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Title of Paper:

Applying the *Decision Making Maturity Model* (DM3) to Evaluate and Enhance the Design of C2 Systems

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Topics:
Track 2: Networks and Networking
Track 6: C2 Metrics and Assessment
Track 8: C2 Technologies and Systems

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ABSTRACT

Command and control systems are designed to provide countless types of information in numerous forms and for a large number of users. These facts, while obvious, are also the key reasons why there is such a diverse set of ways to design, use and evaluate C2 systems. Today, new technologies and software systems are again raising questions on how to design C2 Systems and share information on the digital battlefield. One C2 design approach calls for applying principles generally known as Service Oriented Architecture(SOA). While this approach allows for increased flexibility and interoperability of information, a new type of challenge arises; How to implement the SOA and how to evaluate the resulting C2 systems. Additionally, the ability to evaluate the algorithms, software and other services used in the C2 systems becomes even more complex because systems composed by using SOA become very fluid while adjusting to the dynamic needs of the warfighter. This paper will present the Decision Making Maturity Model (DM3) which uses a universal metric applicable to decision making by directly linking the operational effectiveness of SOA's, and C2 systems with the decisions to be made. This model can be applied during design, implementation and lifecycle evolution of C2 systems. The DM3 Process provides a scenario independent, non-intrusive process, for continuously monitoring the effectiveness of command and control systems in the new net-centric operational environment.

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> "NATO and its member nations are in the midst of a revolution in military affairs. There are three major dimensions to this revolution – geopolitical dimension, a technological dimension, and a closely coupled conceptual dimension. This multidimensional revolution poses significant new challenges for the analysis in general and command and control assessment in particular"
>
> *- NATO Code of Best Practice for C2 Assessment*

1.0 Introduction to the Decision Making Maturity Model (DM3)

The objective of command and control systems, now and in the future, is to provide an efficient system for providing situational understanding which also enables both swift execution of decisions and tracks the progress of mission execution. These capabilities are being provided at an ever increasing rate as each of the military services strives to meet the Department of Defense (DoD) directives to support net-centric operations. This trend is also creating ever more complex C2 systems with increasingly wide range of missions and information. While this allows more information to be accessible to the command, this begs questions like: "Is this the right information?"; "How reliable is this information?"; or "Why did it take so long to get this information?" Essentially, with increasing sets of control systems providing information for the command, how do we assess the effectiveness of the sets of information systems used in complex command and control systems? The **Decision Making Maturity Model (DM3)** provides a process for assessing the effectiveness of command and control systems regardless of the scenario.

Command and Control has been defined by NATO as…

"The organization, process, procedures, and system necessary to allow timely political and military decision making and to enable military commanders to direct and control military forces. (NATO 1996) C2 systems are further defined NATO documents to include : headquarters facilities, communications, information systems and sensor and warning installations (NATO 1998)."

This paper will present the **Decision Making Maturity Model (DM3)** which provides a fundamental process for evaluating the operational effectiveness of C2 systems, their design and associated service oriented architectures(SOA)s, regardless of the scenario. The **DM3** leverages the steps identified in the NATO Code of Best Practice (COBP) for C2 Assessments and provides a scenario independent and the universal metrics needed to provide a consistent process for evaluating, improving and designing C2 Systems and the accompanying SOAs.

1.1 Needs of the Assessment System[1]

As mentioned in the opening quote, the three dimensions, geopolitical, technological dimension, conceptual, are part of the complete equation considered when assessing C2 systems. Today's, technology evolution has outpaced the evaluation and assessment capabilities. The complexity associated with assessing C2 systems is the result of having a diverse collection of, legacy custom built C2 systems, native applications, web-based browser systems and capabilities provided in a service oriented architecture (SOA). All of these systems touch some part of each of the above dimensions and most importantly as the technological dimension grows ever more capable and prolific the ability to integrate it with the conceptual dimension also becomes ever more important. This fact is one of the most important drivers for change in the assessment process; the information domain and cognitive domain are too interconnected to be assessed separately. The **DM3** recognizes this requirement and provides a process for consistently

[1] Note: The DM3 leverages advances in commercial business intelligence applications/concepts, enterprise analytics, as well as service oriented architectures and other information technology changes. These tools and processes are then integrated with the current state-of-the-practice C2 thinking, resulting in the complete DM3 Process.

measuring both. However, the **DM3** process also recognizes that there are there other assessment needs which are equally important such as the need to:

- Evaluate the agility of C2 systems to accommodate ever changing missions and information needs "agility is becoming the measure value of choice" page 70.
- Evaluate C2 systems across all C2 functions, (i.e. logistics, targeting, legal, intel.)
- Directly associate a commanders decision with the associated IT systems and staff processes used when making a particular decision
- Evaluate the numerous incremental steps taken to provide a commander with decision making information
- Evaluate the overall process for operational effectiveness with enough detail to provide improvement recommendations based on real data rather than subjectively

While this is just a sub-set of the assessment considerations used when developing the DM3 Process they do represent some of the largest challenges to current C2 assessment processes. Other challenges for C2 assessment are due to the rapid change of technology and complexity associated with the constantly changing operational missions.

1.2 Challenges with current Assessment Methods

In response to the challenges with C2 assessment, the *NATO COBP for C2 Assessment* was published to help define a high-level process for C2 assessment. The NATO COBP provides a good guide for assessment but lacks the detailed descriptions required for uniform assessment process. Additionally, today's, new technologies and software systems, while increasing capability, are also raising questions on how to design C2 systems and share information on the digital battlefield. One response resulted in the introduction of a Service Oriented Architecture(SOA). While this increased the flexibility and interoperability of information, it still raises the question of how to select the SOA and evaluate the C2 systems. Even as the SOA allows the agility to provide customized views of information for the command, there also needs to be a method for ensuring that the "proper[2]" information is both assessable, and provided in the "proper[3]" formatted.

