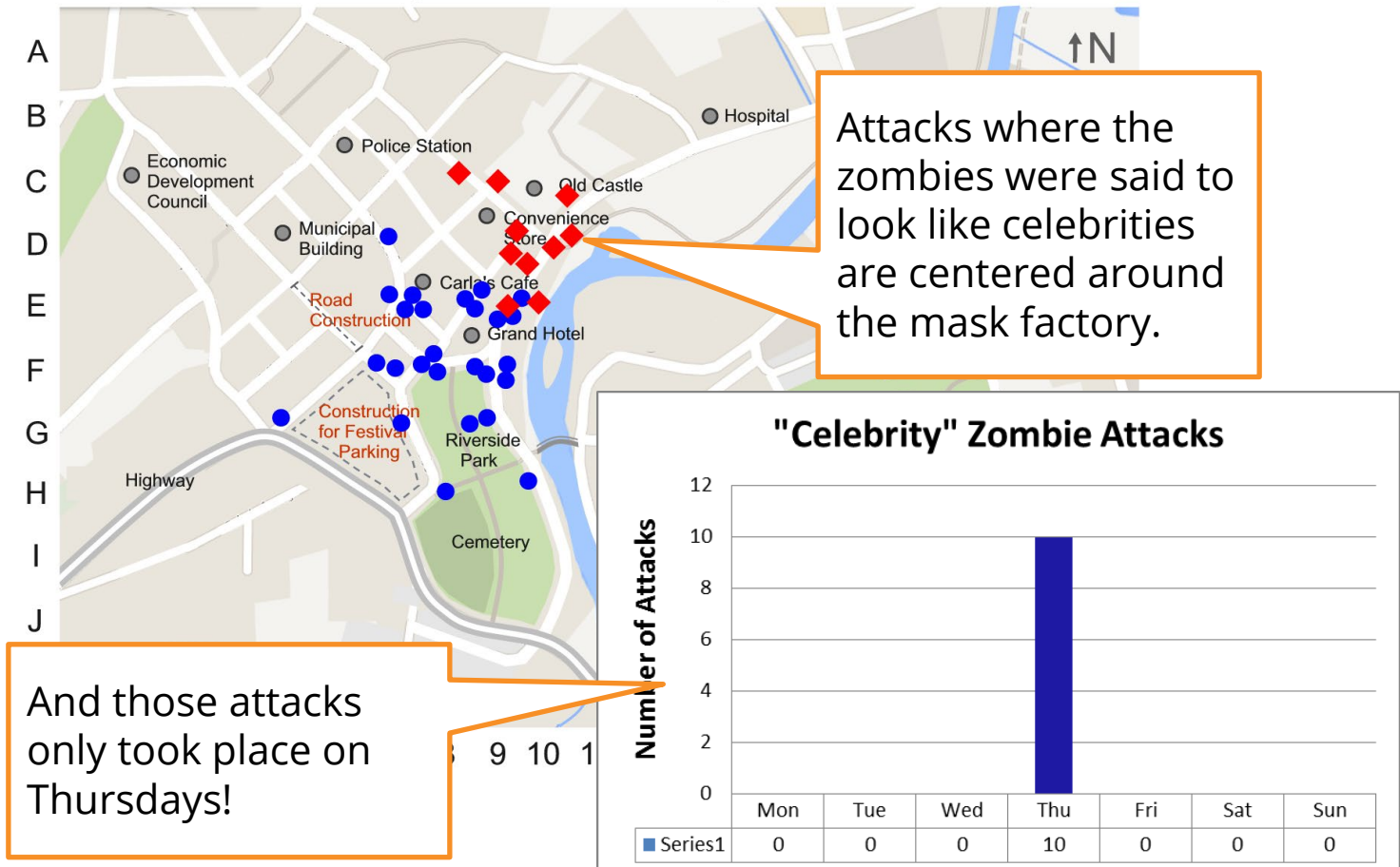
Analyze

Improve

Control

What do we know about these suspect “celebrity” zombie attacks?

Map of Central Dragos



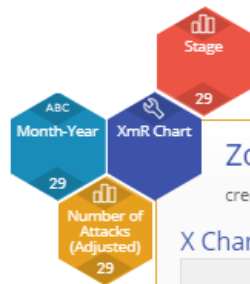
Define

Measure

Analyze

Improve

Control



### Zombie Attacks by Month (Real)

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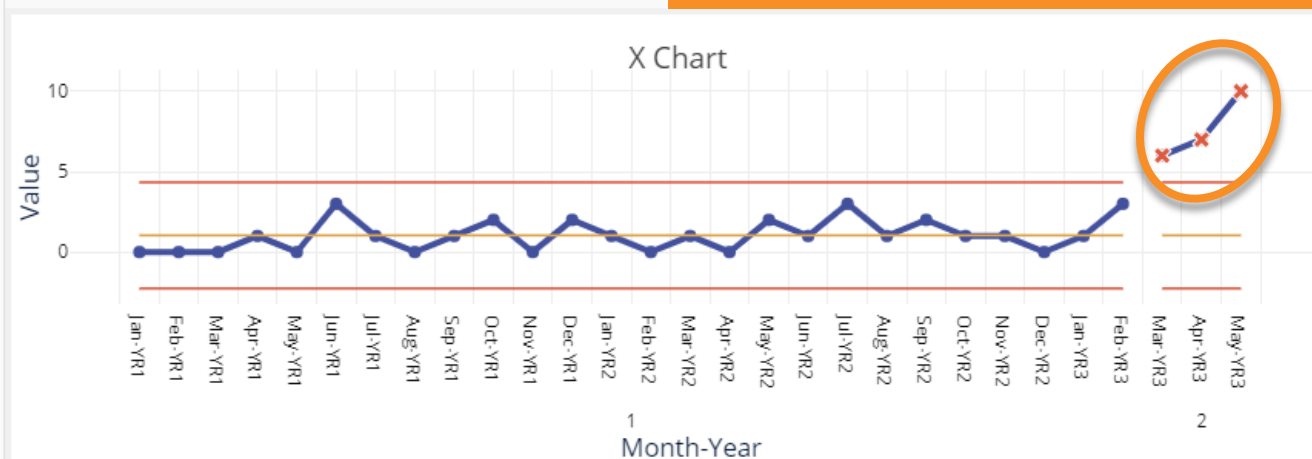
#### X Chart Statistics

|         | Stage 1 | Stage 2 |
|---------|---------|---------|
| UCL     | 4.336   | 12.99   |
| Average | 1.038   | 7.667   |
| LCL     | -2.259  | 2.348   |

