

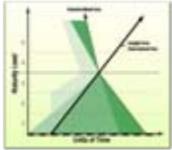
12th ICCRTS  
“Adapting C2 to the 21st Century”  
Paper # I-173

***Evaluating and Enhancing C2 Systems with the  
Decision-Making Assessment Process (D-MAP)***

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# Agenda

- ▶ **Assessing C2 Systems**
- ▶ **The Decision-Making Maturity Model (DM3)**
- ▶ **The Decision-Making Assessment Process (D-MAP)**
- ▶ **Sample Scenario**
- ▶ **Conclusion**

# Challenges with Assessing C2 Systems

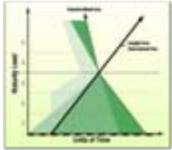
- ▶ SOA-based C2 systems are often non-deterministic
- ▶ Assessment processes are scenario-specific, difficult to customize and non-scalable
- ▶ Information systems are assessed independent of staff processes
- ▶ Operational drills are assessed independently of both staff and C2 Systems
- ▶ Universal process and metric for C2 evaluation have not been identified
- ▶ Current assessment processes are of finite duration that prevents long term studies

# An effective assessment system will result in operational improvements to a system and support those changes with empirical evidence

The Goals of a good assessment process should:

- ▶ Be mission, scenario, language, and system agnostic
- ▶ Non-intrusively reduce the assessment paradox (*i.e. when people know they are being assessed their activities change*)
- ▶ Provide documentation and traceability data for trend analysis for use in AARs and doctrine development
- ▶ Ultimately ensure commanders can make **better combat decisions faster**
- ▶ Provide an universal objective capability goal to continually drive future improvements

Just as Six Sigma provides a process to improve business operations and effectiveness the C2 community needs a process which also drives continuous improvement against empirical evidence.



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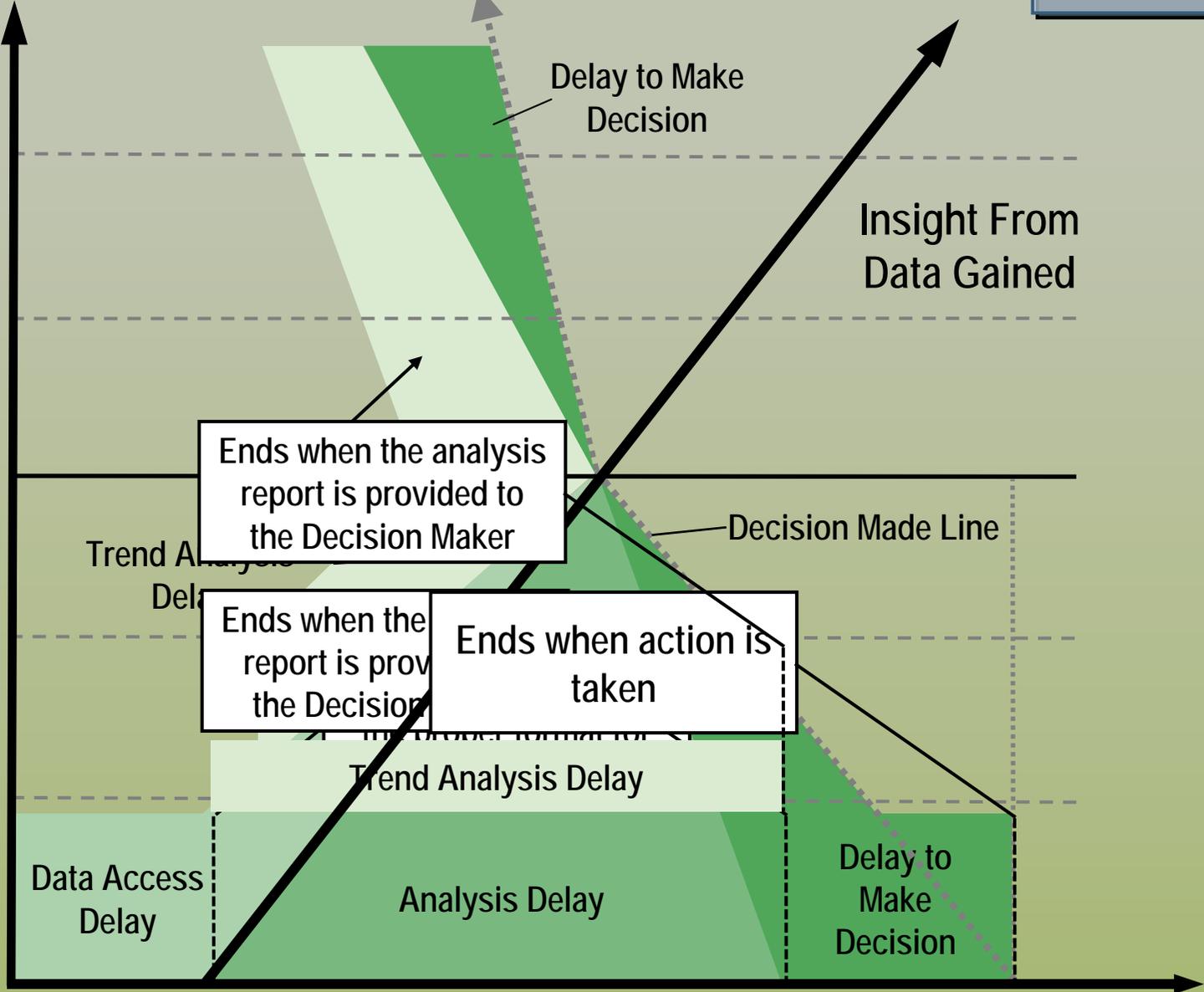
- ▶ Challenges with Assessing C2 Systems
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- ▶ Conclusion

## **The Decision-Making Maturity Model (DM3) provides a model that helps to analyze the decision-making process**

- ▶ It assesses the effectiveness of each C2 task with respect to time
- ▶ It provides an exceptionally detailed scorecard for each of the sub-tasks in the decision-making process
- ▶ It is based on the concept of discreet zones or time segments
- ▶ It assesses the overall maturity of the decision-making process
- ▶ The assessment levels provide clear paths to improve the decision-making processes towards an ability to achieve predictive decision-making