While data visibility and accessibility are continuing to strain the assessment process other challenges for C2 assessment include:

- The introduction of new C2 systems which are SOA based and highly flexible
- A lack of methods tools and data appropriate for all scenarios
- Many assessment processes are scenario specific and difficult to customize
- Information systems are assessed independent of staff process
- Operational drills are assessed independently of both staff and C2 Systems
- Different missions require different assessments
- Universal process and metric for C2 evaluation has not been identified
- Current assessment processes are of finite duration and limiting long term studies

This short list illustrates the most challenging aspects of future C2 assessment and touches lightly on the need for a continuous assessment process which does not interfere with complex military operations. The DM3 Process in conjunction with the assessment steps provides the foundation concepts required to develop a continues assessment process in place throughout operations.

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[2] *Proper is a subjective term which is validated in the assessment process through the use of heuristics from senior advisors.*

[3] *Proper is used here to ensure the format of the information allows the quickest understanding of the information by the decision maker for the current situation. Again, this is facilitated by senior advisors during the assessment process..*

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Finally, there is significant challenge inherent with assessing different decision types such as automated, contingent and complex. The DM3 Process provides the capability to assess all of these decision types in a highly repeatable and consistent way.

1.3 Objective and Goals of the DM3

The objective of the DM3 is to ensure that command and control systems provide the maximum capability and functionally to the warfighting decision maker. The DM3 assessment process is focused on evaluating the effectiveness of the C2 systems to provided the needed information for decision making. The process of starting from a need, to answer a question which is directly related to an operational need, both the technological and cognitive domains can be assessed for their effectiveness. Essentially the objectives of the DM3 Process is to:

- Ensure that the operational decision to be made is supported effectively by the C2 system.
- Assess how effective each C2 system is at providing the operational information needed by the decision makers
- Assess how effective the staff process is in utilizing the C2 system to support decision making
- Assess the benefits provided verses the cost of maintaining each C2 system
- Provide a universal process for C2 assessment
- Provide a non-intrusive method for allowing continuous assessment of the C2 systems during operations

The goal of the DM3 Process is to provide a consistent, measurable and specific method for assessing the effectiveness of C2 systems allowing decision makers to move from "just successfully fielding" C2 systems to learning how they are using their C2 systems while systematically and continuously improving them.

Ultimately, the DM3 Process should become ingrained with and part of the operational organizations' to allow for continuous monitoring and improvement. The DM3 Process is not a technology solution in itself, but leverages technology to create a fundamentally new way to assess operations. This process is essentially a new way of considering how to assess the effectiveness of the organizational decision making process and its information systems.

2.0 Solution

> "The purpose of Command and Control is to bring all available information and all available assets to bear."
>
> - *Understanding Command and Control*, Albert & Hayes

The DM3 Process was developed to assess the ability of command and control systems to access and utilize data for decision making. The DM3 Process was developed around that core need and is designed to accommodate military battle drills, and assess the effectiveness of the integration of the information and cognitive domains with equal resolution.

2.1 Assumptions

Development of the DM3 was predicated around several assumptions which were used to define the scope and capabilities required of an information age assessment process. These assumptions also consider the importance of agility and resilience in a C2 system which further defined the assumptions used for developing the DM3.

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The assumptions were developed by understanding that:

- **Technology evolution will continue to change C2 systems.** As the information age continues and new technologies or approaches such as Web 2.0 or Service Oriented Architectures are developed the ability to assess the effectiveness of the C2 system will continue to change, especially if the assessment tool is technology specific. The assessment tool should remain technology agnostic.

- **Net-Centric Operations will continue to expand.** As the Global Information Grid(GIG) expands and provides both greater access and breadth of information, the ability to directly associate operational decisions with specific information sources and process flows will become increasingly difficult to track and important to document. Documentation and utilization of data accessed and used on the GIG will provide the basis for further evaluating the effectiveness of the source data system.

- **Service Oriented Architecture will continue to expand.** As more existing systems are modified to expose their individual, capabilities for use on the GIG, tracking the source of information as well as the timeliness and accuracy of the data will become increasingly important. The assessment process needs to be capability focused yet system agnostic.

- **Action is taken when a decision is made.** Decision makers are using C2 systems to take action. Effect Based Operations (EBO) are based on the premise that a Decision Maker takes an action, measures the effects, and adapts the plan, based on the effects of the last action. Therefore, the C2 assessment process needs to focus on the time it takes for action to be taken reference an event.

Finally, the self-synchronizing nature of the net-centric operational environment will make it increasingly difficult to evaluate the effectiveness of the information systems at no more than a macro-level unless there is a process to better understand the micro-level data processing steps associated with the modern net-enabled C2 system.

> "Traditional notions of Command and Control assume a set of predefined hierarchical relationships that, for the most part are fixed. ....Roles, responsibilities, and relationships (or a subset of these) may be self-organized and may change as a function of time and circumstance[4]."
>
> *- Understanding Command and Control, Albert & Hayes*

2.2 Approach to the Solution

The C2 system is comprised fundamentally, of a command element, which communicates with a control element, which directs an action, which in turn produces feedback in some form to the control element. Ideally, at this point the control element would then communicated back to the command element. This process represents the elemental steps of a traditional C2 system[5]. In the net-centric operational environment the "communication" and "feedback" is now a mix of human and automated responses. The agility of the C2 system is now dependant upon the speed in which the Decision Maker receives a comprehensive and accurate picture of the situation. But now all information or control systems are equal in speed or quality, additionally some systems still rely primarily on humans and their cognitive efforts. It therefore becomes more important than ever to fully understand where the information is coming from when the Decision Maker looks at the Common Operation Picture (COP) and subsequently applies his/her art of command to the decision making process.

