Info-Centric Scenario Development

Presentation to 19th ISMOR
Oxford, UK
29 August 2002

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Abstract:

The development of the Future Combat System (FCS) concepts within the framework of the parallel development of the U.S. Army's Objective Force Operational and Organization (O&O) Concept poses significant modeling and modeling support (scenarios) challenges to analysts serving the Army decision-making process. Based on the projected capabilities of future forces and the emerging operational environments, information operations and C4I capabilities must be represented in scenarios and modeling efforts. This is required to effectively examine and analyze the operational effectiveness of the future Objective Force and its combat systems.

In order to fully support future decisions, the Army requires analytic efforts that encompass and address the value of information, situational awareness, and rapid, reliable communications.

Operational scenarios are currently generally developed and documented without providing for dynamic maneuver decision making that would occur based on the availability, collection, and fusion of battlefield information.

This effort was specifically undertaken to provide the scenario foundation for such analyses by updating current scenarios to accommodate such analyses and to develop the principles upon which such scenarios could be produced in the future.
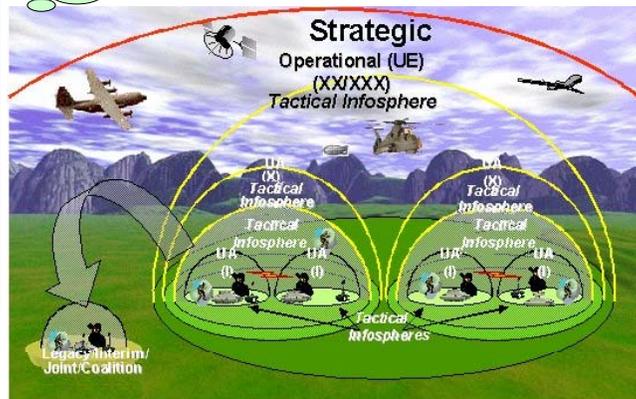
The Challenge

The challenge is to create operational scenarios robust enough to provide an adequate context for the analysis of the value of information, situational awareness and rapid, reliable communications.
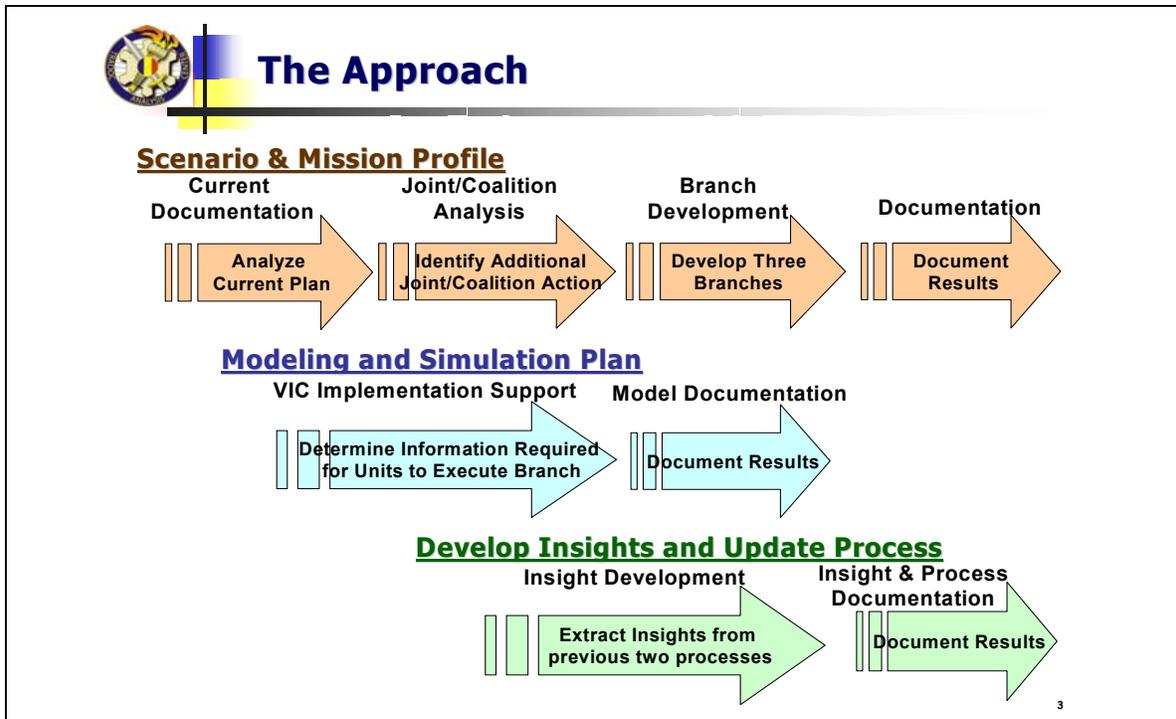
Military Transformation