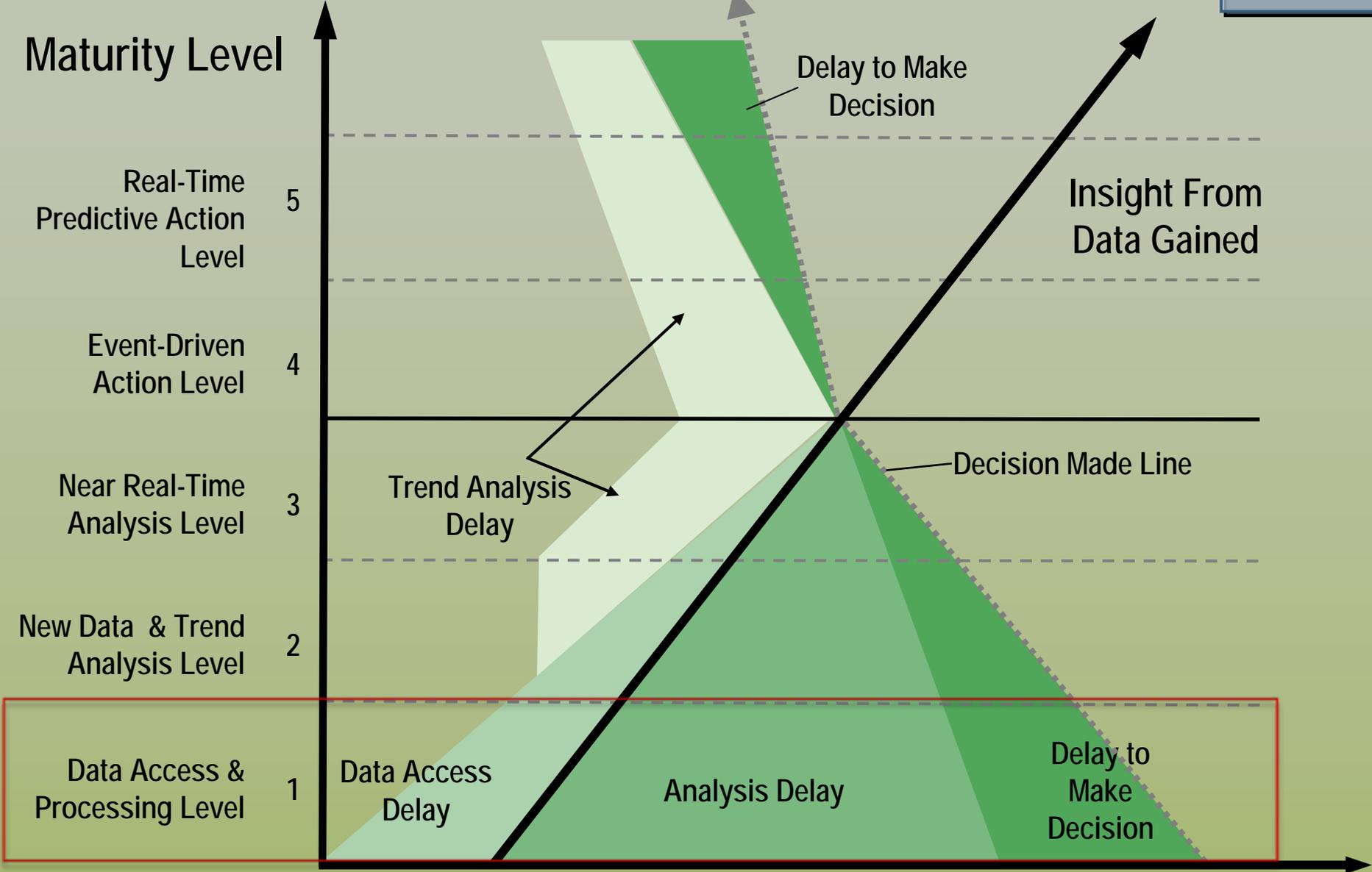
# Maturity Level

- 5 Real-Time Predictive Action Level
- 4 Event-Driven Action Level
- 3 Near Real-Time Analysis Level
- 2 New Data & Trend Analysis Level
- 1 Data Access & Processing Level



# Units of Time

# Maturity Level



Insight From Data Gained

Delay to Make Decision

Decision Made Line

Trend Analysis Delay

Data Access Delay

Analysis Delay

Delay to Make Decision

Units of Time



# Maturity Level 1

## Data Access and Processing



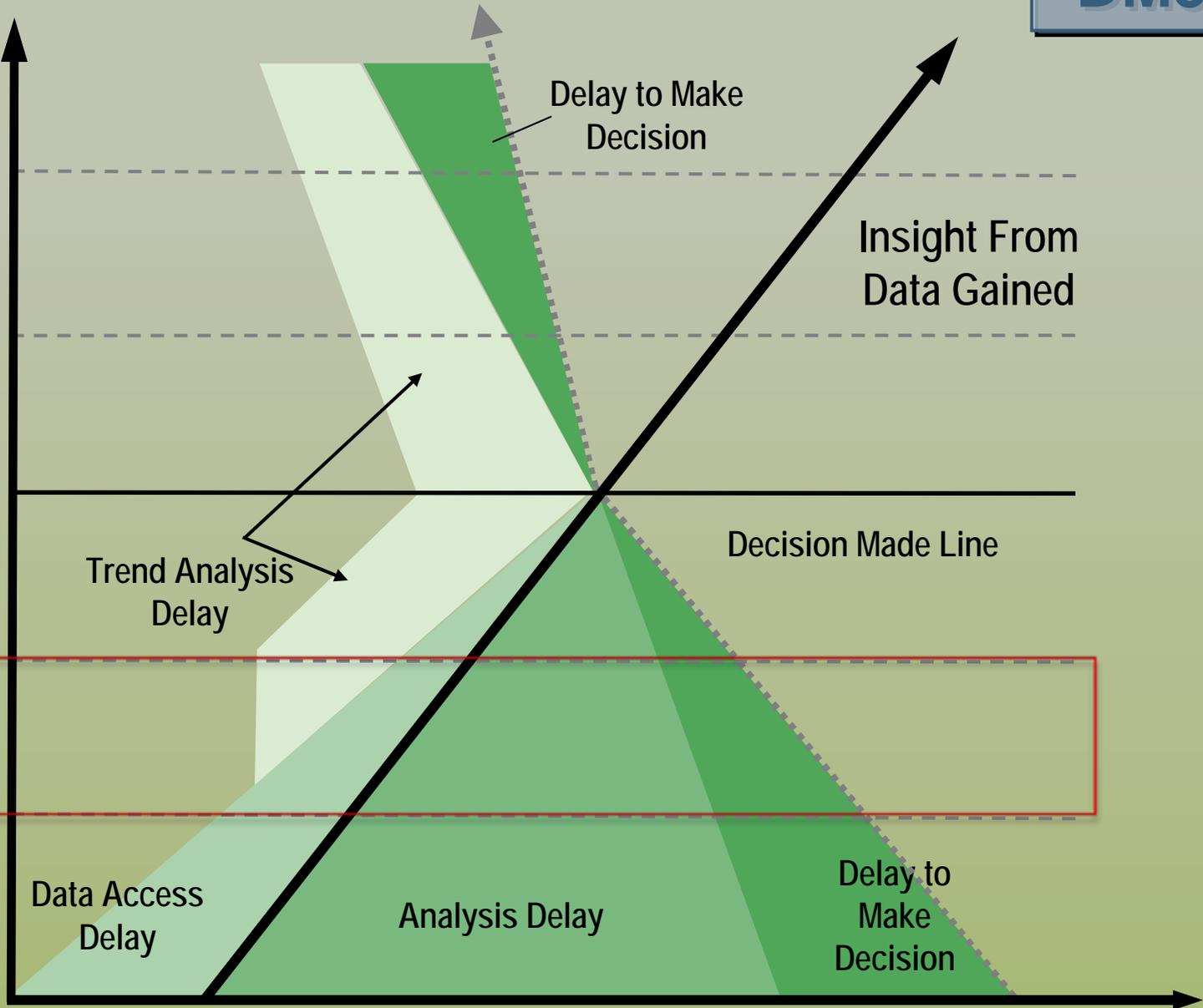
**Data Access Delay = Analysis Delay**

or

**Data Access Delay + Analysis Delay > 50% of total time**

# Maturity Level

- 5 Real-Time Predictive Action Level
- 4 Event-Driven Action Level
- 3 Near Real-Time Analysis Level
- 2 New Data & Trend Analysis Level
- 1 Data Access & Processing Level