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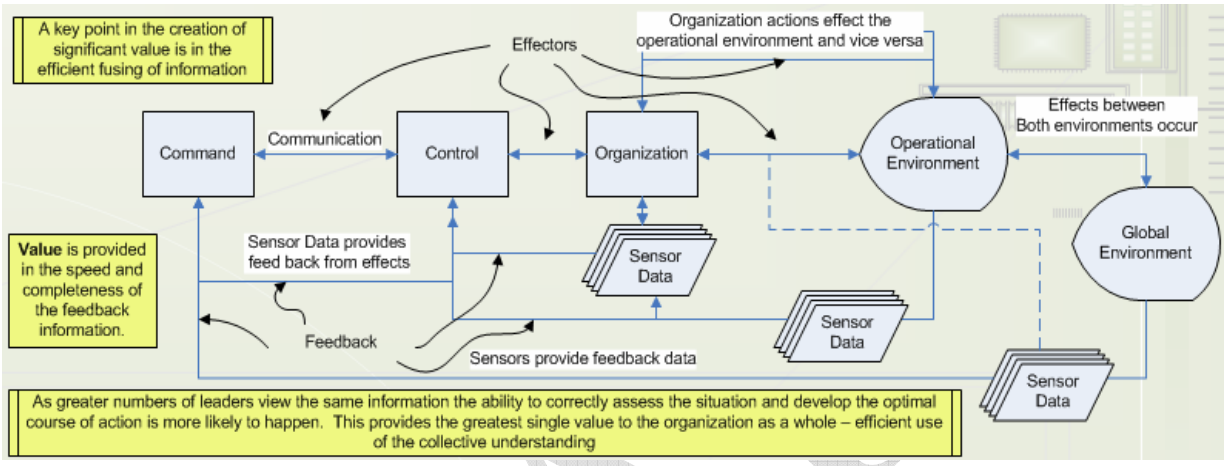
4 *For more, see the ONR-sponsored research initiative: Handley, Holly. "Adaptive Architecture for Command and Control." April 2005*

5 *For more detail can be found in Chapter 1, of "Understanding Command and Control", by Alberts and Hayes.*

Understanding where the information is coming from is an essential part of evaluating the effectiveness of the C2 system Information. Our decomposition of various COPs has found a clear pattern of information sources which Decision Makers are constantly accessing, organizational, operational environment and global environment. Each of these information sources has characteristics associated with them which aligns with the information decision makers rely on. When looking at the diagram the information systems, which comprise the net-centric operation environment, is the sensors and connections between the command, control and environments. By understanding which information system is accessing what kind of data this influences a reliability factor. As shown in the graphic below, the further from the command and control elements the sensor is the less timely and accurate the information will be.



Traits of Information Sources		
Organization Information	**Operational Environment**	**Global Environment**
- Can be more completely and accurately collected	- Less complete data is collected and it may be incorrect or unreliable	- Very diverse and disparate information sources are available for searching and analysis – consider a Google search on the internet
- Metrics are more easily defined and are generally measurable against past performance	- Metrics are available but are harder to define and tend to be much more difficult to measure.	- Metrics are available but are often dated by several weeks to months
- Technical requirements to transport the data to information systems can by individually developed and point to point connections generally work well	- Technical requirements to transport the date to information systems requires considerably more integration and complex development	- Metrics are measurable but accuracy is often very suspect
- Organizational metrics are the key factors used by the organization at the operational level	- Operational metrics are key indicators used to make mid-term decisions at the higher management levels.	- Technical requirements to transport the data to a single information system becomes more complex especially if any level of automation is used
- The metrics are summarized for reporting to higher	- General trends and patterns are summarized for reporting to higher	- Global metrics indicate yearly or multi-year trends and are used full at the highest level of command

For example the information on the organization is the closest to the control element therefore it will have the most complete information and timely information. It is also is the most controlled system since is build and used exclusively by the organization itself. However the operational environment is not completely under the control of the organization which means that information will be in varying forms and quality and reduces the Decision makers confidence in the information. This influences the cognitive elements of the decision making process, which often results in additional confirmation of operation information to reach an appropriate confidence level for the decision Maker. This fact is reinforced by Alberts and Hayes as show below.

> "The nature of the interactions among entities is, arguably, the critical element in the tents of Network Centric Warfare and the principle of Power to the Edge. As such, the

> interactions that are permitted and those that actually take place need to be characterized and observed."
>
> *- Understanding Command and Control, Albert & Hayes*

While this subject could be further expanded upon in much greater detail is suffice to say here that data origination and quality of information are key factors in assessing the effectiveness of C2 systems. However an appropriate mix of information from each of these environments is required for an effective COP.

Understanding where the information is coming from or which process it is moving through is just one critical step in the assessment process identifying other metrics and measures is the next step.

2.3 Universal Metrics for Decision Making

> "The evaluation of tasks provides the most detailed insight into C2 activities. The primary measures are expressed in terms of time and accuracy."
>
> *- NATO COBP for C2 Assessment*

It is clear that time and accuracy are the metrics of choice, previously, however, the ability to collect the task level actions and decisions made with enough precision and reliability to be effective was in question, or cost prohibitive, until now. By leveraging web applications and other technology available in the net-centric operational environment time and accuracy measures can be completed in a fundamentally new way. These metrics for time and accuracy are recommended in the NATO COBP for C2 Assessment with additional metrics that are now appropriate for assessing C2 systems in the information age.