• Increased reliance on the projected C4ISR system to enable a move from the current plan-centric doctrine to a more execution-centric doctrine.

• Commanders comfortable making significant and frequent adjustments to their plan during execution.

• Highly dependent on the quality and timeliness of information received during the execution of the operation

• Current scenarios:

  • Focus is primarily on the physical domain of the battlespace and representing plan-centric doctrine.

  • Mute the effect of and decisions generated as a result of information gathered during execution.

The Challenge:

Access to and exploitation of timely information is a key element of America's future warfighting and crisis management capabilities. The projected force-level multiplier advantage of information technology stands far above that of all other technical areas.

As a result of these projected capabilities, the military's approach to warfighting is also undergoing a transformation. A major aspect of this transformation is the increased reliance on the projected Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance, (C4ISR) system to enable a move from the current plan-centric doctrine to a more execution-centric doctrine. The information superiority offered by the future C4ISR system enables commanders to be comfortable making significant and frequent adjustments to their plan during execution. These adjustments work to optimize the effectiveness of the forces during execution. The relative ability of a force to be effective with this warfighting approach is highly dependent on the quality and timeliness of information received during the execution of the operation

Most current scenarios provide for the examination of an evolutionary extrapolation of current physical capabilities within the general context of current doctrine. The focus of these scenarios is primarily on the physical domain of the battlespace. Because they represent plan-centric doctrine, they currently mute the effect of information and decisions generated as a result of information gathered during execution. They thereby constrain the ability to examine the impact of various future C4ISR systems within the context of future warfighting concepts developed to leverage information superiority.

The Approach

Scenario & Mission Profile

Current Documentation — Analyze Current Plan
Joint/Coalition Analysis — Identify Additional Joint/Coalition Action
Branch Development — Develop Three Branches
Documentation — Document Results

Modeling and Simulation Plan

VIC Implementation Support — Determine Information Required for Units to Execute Branch
Model Documentation — Document Results

Develop Insights and Update Process

Insight Development — Extract Insights from previous two processes
Insight & Process Documentation — Document Results

The Approach:

The approach to this work was to deal directly with one existing scenario and with one scenario that was in the process of being developed. The existing scenario was a South West Asia Scenario that involved a counterattack by a heavy corps. The scenario in the process of being developed was a Caspian Scenario that was a complex operation involving a medium weight division.

The first step was to conduct an analysis of the current scenario documentation, identify deficiencies, and develop branches that could be executed based on the availability of information provided by proposed C4ISR systems.

The second step was to develop the specific model enhancements to the representation of the scenario that would provide for decision opportunities during the course of the operation.