Delay to Make Decision

Insight From Data Gained

Trend Analysis Delay

Decision Made Line

New Data & Trend Analysis Level

Data Access Delay

Analysis Delay

Delay to Make Decision

# Units of Time

## Maturity Level 2 New Data and Trend Analysis

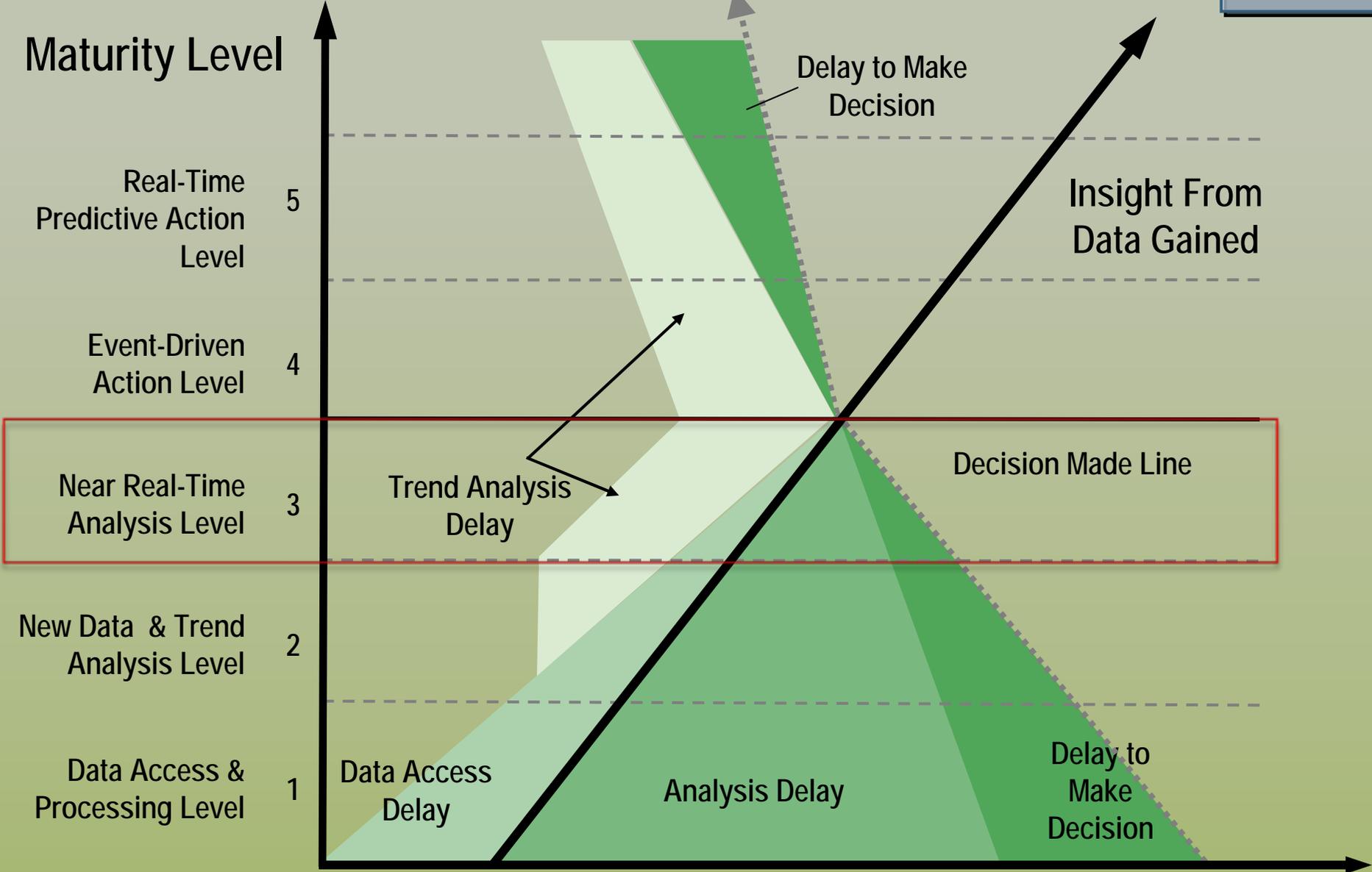


**Trend Analysis is present**

**and**

**Data Access + Analysis > 50% of total time**

# Maturity Level



Real-Time Predictive Action Level  
5

Event-Driven Action Level  
4

Near Real-Time Analysis Level  
3

New Data & Trend Analysis Level  
2

Data Access & Processing Level  
1

Delay to Make Decision

Insight From Data Gained

Trend Analysis Delay

Decision Made Line

Data Access Delay

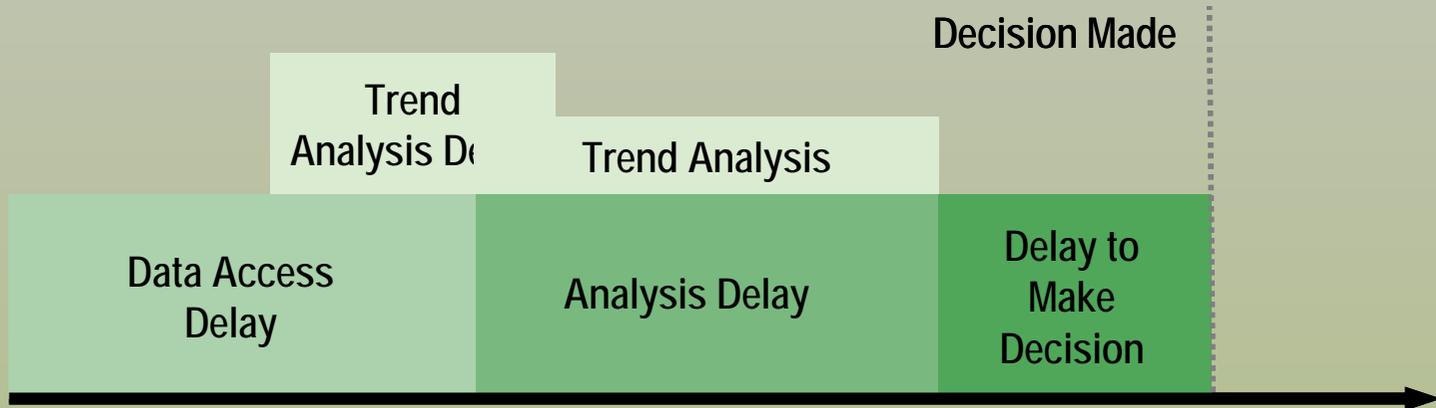
Analysis Delay

Delay to Make Decision

Units of Time

# Maturity Level 3

## Near real-time Automation



**Trend Analysis is present**

**and**

**Data Access + Analysis < 50% of total time**

Maturity Level

Real-Time Predictive Action Level

5

Event-Driven Action Level

4

Near Real-Time Analysis Level

3

New Data & Trend Analysis Level

2

Data Access & Processing Level