#### Moving Range Chart Statistics

|         | Stage 1 | Stage 2 |
|---------|---------|---------|
| UCL     | 4.051   | 6.535   |
| Average | 1.24    | 2       |
| LCL     | 0       | 0       |

#### Charts of Number of Attacks (Adjusted)



After adjusting for false attacks, Zombie attacks are lower but still out of control!

Define ✓

Measure ✓

Analyze

Improve

Control

## Unadjusted

|                             |                                   |         |
|-----------------------------|-----------------------------------|---------|
| Total Population of Dragos  |                                   | 25,478  |
| Population in City Center   |                                   | 3,134   |
|                             |                                   | +       |
| Tourists & Visitors - Daily |                                   | 150     |
| Total                       |                                   | 3,284   |
|                             |                                   | x       |
| Ave. Trips Outside/Day      |                                   | 3.5     |
| Opportunities Per Day       |                                   | 11,494  |
|                             |                                   | x       |
| Number of Days              |                                   | 92      |
| Total Opportunities         |                                   | 1057448 |
| Attacks                     | March                             | 9       |
|                             | April                             | 11      |
|                             | May                               | 13      |
|                             |                                   | 33      |
| DPMO                        | $33 / 1,057,488 \times 1,000,000$ | 31      |

## Adjusted

|                             |                                   |         |
|-----------------------------|-----------------------------------|---------|
| Total Population of Dragos  |                                   | 25,478  |
| Population in City Center   |                                   | 3,134   |
|                             |                                   | +       |
| Tourists & Visitors - Daily |                                   | 150     |
| Total                       |                                   | 3,284   |
|                             |                                   | x       |
| Ave. Trips Outside/Day      |                                   | 3.5     |
| Opportunities Per Day       |                                   | 11,494  |
|                             |                                   | x       |
| Number of Days              |                                   | 92      |
| Total Opportunities         |                                   | 1057448 |
| Attacks                     | March                             | 9       |
|                             | April                             | 11      |
|                             | May                               | 13      |
|                             |                                   | 23      |
| DPMO                        | $23 / 1,057,488 \times 1,000,000$ | 22      |

Adjusted DPMO Lower But Still Elevated

Define ✓

Measure ✓

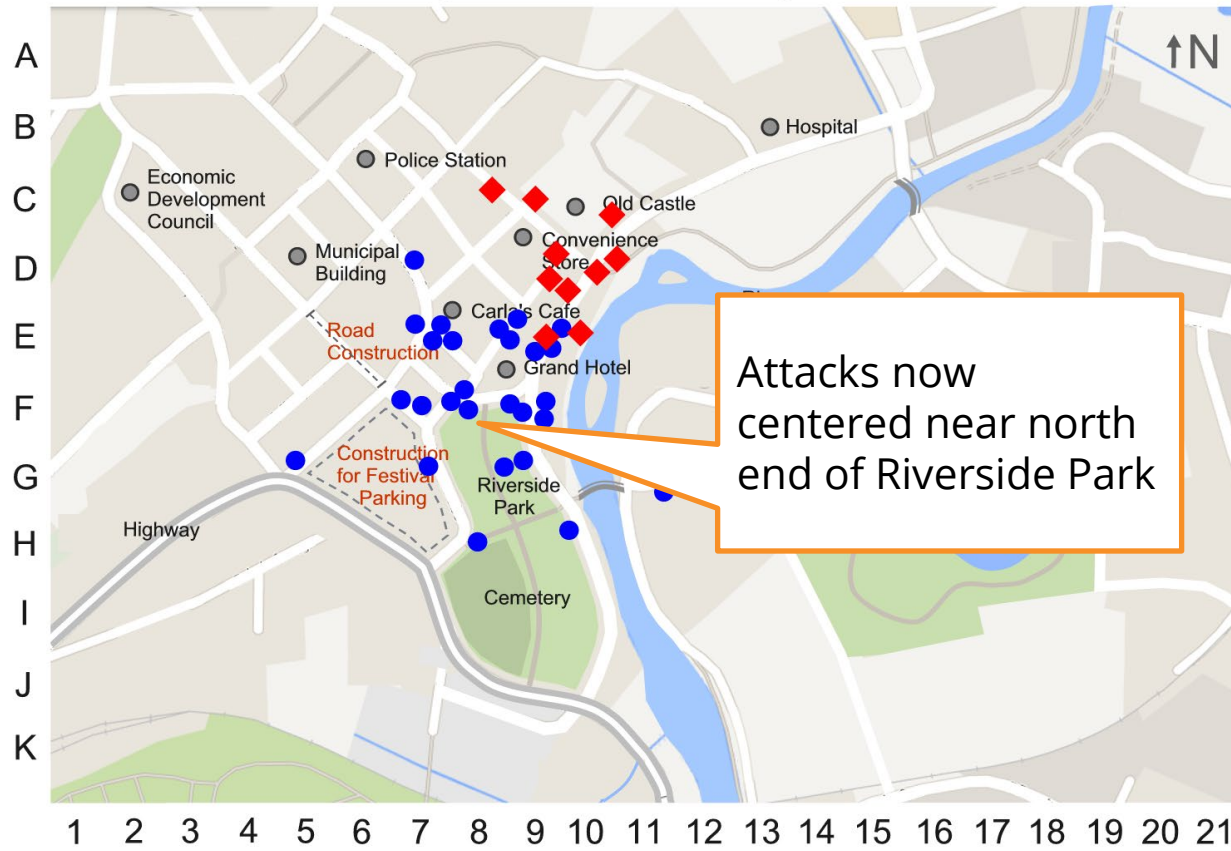
Analyze

Improve

Control

How does the location plot change after removing false attacks?