The third step was to generalize lessons from these specific efforts. The focus of this paper is on the insights gained during the conduct of this study.
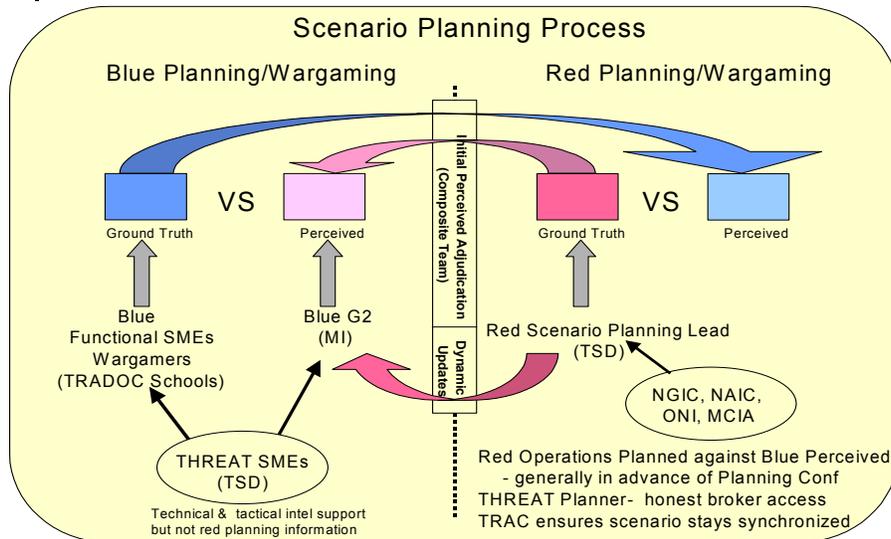
Initial Conditions:

Initial conditions frame the details of the context of the scenario and provide the fundamental information that modelers will need to implement the scenario in a simulation. Current scenarios provide a very robust description of the initial conditions related to the physical domain. They do not provide the same richness for the information and cognitive domains. The major reasons for this have been two-fold. The first is because most operational and tactical models have not represented either interactions or effects in either of these domains except at a very macro level. The second was that the capabilities of our combat systems and our existing doctrine did not provide much consideration of these domains.

With the advent of new capabilities and the transformation of our warfighting concepts these domains are now critical to correct representation and investigation of future systems and future warfighting concepts. Thus, there exists a requirement for a more robust representation of initial conditions in each of these domains.

Efforts are currently underway to improve model and simulation representation of both the information and cognitive domains. Scenarios should provide a robust enough representation so that when models and simulations can indeed better represent those domains, the scenarios that we have in place do not constrain our ability to conduct effective analysis.

Scenario Planning Process

Blue Planning/Wargaming   **Red Planning/Wargaming**

VS   VS

Ground Truth   Perceived   Ground Truth   Perceived

Initial Perceived Adjudication (Composite Team)

Dynamic Updates

Blue Functional SMEs Wargamers (TRADOC Schools)

Blue G2 (MI)

Red Scenario Planning Lead (TSD)

THREAT SMEs (TSD)

NGIC, NAIC, ONI, MCIA

Technical & tactical intel support but not red planning information

Red Operations Planned against Blue Perceived
- generally in advance of Planning Conf
THREAT Planner- honest broker access
TRAC ensures scenario stays synchronized
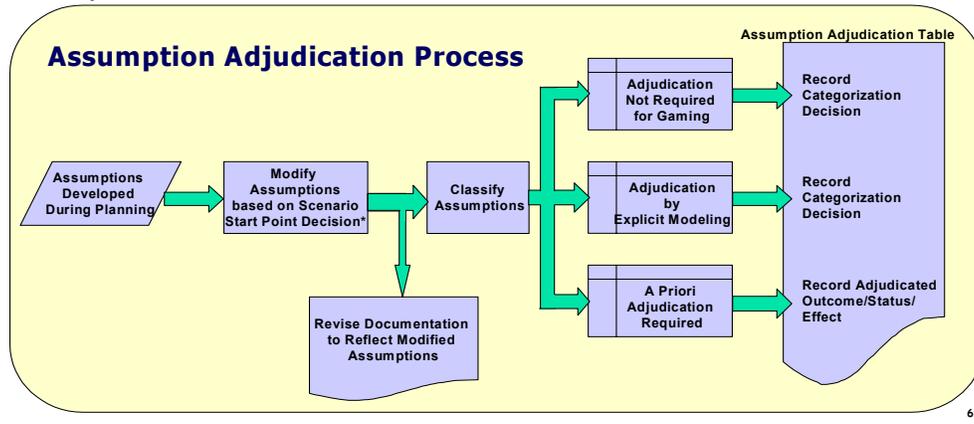
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Initial Perceived Views:

The key to info-centric scenarios is maintaining an information differential between the Red and Blue plans and by extension during the scenario preparation process. This means that extra effort must be expended to first define a robust representation of ground truth, and then adjudicate what amount of that ground truth each side would know at the beginning of its planning process. This becomes the initial perceived view for each side as they begin planning. The information differential defined by the difference between the perceived view and ground truth is what provides the essential foundation for unanticipated differences in each sides plan. Subsequently, this becomes the basis for representing execution-centric decision-making.

This differential must be developed and maintained in a deliberate and disciplined fashion. To this end, while the development of scenarios is an iterative process and demands the integration of expertise from many fields, extra efforts must be made to preclude inappropriate information crossing boundaries between Red and Blue planners. Planners, as is their nature, try to reduce uncertainty as they plan; the result is constant pressure to define the respective enemy picture in more detail. Arguments will be presented as to why they should know certain information that they don't have from the adjudicated initial perceived view. A conservative view should be taken to resist sharing too much information that will degrade the ability to evaluate the operational contribution of C4ISR systems or the concept regarding their use.

Assumptions

▸ Planners make assumptions as part of the plan development process.
▸ These assumptions when implemented in a model are necessarily either true or false.
▸ Consistent, transparent implementation is important to rigorous analysis.
▸ Explicitly enumerated and adjudicated RED and BLUE scenario assumptions are required in the scenario documentation.

Assumption Adjudication Process

Assumption Adjudication Table

Assumptions Developed During Planning → Modify Assumptions based on Scenario Start Point Decision* → Classify Assumptions

Adjudication Not Required for Gaming → Record Categorization Decision

Adjudication by Explicit Modeling → Record Categorization Decision

A Priori Adjudication Required → Record Adjudicated Outcome/Status/Effect

Revise Documentation to Reflect Modified Assumptions

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Assumptions:

Assumptions are another representation of the information differential between what a planner knows when creating the plan and extant ground truth. Each side makes assumptions about certain characteristics of the fight that allows their respective planning to continue. The assumptions should be kept to a minimum and only be created when factual information upon which a planning decision must be made is unavailable.

In current scenario documentation many assumptions are hidden within the documentation and not explicitly enumerated. These assumptions could of course be incorrect in part or in total. There is no record that reconciles the truth with the assumption so that modelers implementing the scenario will implement the assumptions in a consistent manner.

Following the development of the respective plans, the assumptions recorded within the plans should be adjudicated. The resolution of these assumptions to support gaming begins with postulating a start point at which the scenario will be implemented in a model. This is usually driven by the purpose of the study that is using the scenario. Assumptions are then reviewed, updated, or modified to reflect this information that the operational planners did not need to consider in their planning process. Then analysts determine to which of three categories a particular assumption belongs. Finally, the veracity of the assumption is adjudicated and recorded to ensure consistent implementation.

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Assumption Adjudication Table

Assumption	Classification	Comments	Adjudication
Red: Our actions to slow entry into theater will be successful.	A Priori Adjudication	It is likely that Red's actions would delay Blue but not by as much as they would have liked. Blue will likely need to resynchronize its planned operations as a result of the delay	Blue's TPFDD slipped 3 days for sea deployment and 2 days for air deployment.
Red: ADA will succeed in protecting main attack	Adjudication by explicit modeling	N/A	N/A
Red: Attacks on U.S homeland reduce industrial base's ability to restock war reserves	Adjudication not required for Gaming	N/A	N/A

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Assumption Adjudication Table:

      The scenario documentation should include an explicit record of the adjudication of the assumptions recorded within both the general scenario or within the operation plans. This is necessary so that when the scenario is implemented in different venues, the initial conditions are kept consistent. The table is an example of a method to record within the scenario documentation the results of this process.