1

Delay to Make Decision

Insight From Data Gained

Decision Made Line

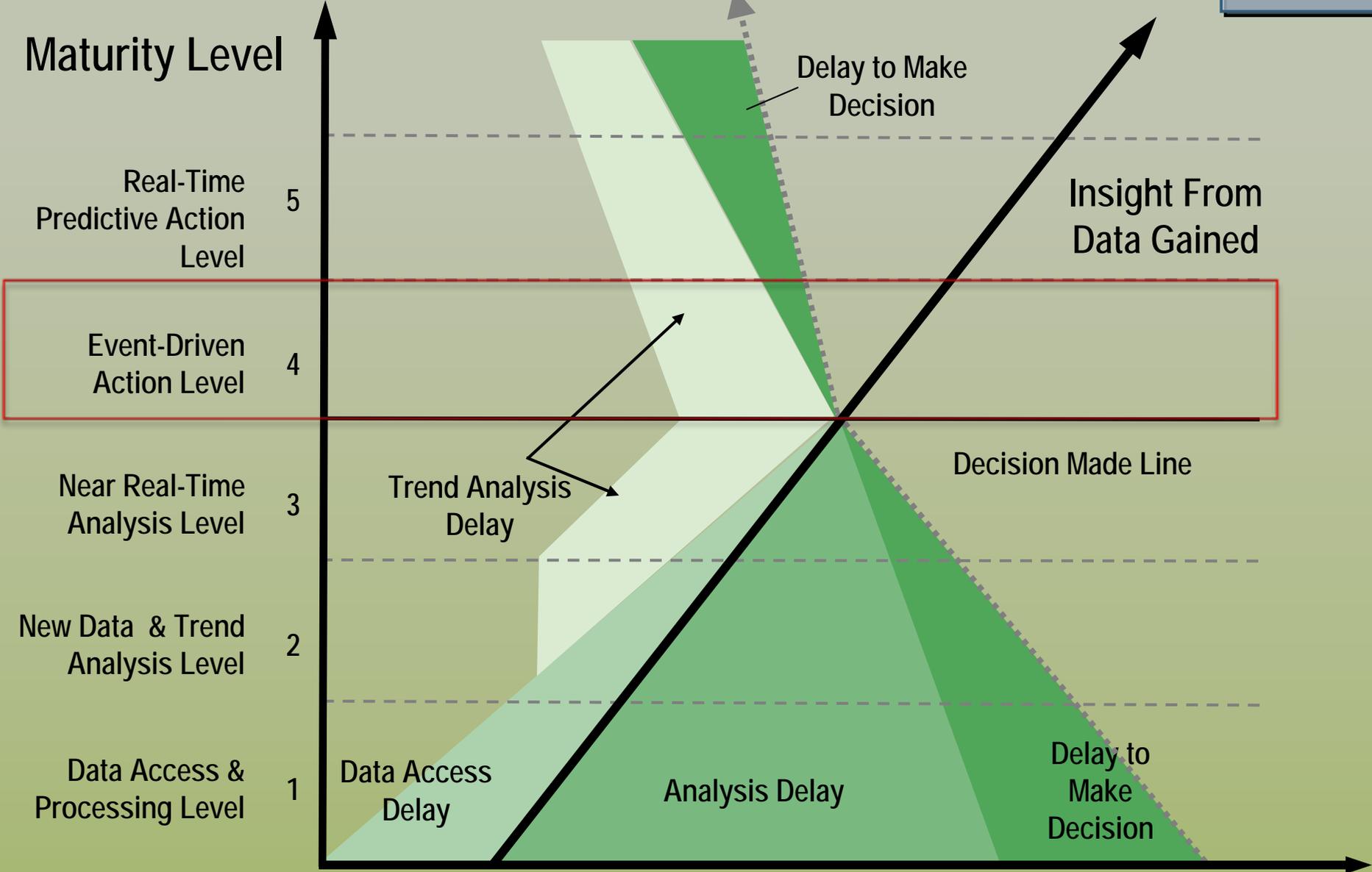
Trend Analysis Delay

Data Access Delay

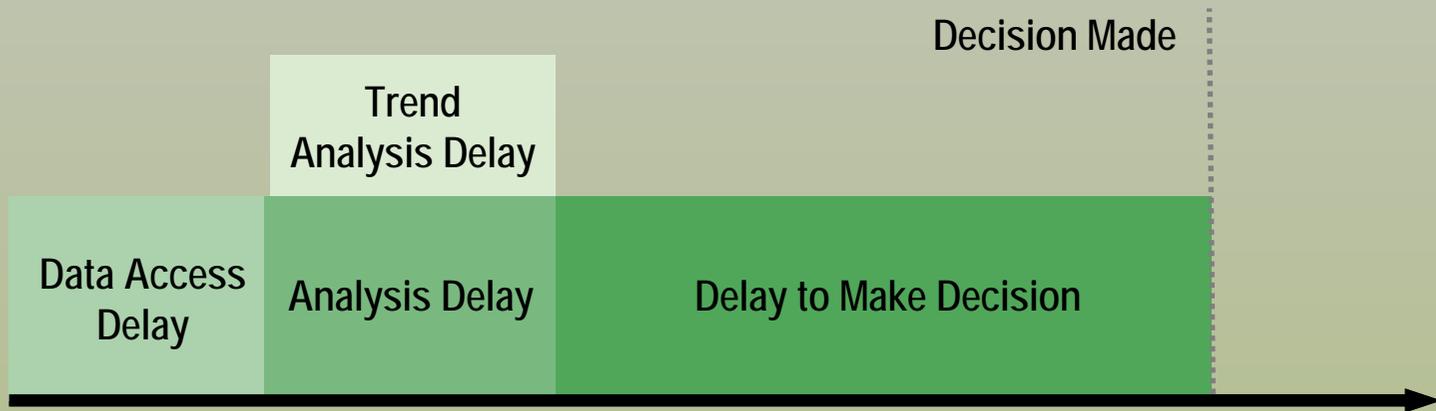
Analysis Delay

Delay to Make Decision

Units of Time

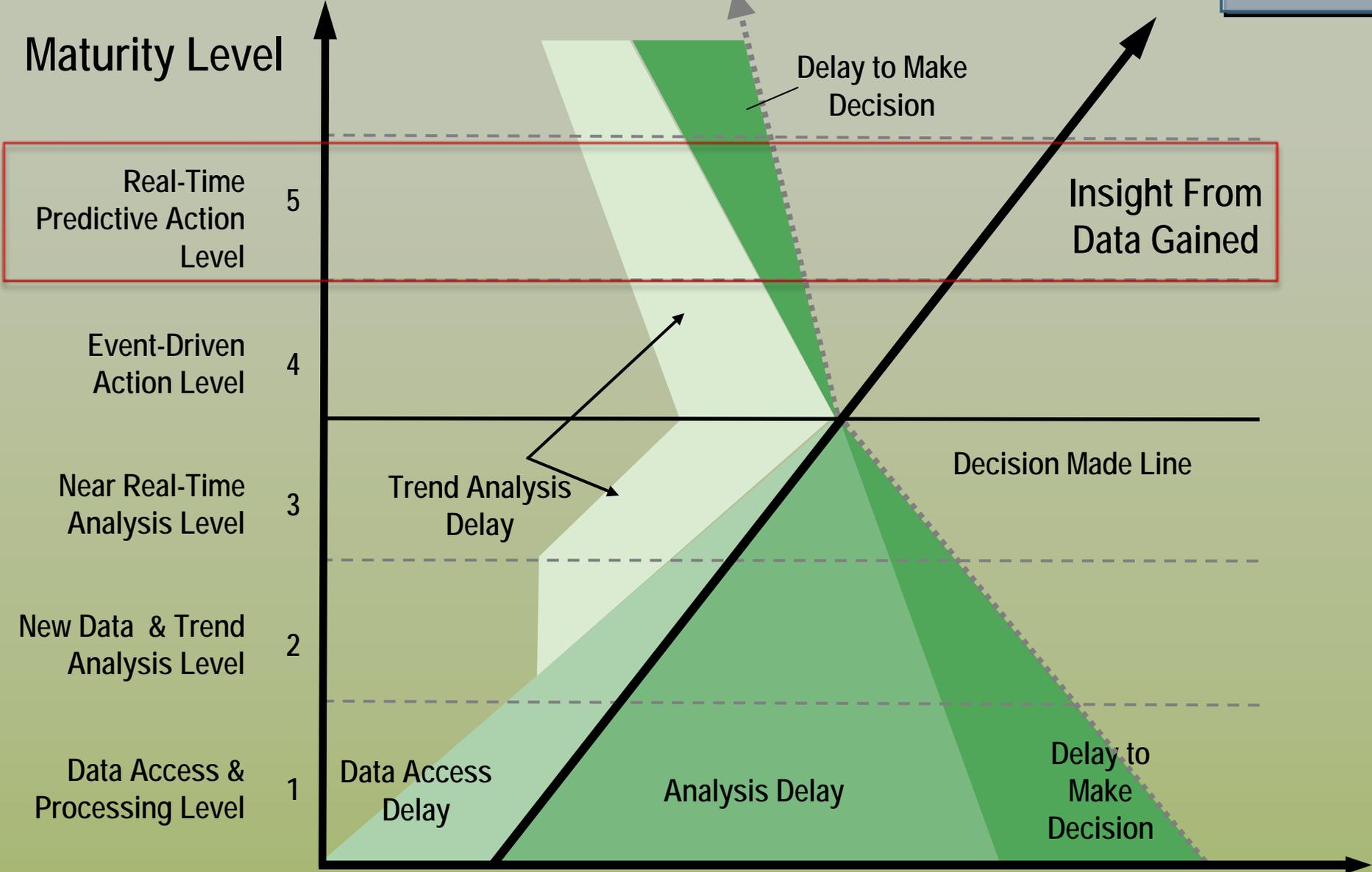


# Maturity Level 4 Event-Driven Action



**Recommended action is given before data is received**

# Maturity Level



Real-Time Predictive Action Level

5

Insight From Data Gained

Event-Driven Action Level

4

Near Real-Time Analysis Level

3

Decision Made Line

New Data & Trend Analysis Level

2

Data Access & Processing Level

1

Data Access Delay

Analysis Delay

Delay to Make Decision

Trend Analysis Delay

Delay to Make Decision

Units of Time

# Maturity Level 5

## Real-time Predictive Action

Decision Made



**Action is performed well in advance of the event**

# Maturity Level

Real-Time  
Predictive Action  
Level

5

Event-Driven  
Action Level

4

Near Real-Time  
Analysis Level

3

New Data & Trend  
Analysis Level

2

Data Access &  
Processing Level

1

Delay to Make  