Map of Central Dragos



Define ✓

Measure ✓

Analyze

Improve

Control

Known vs. Unknown Analysis:

| What do we know?                                                                                 | What do we NOT know?                                           |
|--------------------------------------------------------------------------------------------------|----------------------------------------------------------------|
| Most of the reported zombie attacks are real.                                                    | Is there any pattern to the timing of the attacks?             |
| The frequency of zombie attacks is above the upper control limit.                                | Why are the attacks centered around the north end of the park? |
| Zombie attacks are in the central business district, clustered around the north end of the park. | What is the ROOT CAUSE of the increase in frequency?           |

Define ✓

Measure ✓

Analyze

Improve

Control

## 5-Why Analysis

Q: Why are attacks centered in the park?

A: The park is located near the cemetery, a common source of zombies, and the cemetery has physical constraints on the other sides (river, highway).

Q: Why are Zombies leaving their graves?

A: They have been disturbed.

Q: What disturbed them?

A: Wet and warm spring weather? Unknown activity in cemetery? Sign of pending apocalypse? Cosmic fluctuations? Need more data.

Define ✓

Measure ✓

Analyze

Improve

Control

## 5-Why Analysis - Conclusion

If we don't know the root cause, can we at least confirm the source of zombie attacks and contain?

Conclusion (Hypothesis):

**Zombies are coming from the cemetery!**

Define ✓

Measure ✓

Analyze

Improve

Control

Solution: Lock cemetery gates and monitor...



Define ✓

Measure ✓

Analyze

Improve

Control

Zombies spotted outside the gates, on west side of cemetery!



We don't have the location nailed down, and we still don't know the root cause.

Define ✓

Measure ✓

Analyze

Improve

Control



Define ✓

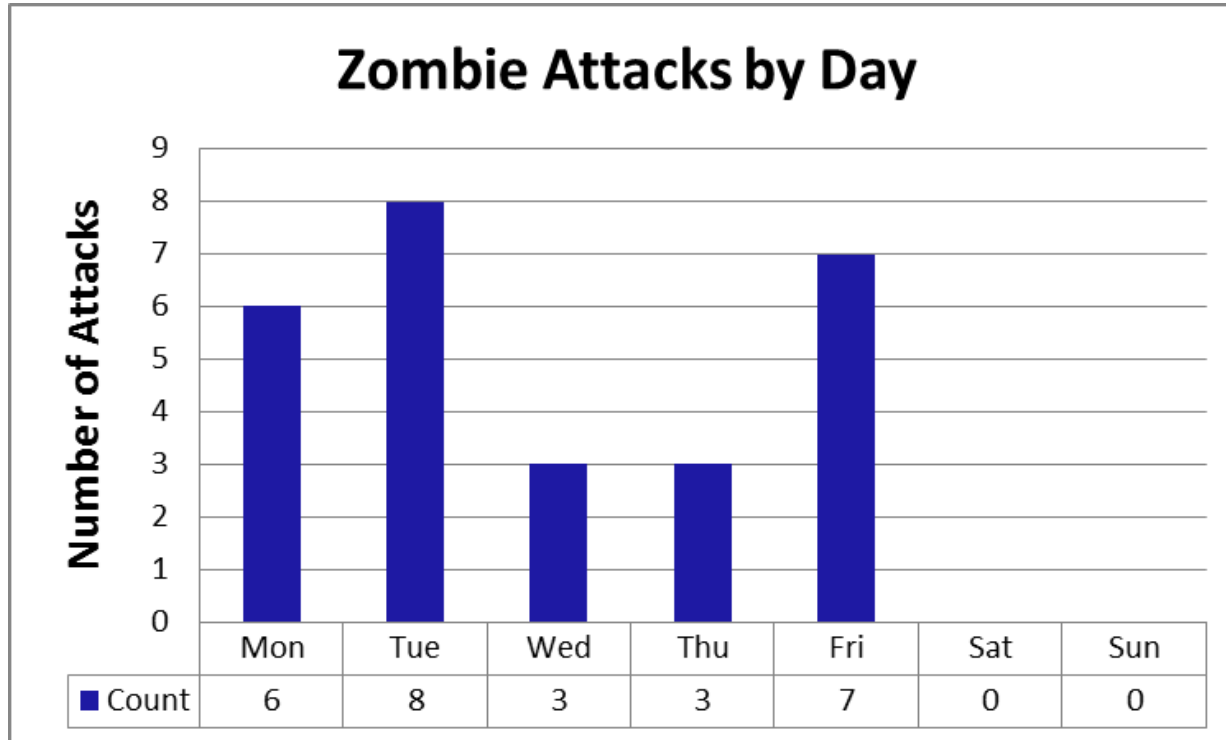
Measure ✓

Analyze

Improve

Control

Analyze for timing patterns – stratify by day:



Note: False attacks have been removed from this dataset.