Branches

- Branches offer the most expeditious opportunity within scenarios to introduce the potential for differentiation in effects or outcome based on differences in the availability of information.
- Branches are reasonably well understood within the context of the MDMP.
  - Are generated during the Wargaming Process within a given COA.
  - Are developed for a specific anticipatory purpose.
  - Have clearly defined criteria for execution.
  - Have linked methods for collection of that criteria.
- Branches offer an opportunity for the following investigative venues:
  - Timeliness improvements: knowing the decision criteria sooner in option than in baseline.
  - Quality improvements: greater fidelity information in option than in baseline.
  - False Positive Corrections: Option corrects baseline perception that decision criteria has been met when it has not.
  - False Negative Corrections: Option corrects baseline perception that decision criteria has not been met when it has.
- Branches constrain the scenario to anticipated operational contingencies and thus offer an additional level of control during analysis.

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Branches:

Branches provide a good starting point for representing the impact of information. They serve as the most expeditious opportunity within scenarios to introduce the potential for differentiation in effects or outcome based on differences in availability of information.

Branches are reasonably well understood within the context of the military decision making process. They are generated during the wargaming process within a given course of action. They are developed for a specific anticipatory purpose. They have clearly defined criteria for execution. They have linked methods for collection of those criteria. All of these aspects of branches are amenable to current modeling methods.

Branches should be included in every scenario for both Red and Blue sides. The branch documentation should include the decision point for executing the branch, the criteria necessary to make the decision, the sensor systems that are tasked to collect the criteria, the general operational concept for executing the branch, and specific functional area adjustments required to execute the branch.

Execution-Centric Decision Making

▸ Current scenarios, even with branches, do not provide opportunities for execution-centric decision making.

  ▸ Branches are based only on information known or assumed a priori by the operational planners and commanders.

  ▸ Branches only represent anticipatory planning based on perceived information.

  ▸ Scenarios currently marginalize the value of information developed/discovered during the course of the operation.

  ▸ Often scenarios and the plans within them have been operationally optimized and already account for every planned enemy action.

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Execution-Centric Decision Making:

Branches, however, are not a panacea to the info-centric approach; they have certain shortcomings. Branches are necessarily developed within the context of potentially knowable information in support of anticipated and planned decisions. Branches do not allow you the opportunity to investigate the potential for proposed systems, organizations, and concepts to exploit the 'a priori' unknown differential between "reality" and the perception of reality generated by the baseline systems, organizations, and concepts.

Execution-centric decision opportunities are provided within the context of an operational scenario by not having each respective plan already account for every enemy action. Currently, opportunities for execution-centric decision-making are significantly muted by each side having too much knowledge of the other side's plan. The result is that each plan already accounts for every action of the other side. This significantly degrades the investigation of the value of information gathered during execution and of the benefit of a C4ISR system that would gather such information. This is because the information has already been accounted for and thus does not have the opportunity to provide an additional benefit to the decision maker or consequently to the operation. (Clearly even if this is provided for in the scenario document, if it is not implemented in the simulation there will still be little opportunity to investigate the value of information.)

▸ Scenarios must accommodate information differentials between opposing plans to provide for execution centric decision making.

    ▸ Need opportunity to identify and react to knowledge of unanticipated actions of opposing forces acquired during the course of an operation.

    ▸ Requires attention during the scenario development process.