Decision

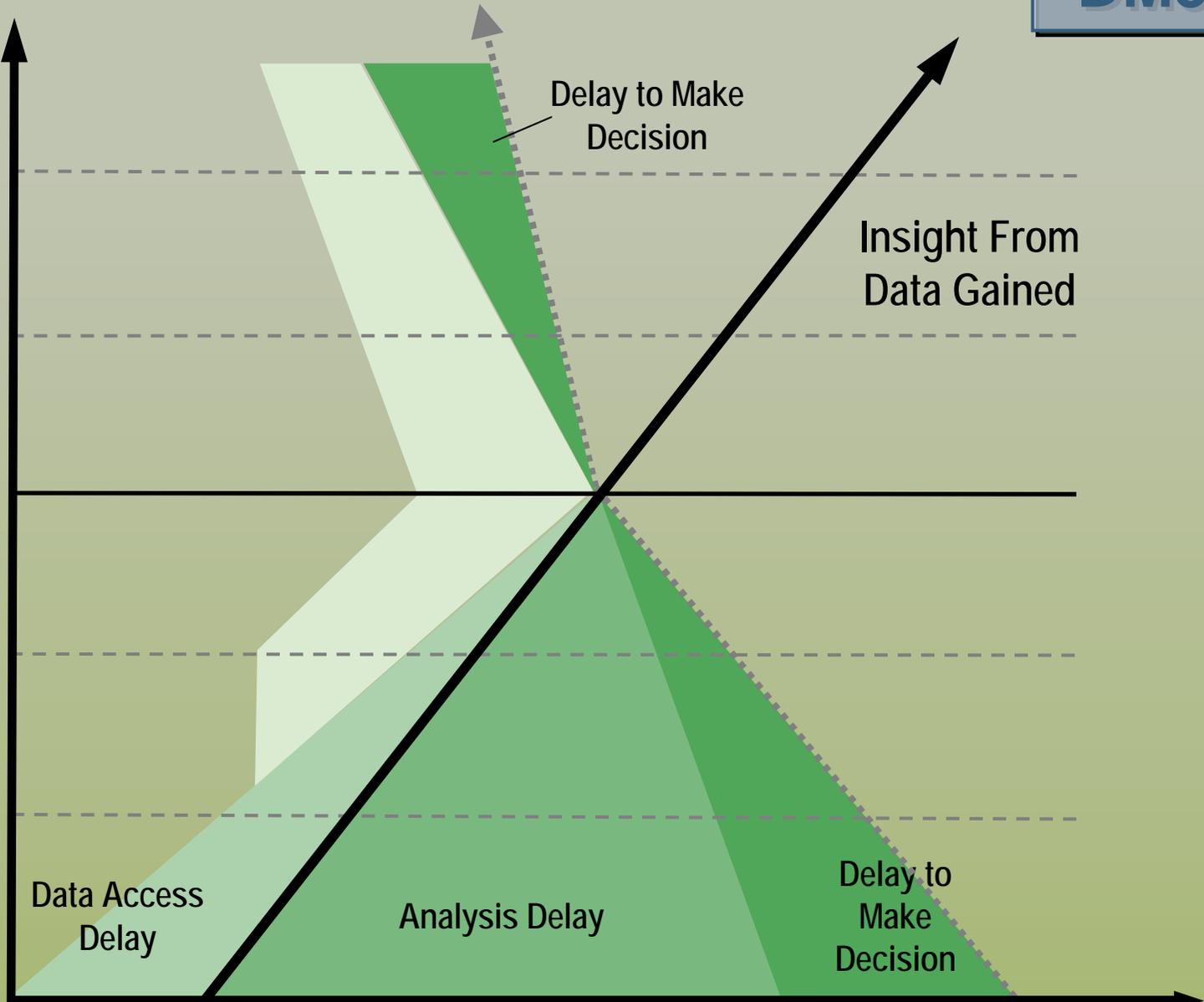
Insight From  
Data Gained

Data Access  
Delay

Analysis Delay

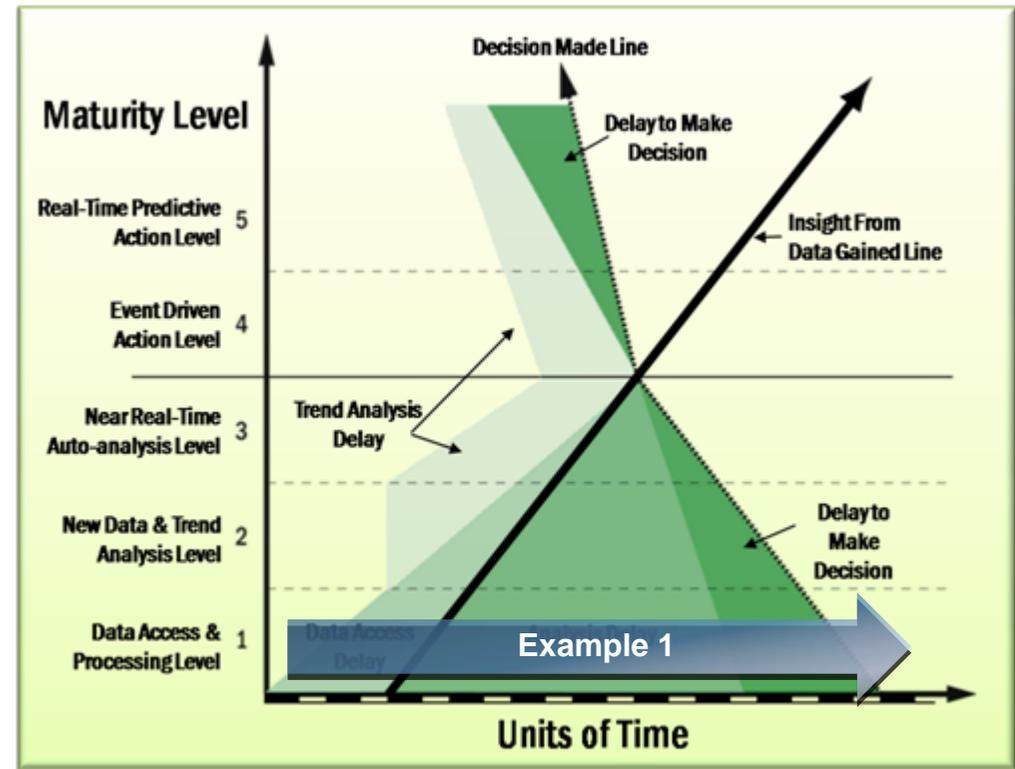
Delay to  
Make  
Decision

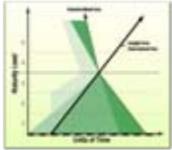
# Units of Time



# The DM3 is used to keep track of the steps used during the decision-making process and provides a universal scale for describing the maturity of the decision-making process used

- ▶ An assessment measures the time it takes to complete each step on the DM3.
- ▶ Based on the time taken for each step the maturity level of the decision process can be determined.
- ▶ For example #1 when:
  - Data Access Delay is 20% of the time
  - Analysis Delay is 55% of the time
  - Delay to Make Decision is 25% of the time
- ▶ Then that decision task is operating at a Maturity Level 1





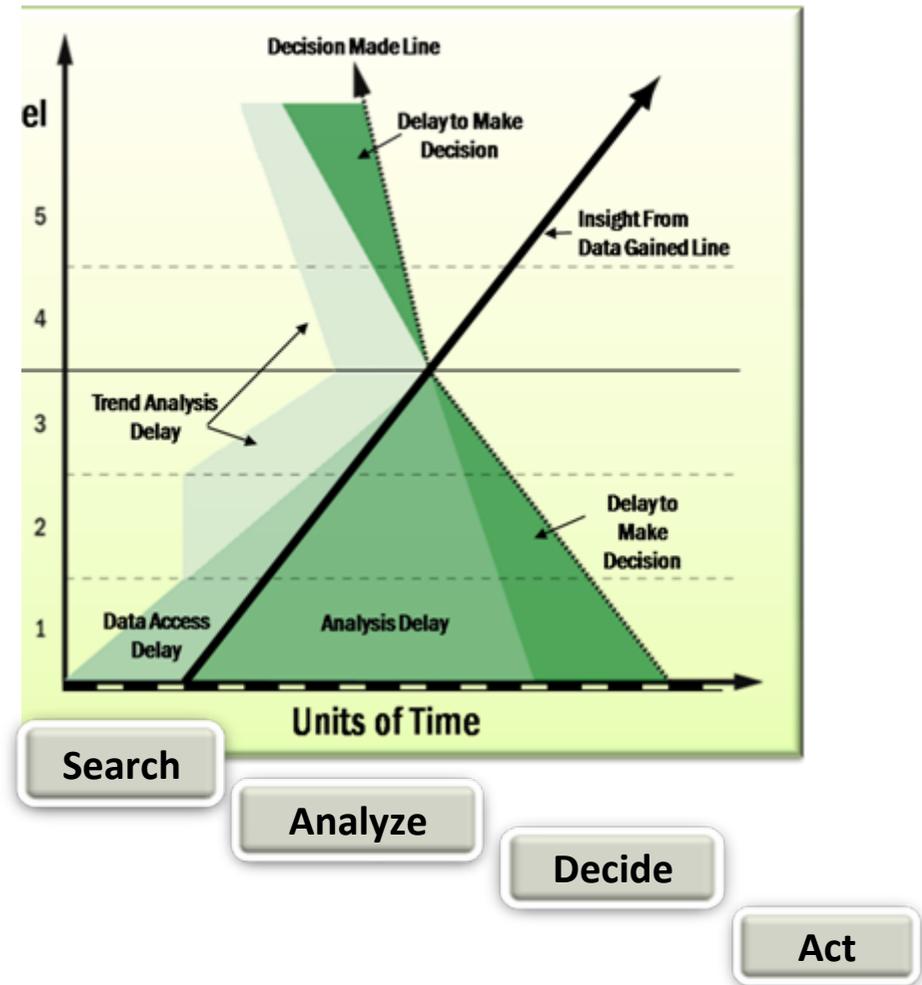
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- ▶ Challenges with Assessing C2 Systems
- ▶ The Decision-Making Maturity Model (DM3)
- ▶ The Decision-Making Assessment Process (D-MAP)
- ▶ Sample Scenario
- ▶ Conclusion