For C2 task, time-based metrics include the:

- Time taken to react to an event (time to notice process and act upon new information)
- Time to perform a task (time to make a decision)
- Time horizon for future decision or predictive analysis
- Rate of performing tasks (tempo)
- Time needed to understand the information
- Time needed to access the data
- Timeliness of the data

Metrics for accuracy include:

- Precision of the observed systems performance
- Reliability of the observed system performance
- Completeness (know unknowns, unknown unknowns)
- Errors (alpha, beta, omission, transposition, severity
- Quality of information produced
- Relevance of the resulting analysis completed

While this list represents a sampling of the metrics which can now be automatically timed the total process of evaluating the information as it moves between the cognitive and information domains throughout its trip from the "Edge Sensor" to the ultimate user still needs to be defined.

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2.4 DESCRIBING THE DM3

The Decision Making Maturity Model (DM3) provides a means to assess the effectiveness of each C2 task with respect to time and also provides a way to assess the maturity of the C2 process. When decomposing decision making and C2 systems with respect to time, steps four elemental time delays occur, these then become the elemental steps of the DM3 which are:

1. **Delay in Data Access.** This is the amount of time needed to find, collect, transport and transform date for eventual use. This step is completed when the user or operation gains insight in how to properly format the data for proper analysis. **This step ends when data is in the proper format for analysis.** As systems become more automated this step should take considerably less time.

2. **Delay for New Data Analysis.** This is the amount of time needed to process formatted data through either an automated analysis algorithm or through a human doing cognitive analysis. Significant delays often occur here as the humans reformat data for different types of analysis. **This step ends when the analysis report is provided to the Decision Maker.**

3. **Delay for Historical Trend Analysis.** This is the amount of time needed to process historical data in context to the decision to be made. When automated this time can be quite brief, however, when conducted by humans the reports are generally much richer but the analysis time can be considerably longer. **This step ends when the analysis report is provided to Decision Maker**

4. **Delay to Make a Decision.** This is the amount of time needed to staff information for final decision. This step can be automated for simple decisions, such as "If Than" statements or very time consuming when making strategic or tactical decisions which involve risk of death or casualties. **This step ends when action is taken or directive given.**

These four steps are used to assess the time taken for each C2 task. Time is the most critical element in modern combat and especially in stability and support operations. By assessing the time taken for each elemental step of a C2 Task the assessors can then focus in on areas that are taking excessive time to better determine how to improve the C2 process used at that level. The resulting times for each step in the process can then be used to show a relative maturing of the decision making process

The DM3 has five decision making maturity levels. There is no absolute values associated with each of the maturity levels, rather it is the ratio of time used during each step in the DM3 which determines the maturity level of the C2 Task/system.

- **Level I - Data Access and Processing.** This level is characterized by the fact that the amount of time for Data Access, Analysis Delay and Decision Delay are all equally long. There is no Trend Analysis conducted at this maturity level. A Level I C2 task is also characterized by having one of these steps taking 50% or more of the total task.

- **Level II – Trend Analysis.** Level II is reached when historical data is included in the analysis and when the total ratio of time spent accessing data and when the delay for analysis is still greater than 50% of the total time needed to make a decision.

- **Level III – Near Real-Time Automated Analysis.** Level III is reached when the total time spent to access and analyze new data is less than 50% of the total process. This conversely means that a larger percentage of time is spent either conducting either automated or manual historical analysis for presentation during the delay to make decision. The transition point from Level III to Level IV is at the automated decision making point in which historical trends are incorporated into instantly collected data and a decision is automatically made. For

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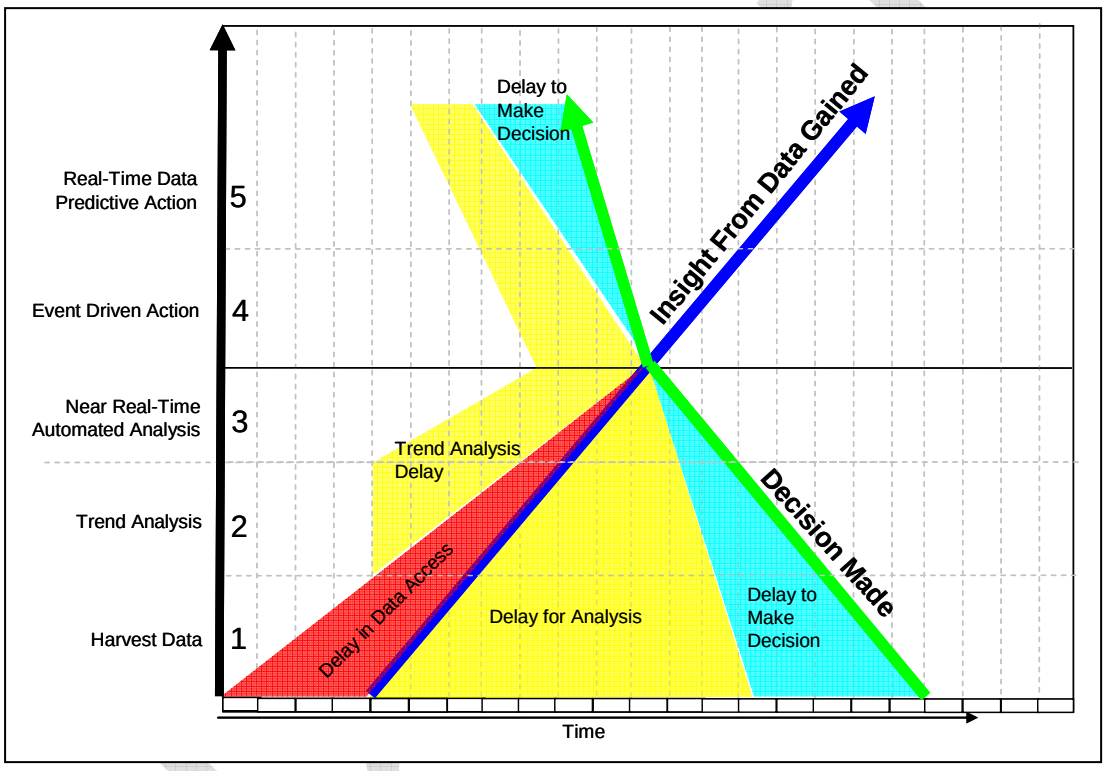
example the conditions for an air defense system, once set, (based upon historical data) received threat of incoming object and instantly engage the threat.