    ▸ Scenarios should document opportunities where actions on one side or the other have been unanticipated during the planning process.
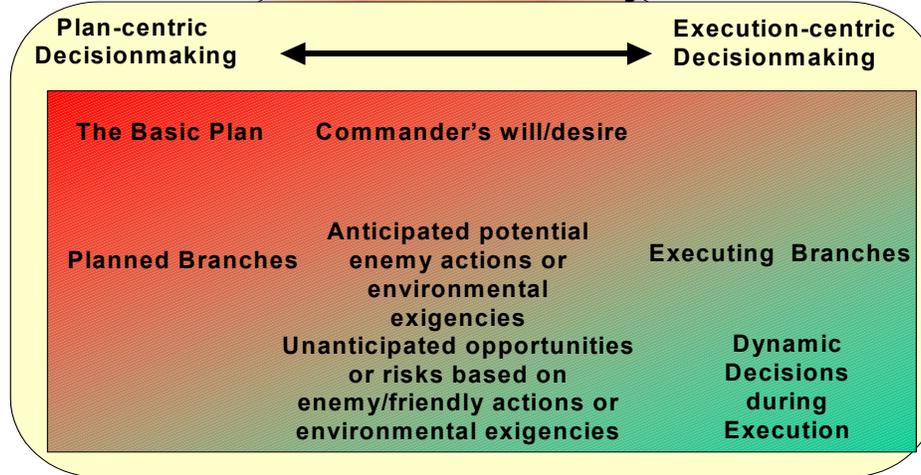
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Execution-Centric Decision Making (Cont):

During the planning process each side must be restricted to an appropriate amount of information regarding the other side. This will generally result in some of the actions by each side being unanticipated by the other side. These unanticipated actions become the genesis of potential execution-centric decision-making. Following the production of plans from the scenario planning conference and follow on efforts, analysts would crosswalk between plans to identify which actions had not been anticipated by the other side. Assuming that the other side would become aware of this action some time during execution, their reaction would be generally outlined within the scenario documentation. Thus, if the respective side's C4ISR system picked up the other side's unanticipated action during execution, they could react in a manner that provided operational benefit. If their C4ISR system did not pick up the action, they would not reap the operational benefit from taking appropriate action. This approach provides the opportunity to measure the operational benefit associated with the information provided by a particular C4ISR system during the course of executing the operation.

Plan-centric vs. Execution-centric:

      This chart depicts why both plan-centric and execution centric decision-making are part of military reality and both need to be represented in our scenarios and simulations. Plans by design reflect the methods by which the commander wishes to cause his will/desire to be implemented based on a priori knowledge of the particular military situation. However, the level of uncertainty regarding the battlespace changes during execution and new information provides the opportunity to modify the plan to optimize the potential for military success. This is the execution-centric portion of the operation.

▶ The representation of the availability, quality, and use of information is central to adequate representation of conflict.

▶ Current technologies offer enhanced capabilities to attack the information domain directly.

▶ Operational Scenarios must address information operations – add Information Operations Annex to each plan.

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Information Operations Planning:

Scenario documentation must include an Information Operations Annex. This is a "must do" to allow calling the product an info-centric scenario. All future operational scenarios above the Brigade level should include an Information Operations Annex. This annex will describe the direct actions, both offensive and defensive, that are being pursued directly in the information domain. Current doctrine regarding the composition of the Annex is adequate for this purpose. This consequently means that information operations expertise must be included in the scenario planning conference.

C4ISR & Decision Support Planning

Strengthen C4ISR representation with more robust planning products:

▸ **Intelligence Collection Plan**

▸ **High Payoff Target List**

▸ **Attack Guidance Matrix**

▸ **Synchronization Matrix**

▸ **Decision Support Matrix**

▸ **Communications Plan**

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C4ISR & Decision Support Planning:

Often the scenario documentation is focused on the maneuver and fires portion of a plan. However, while the basic operational graphics and maneuver plan might have sufficed in the past, the future requires a much stronger linkage and interdependence between the C4ISR system and maneuver and fires. To this end, documentation of that interdependence is required. Current doctrine as well as future concepts define many of the types of documentation that provide the details to properly represent the employment of the C4ISR system and its connection to the maneuver an fires plans.

It is also within this more detailed documentation of the plan that contains most of the criteria necessary to make particular execution decisions other than implementing branch plans. This level of detail is required to adequately represent the effects of particular C4ISR systems on decision making and the consequent operational outcomes.