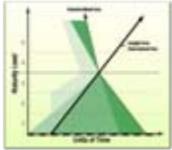
The steps defined in the DM3 can be grouped into four stages: Search, Analyze, Decide and Act (SADA)

- ▶ Military decision making is traditionally defined in four stages: Observe, Orient, Decide, Act (OODA)
- ▶ Transformation from a human-centric problem solving approach, described by OODA, to an information technology decision process solution requires new stages
- ▶ These new stages for IT based C2 systems are: Search, Analyze, Decide, Act (SADA)



**Decision-Making Assessment Process (D-MAP)** is a 9-step methodology for assessing the effectiveness of Command and Control that uses the DM3 to evaluate the operational effectiveness of each decision-making step

1. Identify the highest-level **decision** to be made and the **leader** making the decision.
2. Identify all **information** needed or used to make the decision.
3. Identify information **systems** used
4. Identify the staff **personnel** needed to process the information
5. Identify the **SADA stages** used by the staff and the systems
6. Measure the **time** needed **to access** and collect the data.
7. Measure the **time** needed **to understand** and analyze the information.
8. Measure the **time** needed to make a **decision**.
9. Record the **time** when **action** is taken.



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## **The scenario requires an Army, division-level commander to decide whether to engage a target and how**

- ▶ The target is unanticipated and is identified after the division's Rapid Reaction Force (RRF) is already committed to another engagement.
- ▶ Integration of numerous Legal, Weapon and Logistical systems is needed
- ▶ Information is collected both by automated systems and with human input
- ▶ The commander authorizes the strike when all the needed information is gathered and analyzed

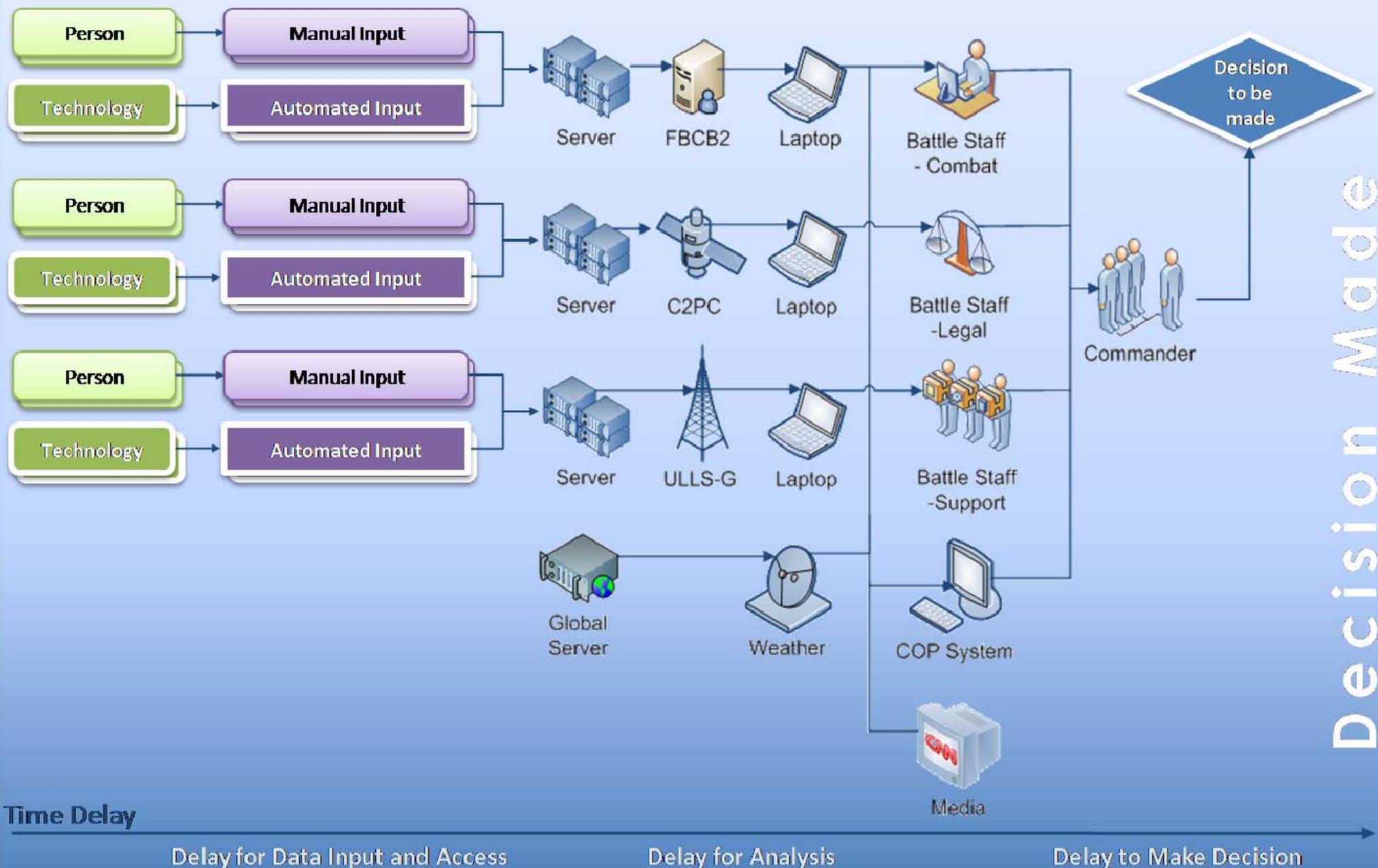
# Processing Steps

## Data Collections

## System Processing

## Staff Processing

## Integration and Presentation



# Steps 1-5 of the D-MAP identify the systems used for decision making in order to prepare for the assessment

## STEP #1

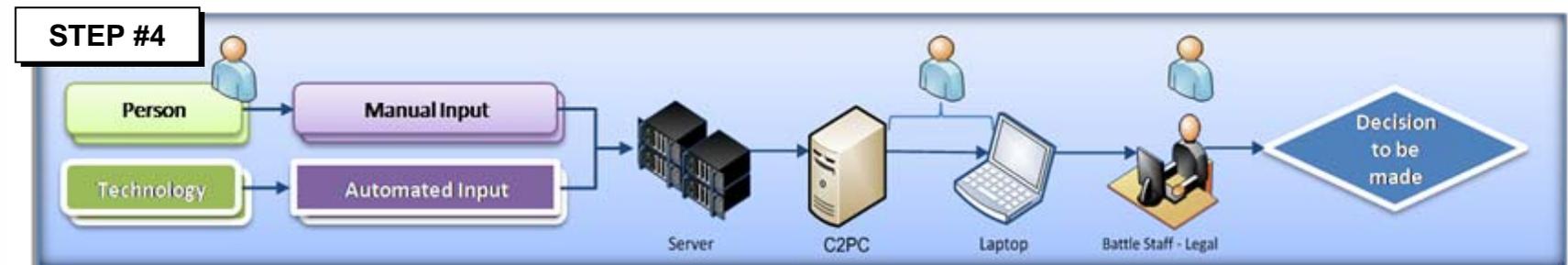
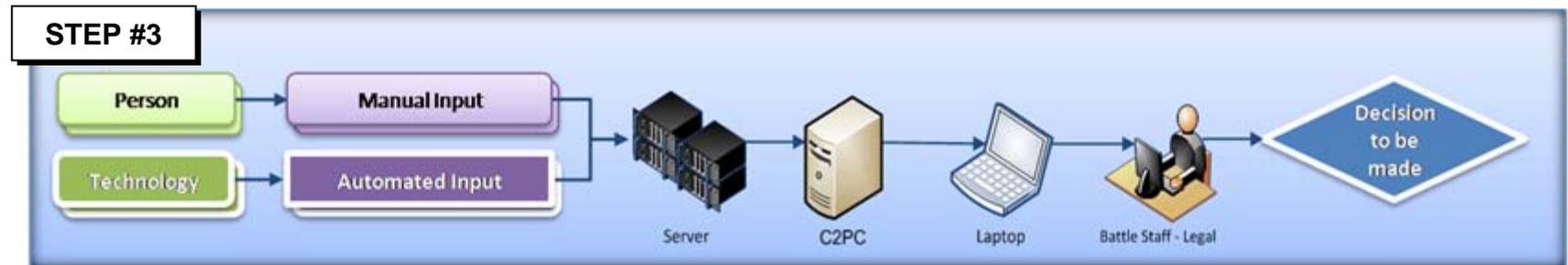
1. The scenario identifies the Division Commander as the decision maker
2. Identify the information needed to make the decision