- **Level IV – Event Driven Action.** Level IV applies trend, historical profiles and algorithms which provide a recommended action in advance of receiving data. Specific events drive the need to make future decisions. This level does not rely on data to make a recommendation or decision but proposes a decision based on previous events. After the action is taken the event in question occurs and data is then collected and processed in preparation for the next event driven action process. The typical lead time for a recommendation at this level is zero to 10% of the total time before the event occurs.

- **Level V – Real-Time Data Predictive Action –** Level V uses trend analysis and complex algorithms to predict actions based on current events in real-time. These predictions allow significantly larger amount of time for decision making in advance of the predicted event occurring. The ability



A C2 system is a collection of C2 tasks. The DM3 has five levels of maturity which a C2 task can be executed at. The maturity level of a C2 system can be assessed at the average level of maturity of the C2 tasks used to complete the C2 system. A C2 system as a whole system can operate within

2.5 How to Use the DM3

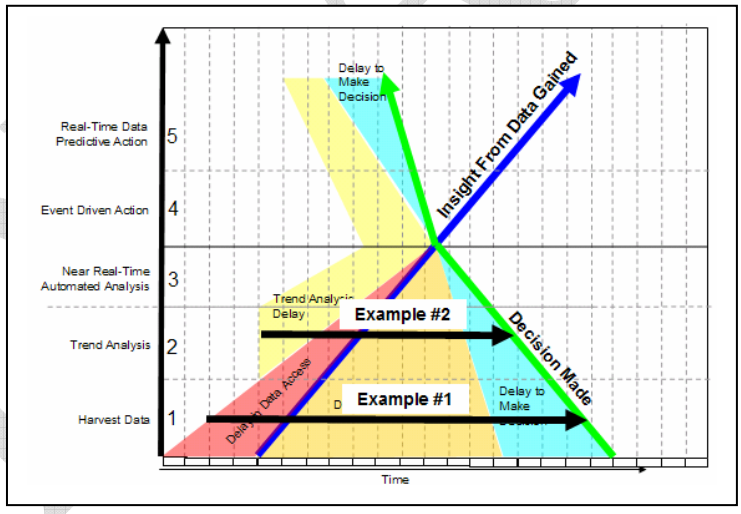
Command and Control information systems provide a structured way to move and use information. When applying the DM3 to C2 tasks it helps to consider the information that is passed along as a type of relay race. For example, data access and collection is the first step in the race where something or someone is needed to find the information and collect it. That information then needs to be transformed and passed-off to the next runner in the race, the analyst. The analyst then must take that information process it and package the information in a form of report which will then be used by the decision makers for consideration for ultimately making the decision. This is a race that has several batton passes and transformations. Should

the batton be in the wrong form or shape it may be dropped or extra time will be needed to process the information.

To read the DM3 start in the lower left corner, note, the DM3 works best with clearly defined battle drills or decision points. Once an event occurs which initiates the need for information the time begins. Time starts only where the decision process begins for example if the accessing data is the first step in the process then start at the lower left corner of the DM3 chart and begin timing at that level. Then based on the defined begin and end points stated above the delay in Data Access step ends when the data is formatted for analysis. Next, begin timing how long the analysis piece takes. This could be either automated or accomplished by humans. Regardless, this step is complete when a final report is presented to the decision maker. Finally once a the information is presented to the decision maker time is started for that step also. Again this could either be an automated or accomplished by a human. Once the decision is made some action needs to be take. No action is again a delay in making a decision, unless there is a decision for no action. By measuring these three steps the total time for decision making for that particular task is completed.

Should the first step in the decision making process included reviewing trend analysis then start measuring time anywhere in Level II. Continue measuring across the model as each step in the process is completed. This new time and order of steps indicates a significantly different level of decision making maturity as well as different time frames for completion. Continue timing the C2 Tasks and as the actions in each decision process are timed the level of Decision making maturity will become apparent.

While this was just a quick overview of how to read the DM3 and assess the maturity level of the each specific decision making task a complete example of how to apply the DM3 Process to a larger decision is presented below.



3.0 APPLYING THE DM3

- Observe Orient Decide Act – Apply the OODA Process to each decision and evaluate the time it take to make each step. Until action is taken by an effector for the decision
- Introduce the DM3 as the framework for evaluating the C2 system for providing the information thru to action which evaluates the Search Analysis Decide Act (SADA) loop –

Describe The Process Steps. – **Insert short explanation after each step**

1. Identify the highest level decision to be made and the leader making the decision
2. Identify information sources needed or used to make the decision
3. Identify information system used
4. Identify the staff personnel needed to process the information
5. Identify steps used by the staff and the systems they use to process the information
6. Measure the time needed to understand the information and evaluate visualization format of the data and information
7. Measure the time need to collect the data for each level
8. Measure the time needed to analyze the data where ever it is analyzed
9. Measure the time needed to make a decision whether it is a staff process or an information system.