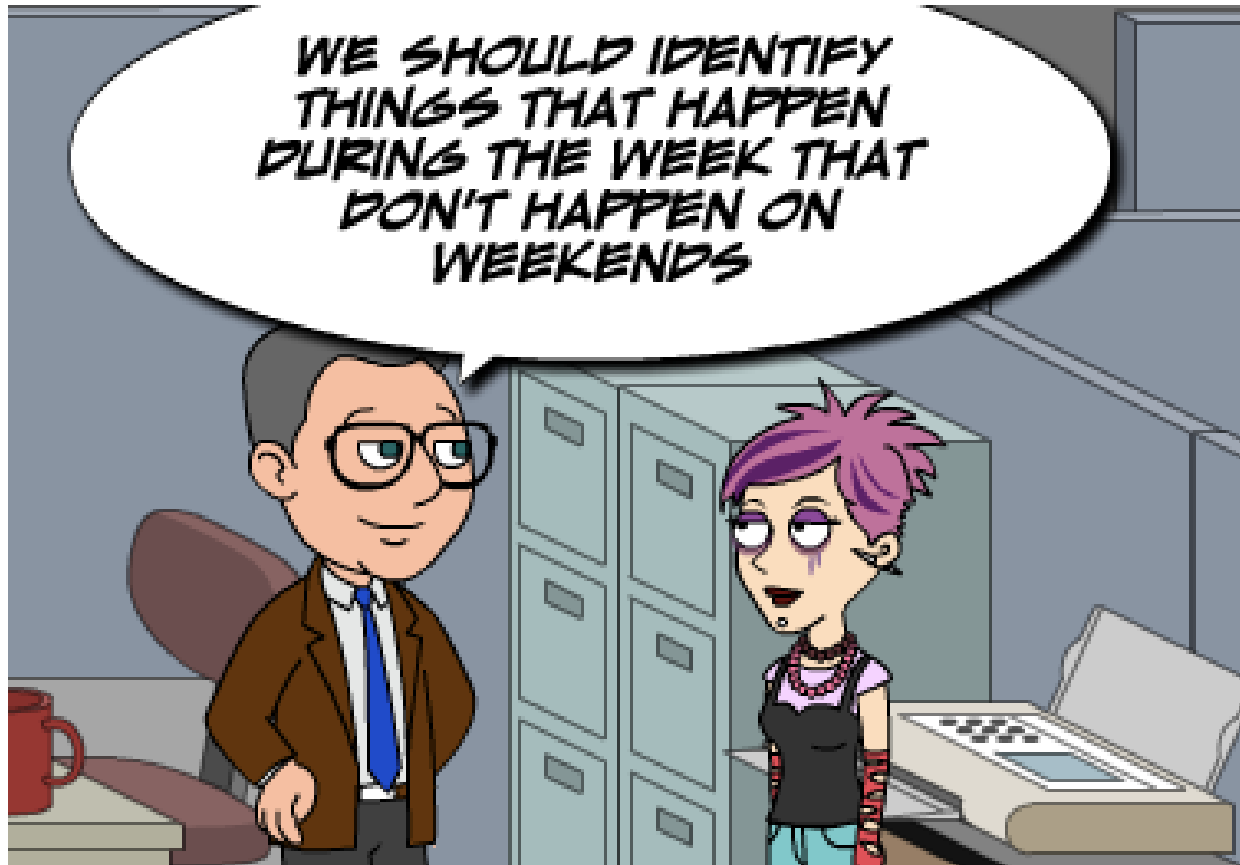
Define ✓

Measure ✓

Analyze

Improve

Control



Define ✓

Measure ✓

Analyze

Improve

Control

What happens differently during the week?

More  
People

Business  
Activities

Constructi

Source of  
disruption?

School

Government  
Activities

Less  
Tourists on  
Weekdays

Define ✓

Measure ✓

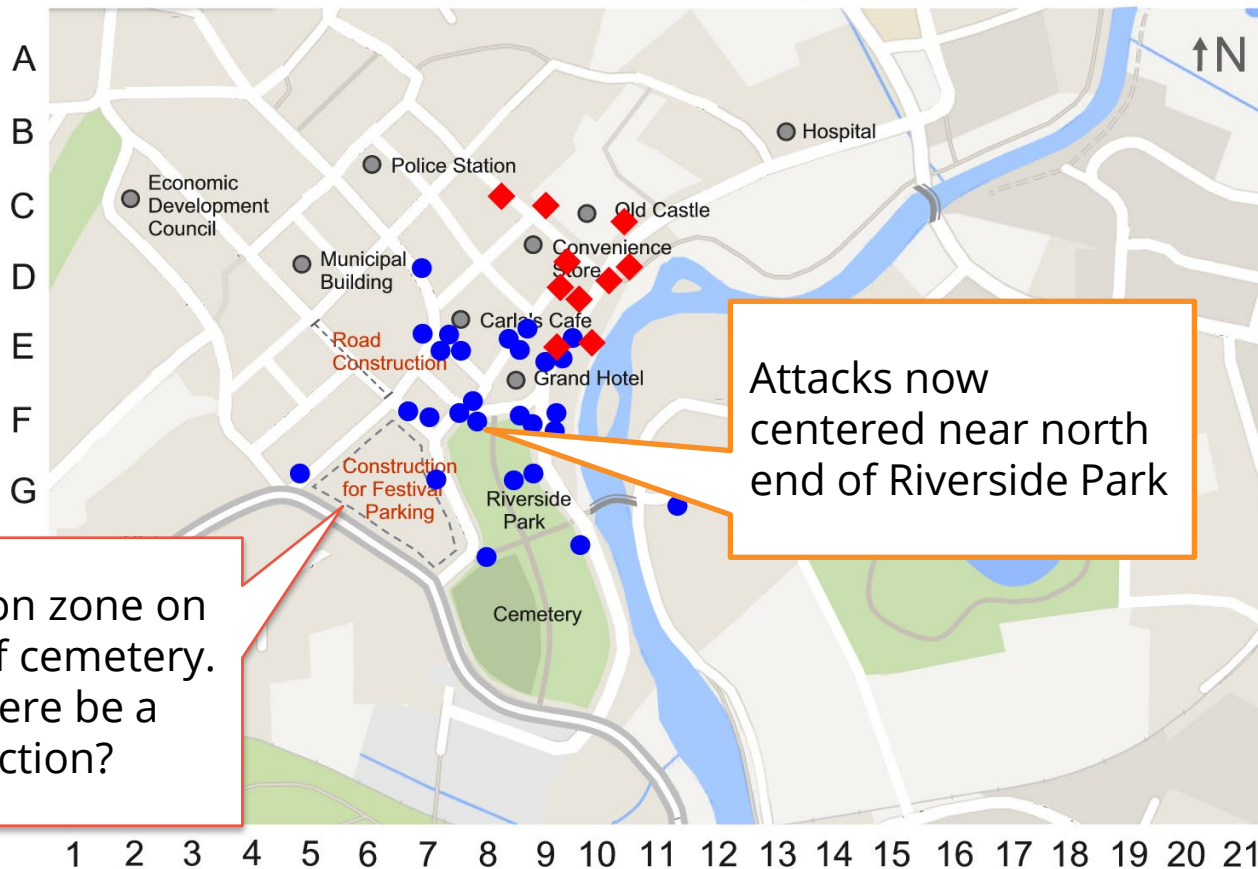
Analyze

Improve

Control

How does the location plot change after removing false attacks?