## STEP #2

Information Needed
Humint Report
Weapon Information
Weapons locations
Weapon effects
Weapon status
No Hit Zones
Friendly Forces
Civilian Activity

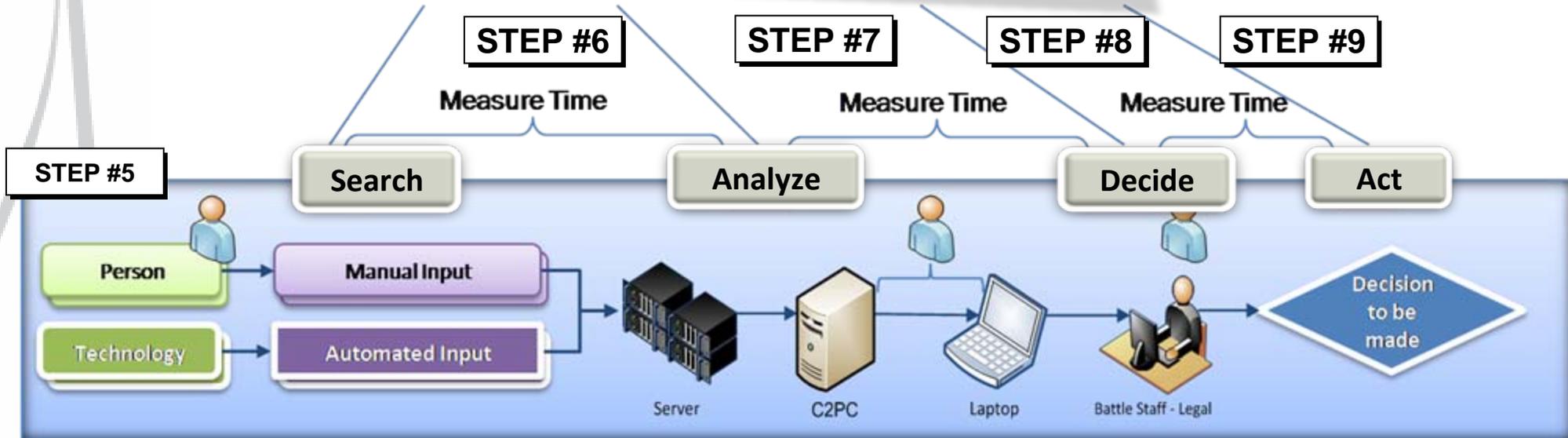
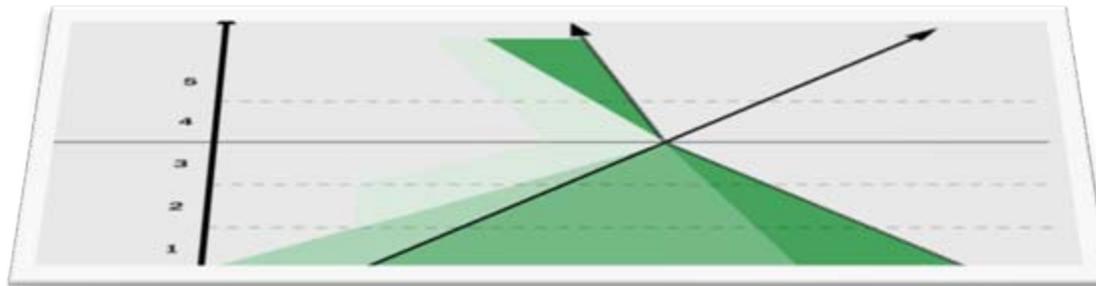
## Steps 3 and 4 of the D-MAP further decompose the decision-making process

3. Identify the information sources used to collect the needed information for each sub-system
4. Identify the staff personnel needed to process the information



Sample Mapping

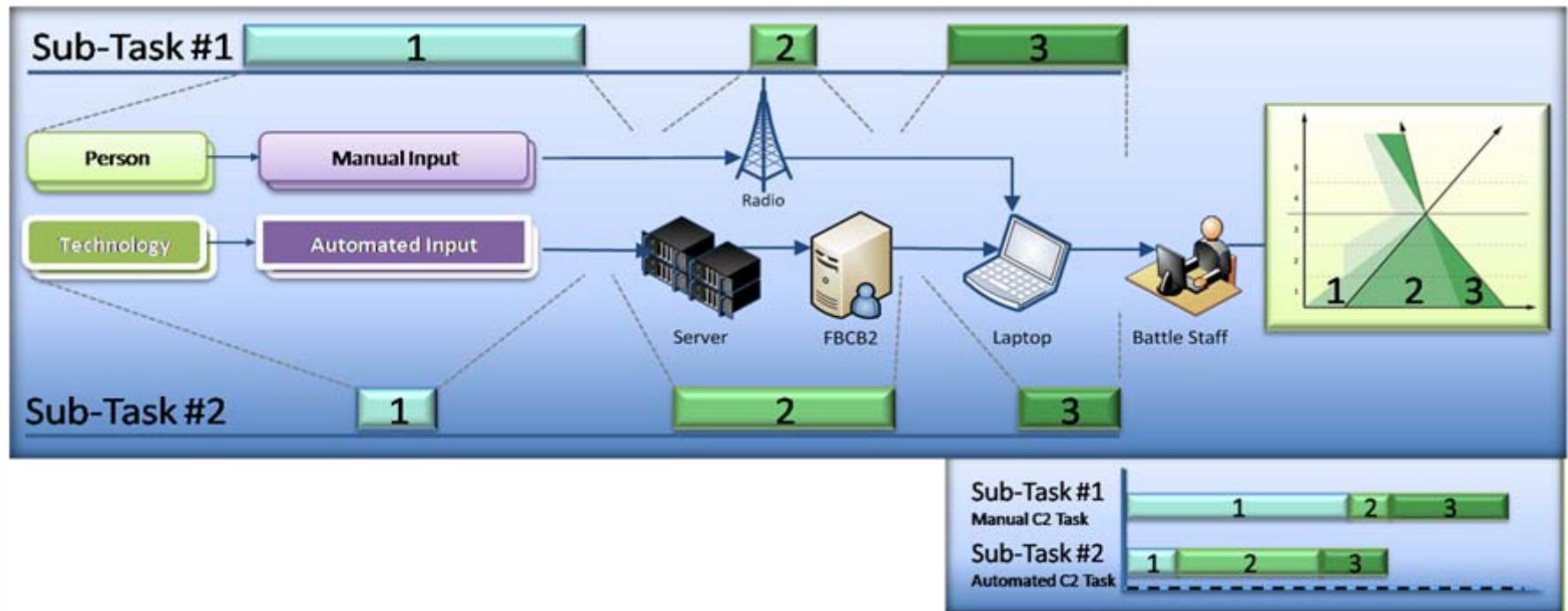
**Steps 5 – 9 of the D-MAP identifies the timing points and measures the time needed to complete each phase of the decision-making sub-task**



Sample SADA Timing Steps

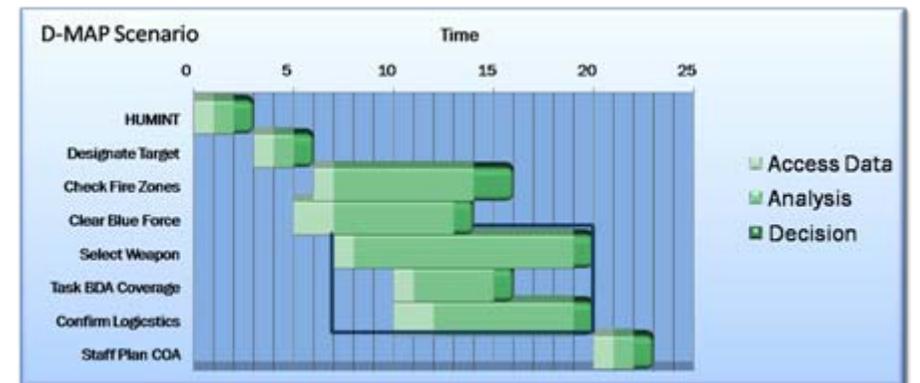
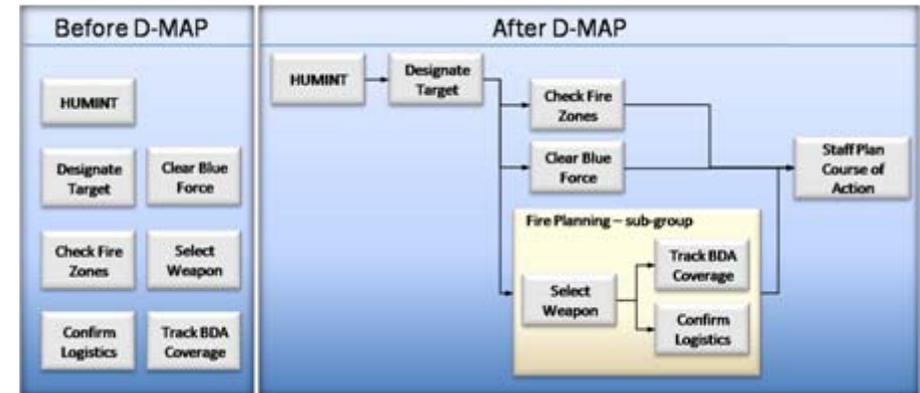
# The timing results of the D-MAP allow for improvement of C2 systems by providing traceable and empirical evidence from the assessment