TODO Graphic - Insert Process representative model – insert Visio graphic here

TODO Graphic - Introduce the Decision Making Maturity Model – DM3 here. Completed

***Explain non-intrusive assessment tool capability.
Total Chilet chart

Total System View

4.0 SCENARIO

The following section outlines a simplified scenario in order to demonstrate application of DM3 principles. This scenario minimizes staff evaluation to demonstrate the fundamental process of evaluating information technology systems. However, these same steps can be applied to evaluate the effectiveness of human processes.

In order to see how the DM3 methodology can be used to evaluate interaction of hetergeneous systems several physical systems participate in this scenario. Below is a depiction of participating systems in the Army battle command system (ABCS).

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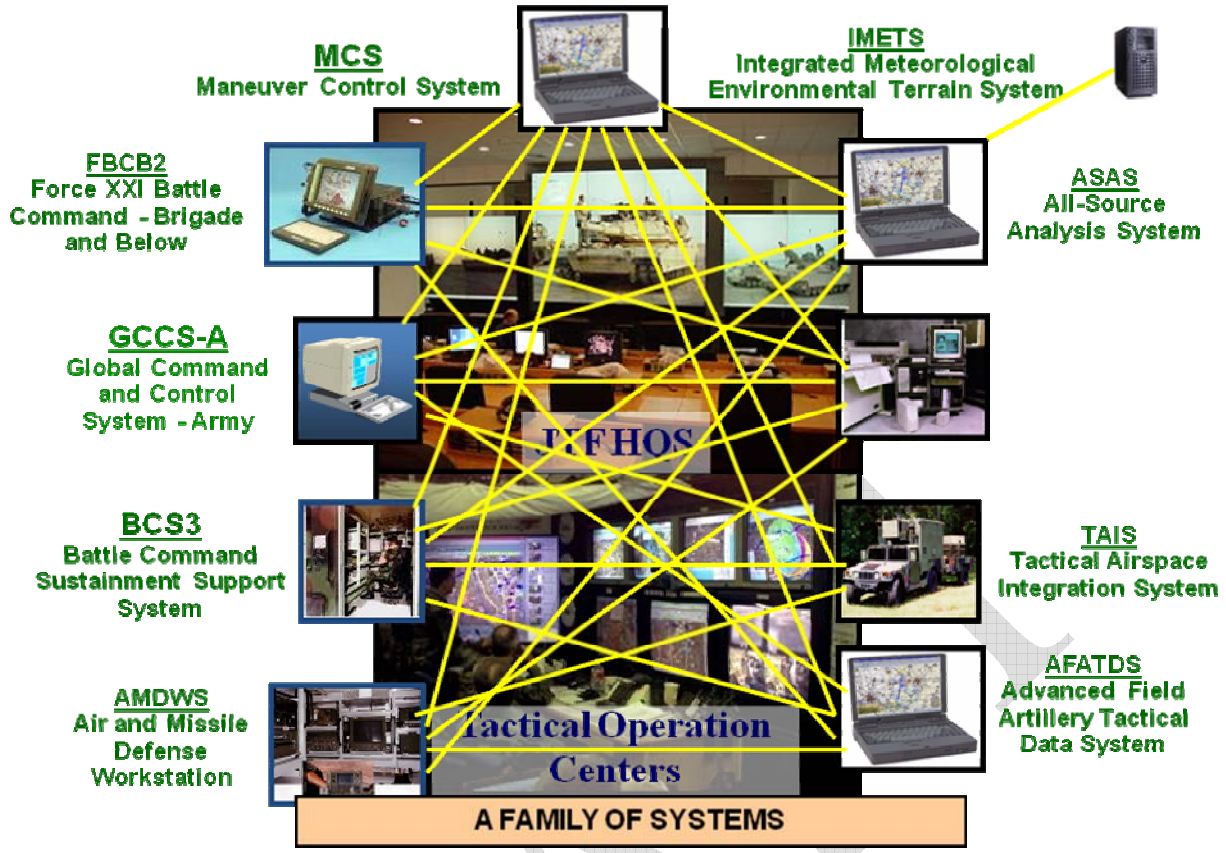

As part of the netcentric transformation these physical systems will be broken up into discreet capabilities or services. Such decomposition will allow for the enterprise as a whole to become more agile. Workflows, scenarios along with mission threads will be composed using capabilities. Depicted below is what the portfolio of such capabilities or services might look like.