Map of Central Dragos



Define ✓

Measure ✓

Analyze

Improve

Control

Let's talk to some of the knowledgeable locals...



Define ✓

Measure ✓

Analyze

Improve

Control

Repositioned security cameras  
and police patrols confirm  
construction site as source of  
Zombies!



Define ✓

Measure ✓

Analyze ✓

Improve

Control

Before we start this phase, let's review the generic critical questions for the Improve Phase of our DMAIC project...

## Improve Phase Critical Questions:

- What changes should be made to improve the process?
- How do we know they will work?
- How can the process be error-proofed?

Define ✓

Measure ✓

Analyze ✓

Improve

Control

Brainstorm Improvements:

Add security  
around  
cemetery site

Create  
physical  
barrier  
around site

Halt the  
construction

Seal the  
graves

Dig up and  
move the old  
cemetery

Implement a  
curfew to keep  
people off the  
streets

Add motion  
detectors  
and alarms

Define ✓

Measure ✓

Analyze ✓

Improve

Control

Select Improvement Action: #1 Seal the Graves

↑ export 📄 copy :



## Solution Selection Matrix

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Instructions

Key: higher numbers are better

| Solution Description                                      | Technical Feasibility | Capital Investment | Ongoing Expense | Effectiveness | Development Time | Unused | Total sum of weight x rating |
|-----------------------------------------------------------|-----------------------|--------------------|-----------------|---------------|------------------|--------|------------------------------|
| Add security around construction site                     | 4                     | 4                  | 1               | 2             | 3                | 1      | 15.0000                      |
| Create physical barrier around construction/cemetery site | 4                     | 1                  | 4               | 4             | 1                | 1      | 15.0000                      |
| Halt the construction                                     | 4                     | 2                  | 1               | 2             | 3                | 1      | 13.0000                      |
| Seal the graves                                           | 5                     | 1                  | 5               | 5             | 3                | 1      | 20.0000                      |
| Add motion detectors and alarms                           | 4                     | 3                  | 2               | 2             | 2                | 1      | 14.0000                      |
| Institute a curfew                                        | 1                     | 5                  | 1               | 2             | 3                | 1      | 13.0000                      |
| Dig up and move old cemetery                              | 3                     | 1                  | 1               | 2             | 1                | 1      | 9.0000                       |

Define ✓

Measure ✓

Analyze ✓

Improve

Control

How can we seal the graves?

Electronic  
containment

Pile large  
stones on  
site

Construct  
building on  
site

Concrete  
cap - pave  
the parking  
lot

Dig up and  
place each  
tomb in  
vault

Easy  
choice!

Site was already supposed to be a parking lot...

Define ✓

Measure ✓

Analyze ✓

Improve

Control

Benchmarking research shows that covering burial sites with concrete has reduced the incidence of zombies at other locations...



Define ✓

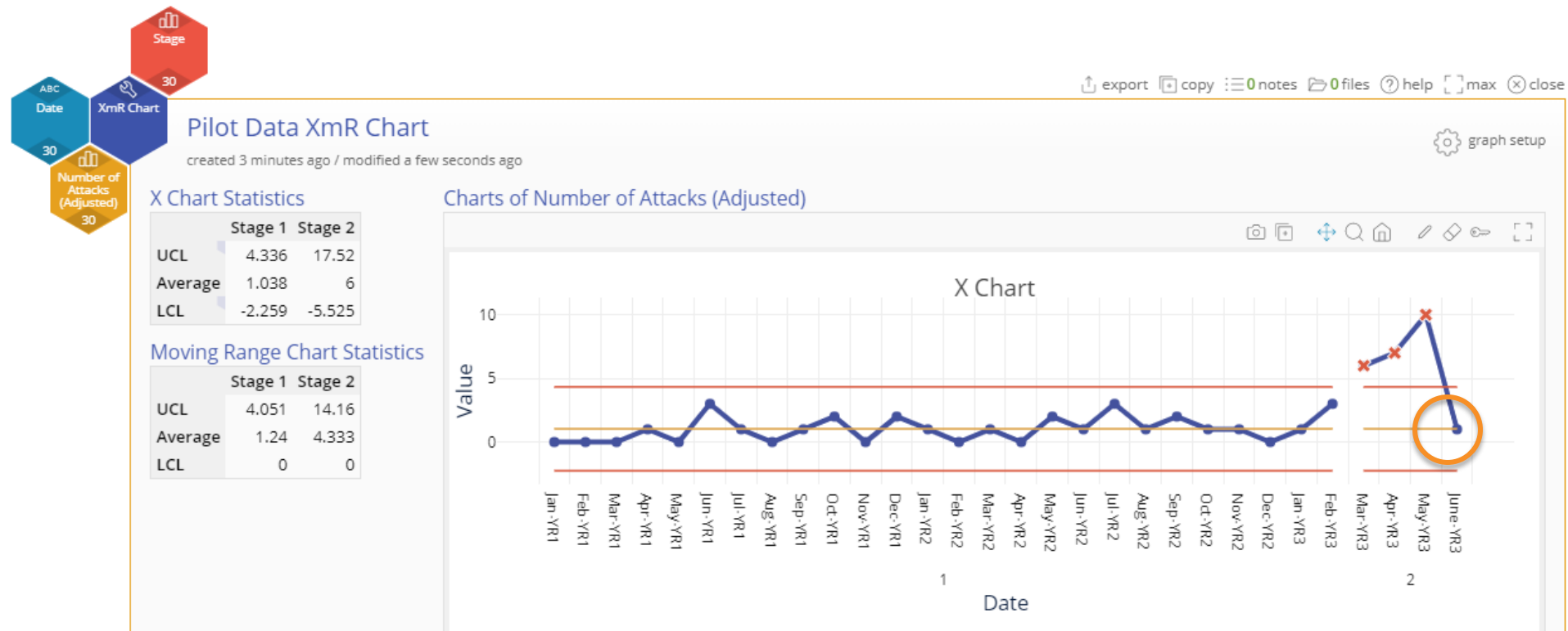
Measure ✓

Analyze ✓

Improve

Control

Back in control after change...