Summary

> **The key to developing info-centric scenarios is maintaining an information differential between Red and Blue during the scenario planning and preparation process.**

▶ Define initial conditions for information domain as well as physical domain.

▶ Adjudicate the veracity and implications of each assumption that is not expected to be explicitly resolved during gaming.

▶ Develop Branches for both Red and Blue plans during scenario development process.

▶ Develop Information Operations Annex for each plan

▶ Produce more robust planning products during the scenario development process.

▶ Cross walk plans at the end of planning to identify execution-centric decision opportunities.

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Summary

This chart shows the key elements in developing information-centric scenarios. Certainly the principal element is maintaining an information differential between the Red and Blue during the development process. Among the contributing aspects are the following:

- Define initial conditions for information domain as well as physical domain.
- Adjudicate the veracity and implications of each assumption that is not expected to be explicitly resolved during gaming.
- Develop Branches for both Red and Blue plans during scenario development process.
- Develop Information Operations Annex for each plan
- Produce more robust planning products during the scenario development process.
- Crosswalk plans at the end of planning to identify execution-centric decision opportunities.
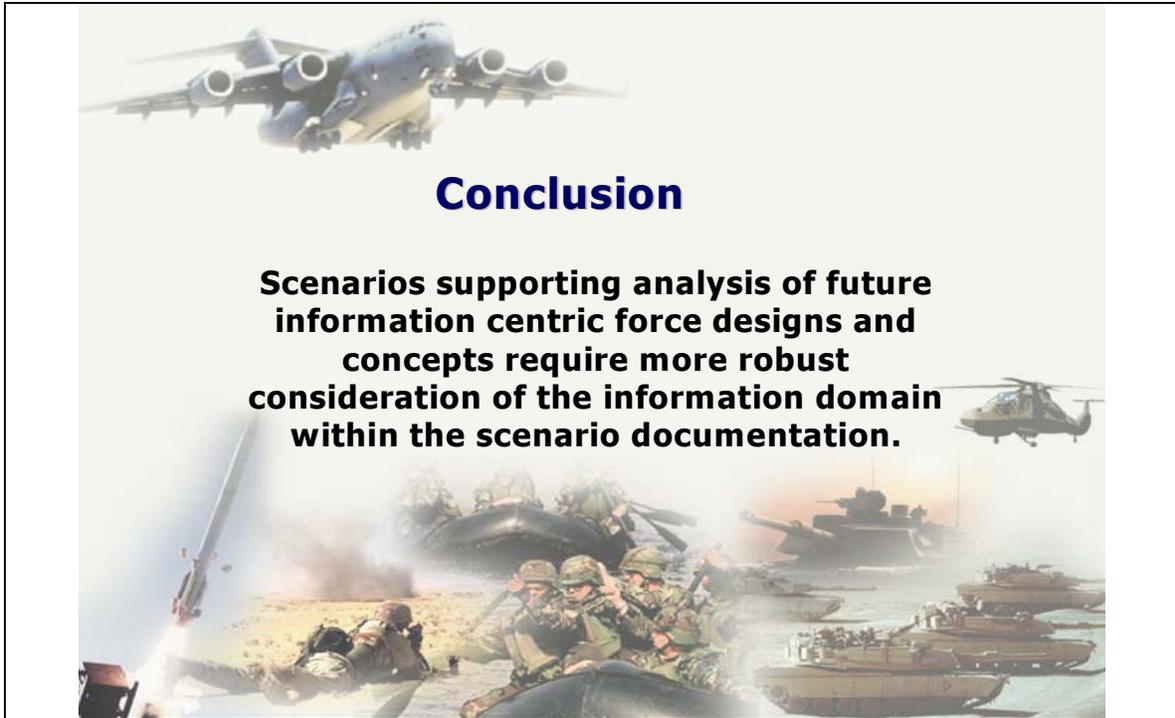
Conclusion

In conclusion, scenarios supporting analysis of future information-centric force designs and concepts require more robust consideration of the information domain within the scenario documentation.

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