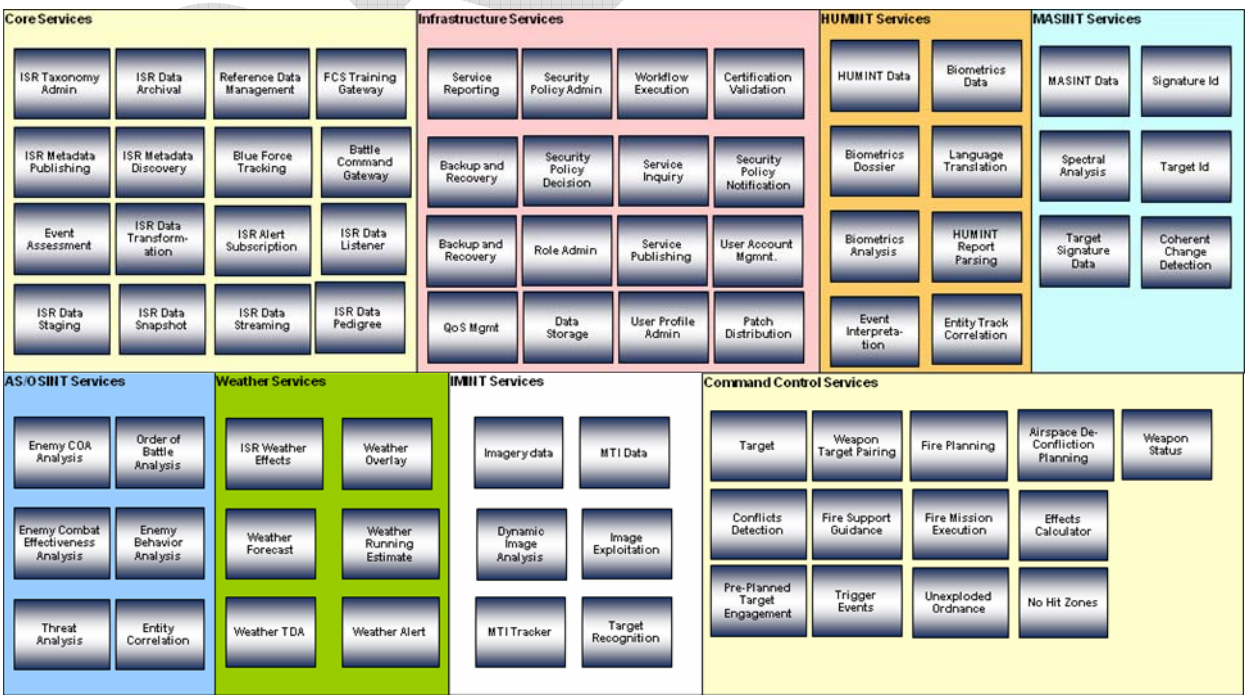

Figure x.x Porfolio of Services

4.1 Scenario Outline

Army Division Level command post needs to decide how to engage a high priority political target. This is an unanticipated target of opportunity that occurred after the Division's Rapid Reaction Force was already committed to another engagement.

A reliable HUMINT source indicates that "Bob" a high priority military target will be at location MT######### at 0300 for a meeting with his key leadership.

4.1.1 Step 1. Identify decision to be made and the leader making the decision

The decisions to be made:
1) Can the commander engage the target?
2) Does the commander engage the target?

A representative system evaluation demonstration is conducted to illustrate how the DM3 process is used to examine the participants in the flow of information as well as the decision points along the way.

TODO: Insert a diagram of representative system

4.1.2 Step 2. Identify information sources needed or used to make the decision

4.1.3 Step 3. Identify information system used

Note: In this simplified scenario only the essential services are examined.

Information	Service	System
Humint Report	HumintService	HDWS
Target Information	TargetManagementService	AFATDS
No hit zones	NoHitZoneService	AFATDS
Conflicts	ConflictsDetectionService	AFATDS + FBCB2+PASS
Weapons in the area	BlueForceTrackingService	FBCB2
Weapon to Target matching	WeaponTargetPairingService	AFATDS
Weapon ranges	WeaponRangeService	AFATDS
Weapon status	AssetStatusService	AFATDS
Weapon Effects	EffectsCalculatorService	AFATDS
Confidence report	TargetDecisionService	AFATDS
Target approval	FiresMissionExecutionService	AFATDS

Table x.x Information, services and systems

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As described earlier it is much easier to create mission threads and scenarios using capabilities instead of stove-piped systems.

The information flow in the scenario is outlined below:

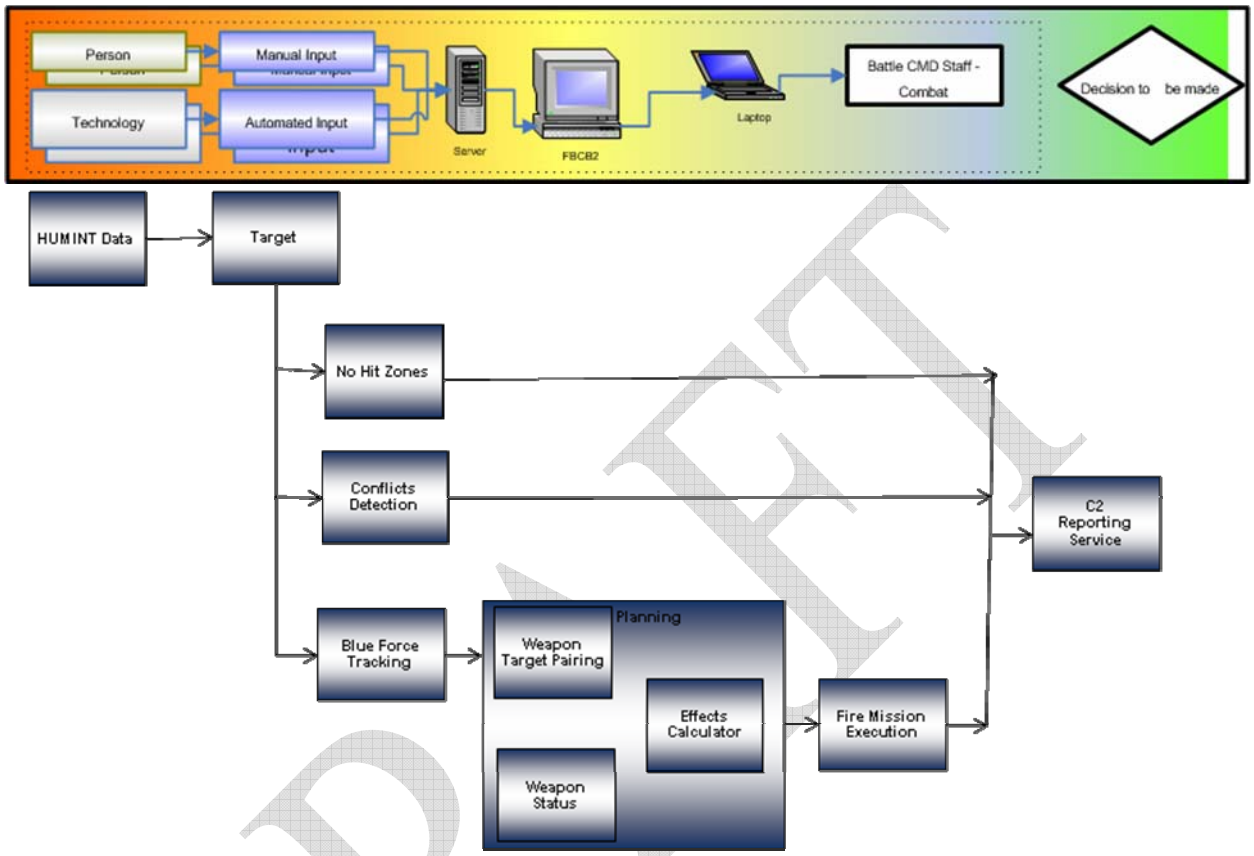

Figure x.x Workflow of Target Scenario

As the scenario unfolds the needed information is gathered by utilizing the outlined services and their underlying systems. Once the information is collected, the commander is presented with a decision. His decision is informed by a checklist that provides an organized view of all the information needed to make the decision. This information can be analyzed in real time by using various visualization techniques.

- Legal
  - Rules of Engagement
  - Political Rules
  - Cultural Rules
- Weapons System Availability
  - Shooter systems : Tank, bomber, fighter, attach helicopter
  - Defensive systems : ADA, Q36
  - Observation systems : Kiowa, UAV's
- Logistical System Support
  - Ammo
  - Fuel
  - People

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TODO: Insert a screenshot of decision console here
Outlines the confidence level for each of the above items

Once the commander is satisfied that all the needed information is gathered and the level of confidence for each criteria is satisfactory he can authorize the strike.

HUMAN PROCESSES

It is much harder to automate metric gathering for processes that involve human involvement. Nevertheless, the approach for is the same.

4.1.4 STEP 4. IDENTIFY THE STAFF PERSONNEL NEEDED TO PROCESS THE INFORMATION

4.1.5 STEP 5. IDENTIFY STEPS USED BY THE STAFF AND THE SYSTEMS THEY USE TO PROCESS THE INFORMATION

Gathering Metrics

As outlined in DM3 steps, along each point in the workflow metrics are gathered that measure the time needed to acquire, understand and evaluate visualization format of the needed information. Let's examine how these steps are executed in one section of this scenario.

A request is made to **BlueForceTrackingService** to find all weapons in the area of interest. The service obtains the needed information from an underlying system and responds with an xml file containing unit coordinates. This document is parsed and translated to the format understood by the visualization tool. At the same time, this document is sent as input to **WeaponTargetPairingService** which responds with a selection of an appropriate weapon for the target.

TODO: Insert a detailed sequence diagram here of BlueForceTracking interaction with WeaponTargetPairingService

The time measurement is accomplished by a monitoring service or agent that is aware of all the steps in the workflow and can non-intrusively monitor the flow of information and gather the metrics.

4.1.6 STEP 6. MEASURE THE TIME NEEDED TO UNDERSTAND THE INFORMATION AND EVALUATE VISUALIZATION FORMAT OF THE DATA AND INFORMATION.

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In this case the time to understand the information is negligible as the translation and evaluations are automated.

4.1.7 STEP 7. MEASURE THE TIME NEEDED TO COLLECT THE DATA FOR EACH LEVEL

During the execution of this scenario 2 seconds pass between the time a request is made to **BlueForceTrackingService** and the time **WeaponTargetPairingService** returns its results. This time was spent by **BlueForceTrackingService** and its underlying system to query the datastore for the last reported locations of units in the specified area of interest. The information is then translated to xml and returned.

4.1.8 STEP 8. MEASURE THE TIME NEEDED TO ANALYZE THE DATA WHEREVER IT IS ANALYZED.

WeaponTargetPairingService takes as input list of the available units and the target information, iterates through the list and applies an algorithm for matching weapons to targets.

4.1.9 STEP 9. MEASURE THE TIME NEEDED TO MAKE A DECISION WHETHER IT IS A STAFF PROCESS OR AN INFORMATION SYSTEM.

Responses from **BlueForceTrackingService** and **WeaponTargetPairingService** results in a list of available appropriate weapons. A final decision for the weapon of choice is made. In this case it takes 1 minute for personnel to make the decision.

TODO: Insert a screenshot with detailed summary of metrics gathered during the execution of scenario.

Provide an overall report for the combined time and factors associated in making that decision.

4.1.10 STEP 10. PROVIDE REPORT FOR MILITARY EVALUATION WHICH INCLUDES OPPORTUNITIES FOR EASY IMPROVEMENTS IN FOR THE PROCESS.

Analyze human heavy legal – no hit zones process C2PC
Analyze BFT IT heavy System – FBCB2 System

Show that the process applies to both types of systems
Graphic – need to make - Show sample report format here.

5.0 RESULTS OF APPLICATION

6.0 BENEFITS

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Continuous assessment
Trend analysis
One battle drill = one assessment suite

7.0 CONCLUSION

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