Define ✓

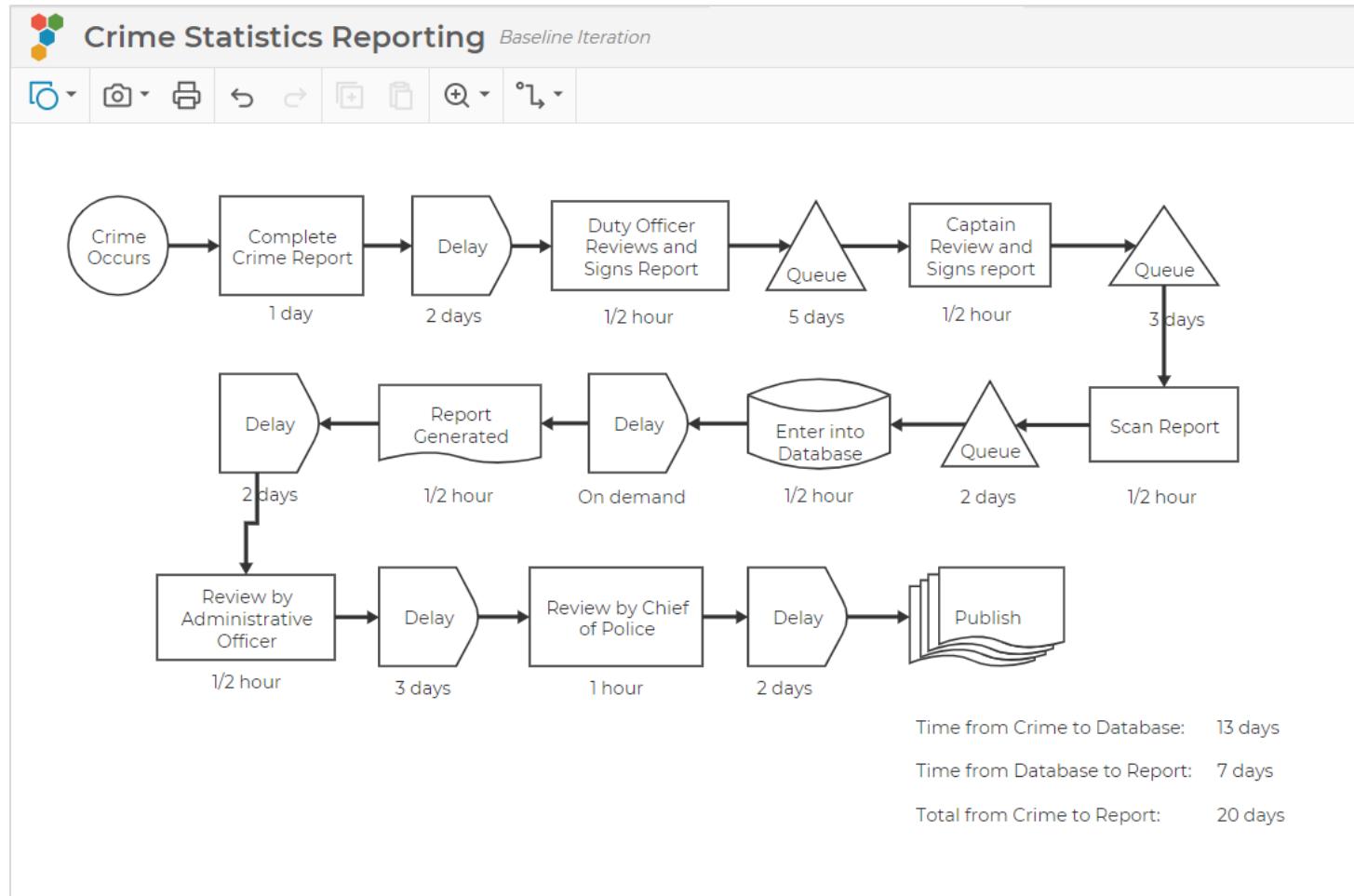
Measure ✓

Analyze ✓

Improve

Control

Improve crime statistics reporting – lots of delays



Note: rework loops not shown for simplicity

Define ✓

Measure ✓

Analyze ✓

Improve

Control



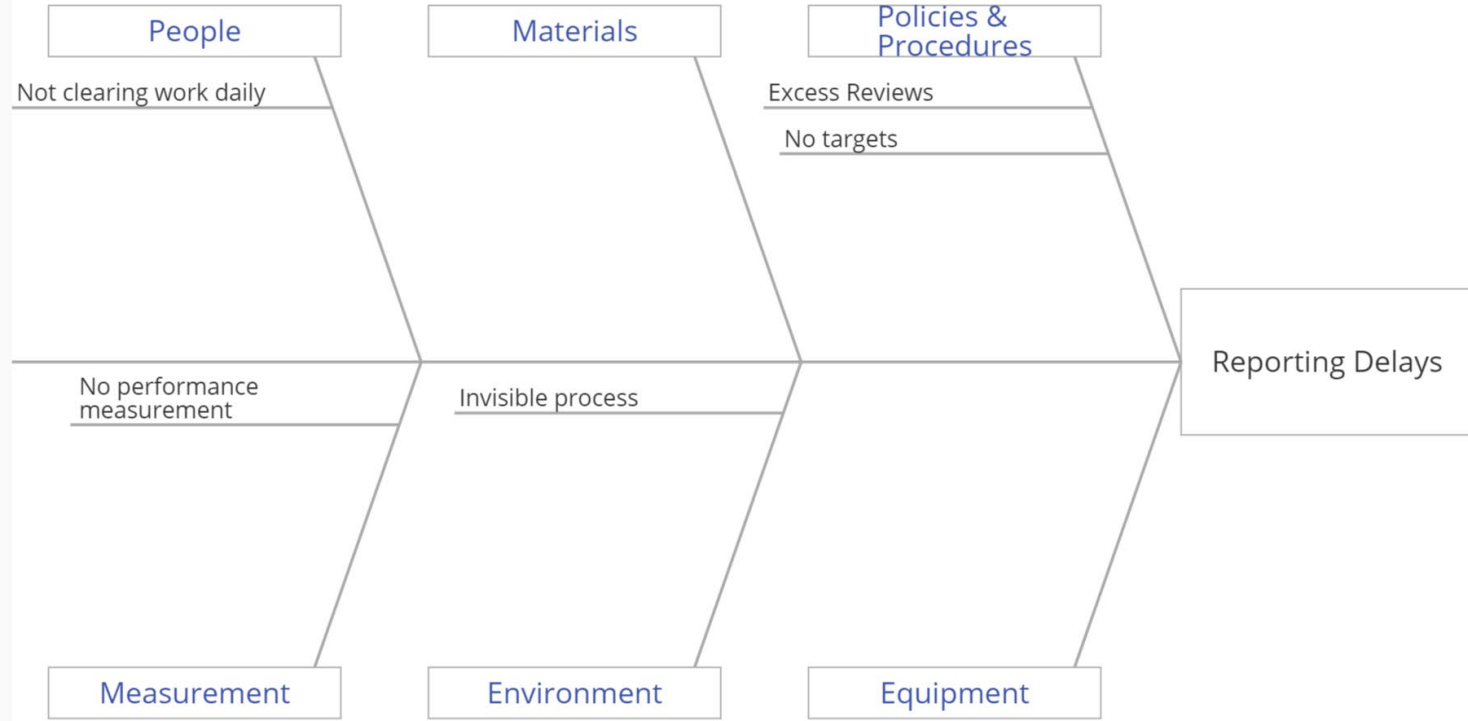
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## Potential Reporting Delay Causes