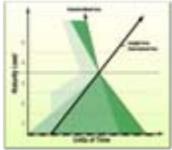
- ▶ Two examples of the types of assessment results are shown here
- ▶ These are illustrative results based on automated vs. human-entered information



## Additional refinements on the decision-making process can be conducted after empirical data is available

- ▶ The exact order and time needed for each step can be isolated and examined
- ▶ The empirical data allows for insight into battle drills and for improved planning of future systems.
- ▶ It allows for measurement and comparison of capabilities between different C2 systems
- ▶ Principles apply regardless of the mission or scenario that involve C2 systems.





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▶ **Conclusion**

## To Review: The Application of the D-MAP leads to numerous benefits .....

The D-MAP:

- ▶ Ensures commanders can make **better** combat decisions **faster**
- ▶ Improves the staff's decision-making processes
- ▶ Eliminates unnecessary operational steps
- ▶ Ensures system design changes are based on empirical data, not on subjective decisions
- ▶ Provides the ability to collect decision-making data for trend analysis for use in AARs and doctrine development

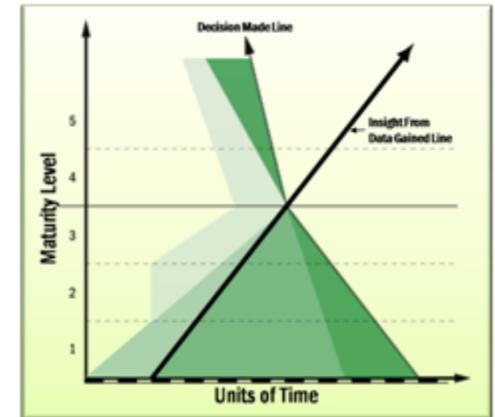
## **Additionally, the D-MAP and DM3 provide the ability to empirically document the assessment findings regardless of the language, system or scenario used**

Application of the D-MAP leads to numerous artifacts needed for acquisition requirement documents and funding discussions, such as:

- ▶ Document the decision-making steps and systems used to when making an operational decision
- ▶ Time delay charts for quickness measures
- ▶ Detailed data format information
- ▶ Quantitative data on numbers of systems used, staff time-online and other human and automation integration metrics
- ▶ Reliability/confidence ratings.
- ▶ Measures the maturing of the decision making as a whole

## Key takeaways...

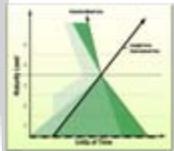
- ▶ C2 systems are fundamentally changing
- ▶ New ways of assessing are needed
- ▶ DM3 provides a model
- ▶ D-MAP outlines the steps
- ▶ Artifacts from the process will be invaluable



Just as businesses and manufacturing organizations use Six Sigma as a way to increase efficiency, the C2 community needs a process for consistently assessing and improving the operational effectiveness of their systems.

*The D-MAP and DM3 provide exactly this capability.*

# Questions?



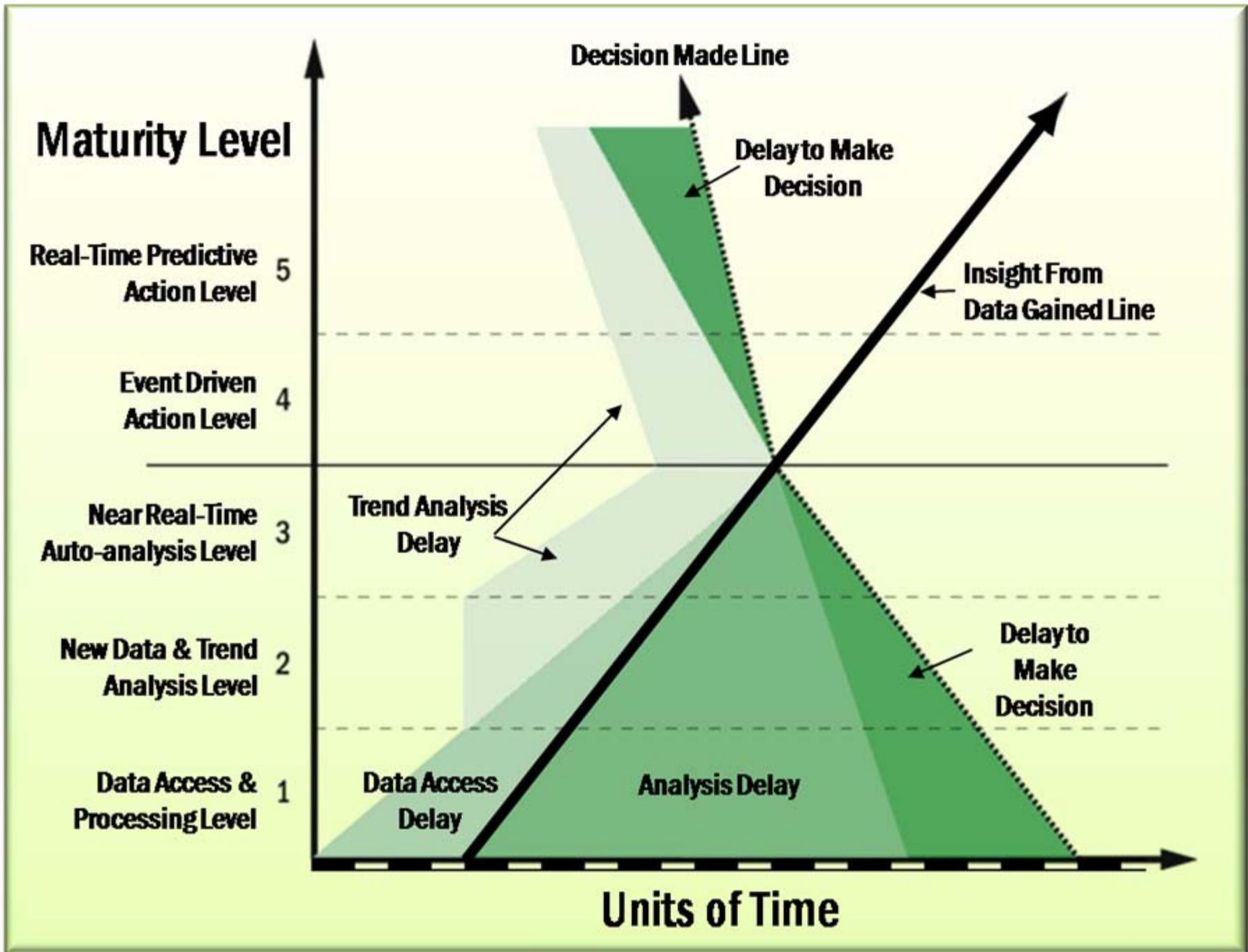
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# Backups



# The DM3 levels are used to assess the decision-making process and provide targets for improvement

- ▶ Level I – Data Access and Processing
  - Data Access = Analysis or
  - Data Access + Analysis < 50% of total time
- ▶ Level II – Trend Analysis
  - Trend Analysis is present and
  - Data Access + Analysis > 50% of total time
- ▶ Level III – Near Real-Time Automation
  - Trend Analysis is present and
  - Data Access + Analysis < 50% of total time
- ▶ Level IV – Event-Driven Action
  - Recommended action is given before data is received
  - Lead time is less than 10% before the event
- ▶ Level V – Real-Time Data Predictive Action