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📷 snapshot

< Edit View



Define ✓

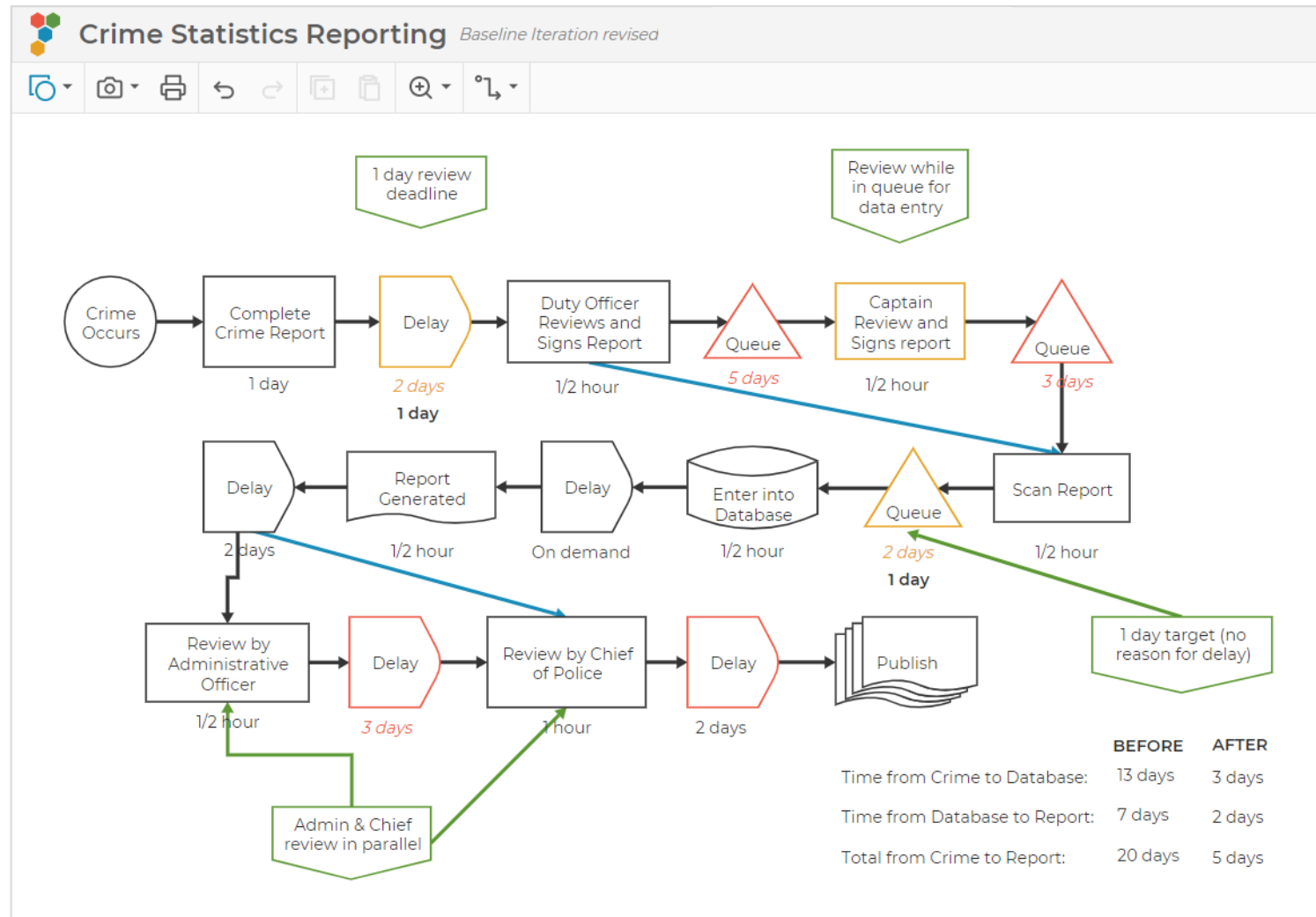
Measure ✓

Analyze ✓

Improve

Control

Cycle time reduced from 20 days to 5 days



Define ✓

Measure ✓

Analyze ✓

Improve

Control

## FMEA & Error-proofing



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### New FMEA

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| Process Step       | Failure Mode            | A) SEVERITY | B) OCCURRENCE | C) DETECTION<br>Probability | Risk Priority<br>Number |
|--------------------|-------------------------|-------------|---------------|-----------------------------|-------------------------|
| Duty Office Review | Mis-categorize Crime    | 2           | 6             | 8                           | 96                      |
| Captain Review     | Lose or Misplace Report | 4           | 2             | 9                           | 72                      |
| Scan               | Missing Data on Scan    | 5           | 1             | 4                           | 20                      |
| Data Entry         | Data Entry Error        | 5           | 2             | 7                           | 70                      |

Define ✓

Measure ✓

Analyze ✓

Improve ✓

Control

Before we start this phase, let's review the generic critical questions for the Control Phase of our DMAIC project...

## Control Phase Critical Questions:

- Did the project achieve the original improvement goal?
- Are controls in place to make sure the changes will stick?
- Did we thank all the team members for their efforts?

Define ✓

Measure ✓

Analyze ✓

Improve ✓

Control

Control plan created

| Process Name or Operation | Process Characteristics         | Method: Measurement       | Method: Sample Size       | Method: Frequency | Method: Control Method  | Reaction Plan     |
|---------------------------|---------------------------------|---------------------------|---------------------------|-------------------|-------------------------|-------------------|
| Zombie Attacks            | Number of Attacks               | Crime Reports             | Count of All Observations | Weekly            | XmR Control Chart       | Reaction Plan 1-A |
| Crime Reports             | Cycle Time from Crime to Report | Comparison of Time Stamps | Monthly                   | Monthly           | X-bar & S Control Chart | Reaction Plan 1-B |
|                           |                                 |                           |                           |                   |                         |                   |

Define ✓

Measure ✓

Analyze ✓

Improve ✓

Control

Visual control...police station



Define ✓

Measure ✓

Analyze ✓

Improve ✓

Control

Standard work created for revised process...



export

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close

### Duty Officer Standard Work

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| Sub Step No. | Work Description                                                                                      | Material Required     | Equipment Required | Process Step Cycle Time:                                                                      |                |                                |
|--------------|-------------------------------------------------------------------------------------------------------|-----------------------|--------------------|-----------------------------------------------------------------------------------------------|----------------|--------------------------------|
|              |                                                                                                       |                       |                    | Key Points (safety, quality, ease of work)                                                    | Time (seconds) | SIP (std inventory in process) |
| 1            | Review crime reports generated during the previous 24 hours, and any crimes reported during shift     | Crime Report          | None               | Check for completeness, including victim name and contact info, complete description of crime | 5 min          | <5                             |
| 2            | Validate details of alleged crime                                                                     | Crime Report          | None               | Look for inconsistencies                                                                      | 10 min         | 1                              |
| 3            | If immediate law enforcement response, speak with officers involved                                   | Crime Report          | Phone              | Corroborate victim, witness, and officer statements                                           | 30 min         | 1                              |
| 4            | If no law enforcement response pending, verify open case status and assign officers for investigation | Crime Report          | Computer Terminal  | Balance case load of investigating officers                                                   | 10 min         | 1                              |
| 5            | Forward crime report to captain for sign-off                                                          | Reviewed crime report | None               | Leave crime report in Captains "Active Cases" inbox.                                          | 5 min          | 1                              |
|              |                                                                                                       |                       |                    |                                                                                               |                |                                |
|              |                                                                                                       |                       |                    |                                                                                               |                |                                |

Define ✓

Measure ✓

Analyze ✓

Improve ✓

Control

Data after improvements indicate DPMO of 1.4!

|                             |                                |        |
|-----------------------------|--------------------------------|--------|
| Total Population of Dragos  |                                | 25,478 |
| Population in City Center   |                                | 3,134  |
|                             |                                | +      |
| Tourists & Visitors - Daily |                                | 150    |
| Total                       |                                | 3,284  |
|                             |                                | x      |
| Ave. Trips Outside/Day      |                                | 3.5    |
| Opportunities Per Day       |                                | 11,494 |
|                             |                                | x      |
| Number of Days              |                                | 61     |
| Total Opportunities         |                                | 701134 |
| Attacks                     | June                           | 1      |
|                             | July                           | 0      |
|                             |                                | 1      |
| DPMO                        | $1 / 701,134 \times 1,000,000$ | 1.4    |



## Sigma Level - After Improvements

created 8 months ago / modified a few seconds ago



Instructions

| Discrete Data                           | Product A |
|-----------------------------------------|-----------|
| Enter number of defects:                | 1         |
| Enter number of units:                  | 701134    |
| Enter number of opportunities per unit: | 1         |
| Or Enter DPMO directly:                 |           |
| Calculated DPMO:                        | 1         |
| Short term sigma level (Z + 1.5)        | 6.2       |
| Long term sigma level (Z)               | 4.7       |

Note: Calculator rounds DPMO

Define ✓

Measure ✓

Analyze ✓

Improve ✓

Control

Share best practices...

- ✓ Verify your measurements – beware of “hoax” data
- ✓ Stratify the data to see a clearer picture
- ✓ Control charts tell the story in a simple way
- ✓ Pilot fixes before implementing
- ✓ Faster reporting means faster reaction

Define ✓

Measure ✓

Analyze ✓

Improve ✓

Control ✓

Congratulate team

