Chapter Four

CS EXECUTION PLANNING AND CONTROL *TO-BE* CONCEPTS AND OPERATIONAL ARCHITECTURE FOR THE FUTURE

There are ways to mitigate the process disconnects identified in Chapter Three. The *TO-BE* concepts described in this chapter integrate operational and CS planning in a closed-loop environment, providing feedback on performance and resources.[1] Figure 4.1 illustrates these concept elements in a process template that can be applied through all phases of an operation from readiness, planning, deployment, employment, and sustainment to redeployment and reconstitution. The figure centers on integrated operations/CS planning and incorporates activities for continually monitoring and adjusting performance.

Some elements of the process, shaded in medium gray in Figure 4.1, take place in planning for operations and should be accomplished as concurrently as possible. A key element of planning and execution in the process template is the feedback loop that determines how well the system is expected to perform (during planning) or is performing (during execution) and warns of potential system failure. It is this feedback loop that tells the logistics and installations support planners to act when the CS plan and infrastructure should be reconfigured to meet dynamic operational requirements, during both planning and execution. The CS organizations will need to be flexible and adaptive to make changes in execution in a timely manner.

The feedback loop not only drives changes in the CS plan but might call for a shift in the operational plan. For the CS system to provide timely feedback to the operators, it must be tightly coupled with their planning and execution processes and systems and provide options that will result in the same effects yet cost less in CS terms. Feedback might include notification of missions that cannot be performed because of CS limitations.

Figure 4.2 shows how the *TO-BE* concepts can be applied to each phase of a contingency. More detail on the *TO-BE* process can be found in Appendix C. From readiness through redeployment and reconstitution, the core process remains the same, but individual information flows vary and plans and assessments become

[1]Elements of these concepts were described in the Air Force C2 Aerospace Command and Control, Intelligence, Surveillance, and Reconnaissance Center, *USAF Command and Control CONOPs*, Vol. III, *Blue Order of Battle, Global Awareness for Expeditionary Aerospace Forces*, Langley Air Force Base, VA, July 7, 2000, as well as in Ray Pyles and Robert Tripp, *Measuring and Managing Readiness: The Concept and Design of the Combat Support Capability Management System*, RAND, N-1840-AF, 1982.

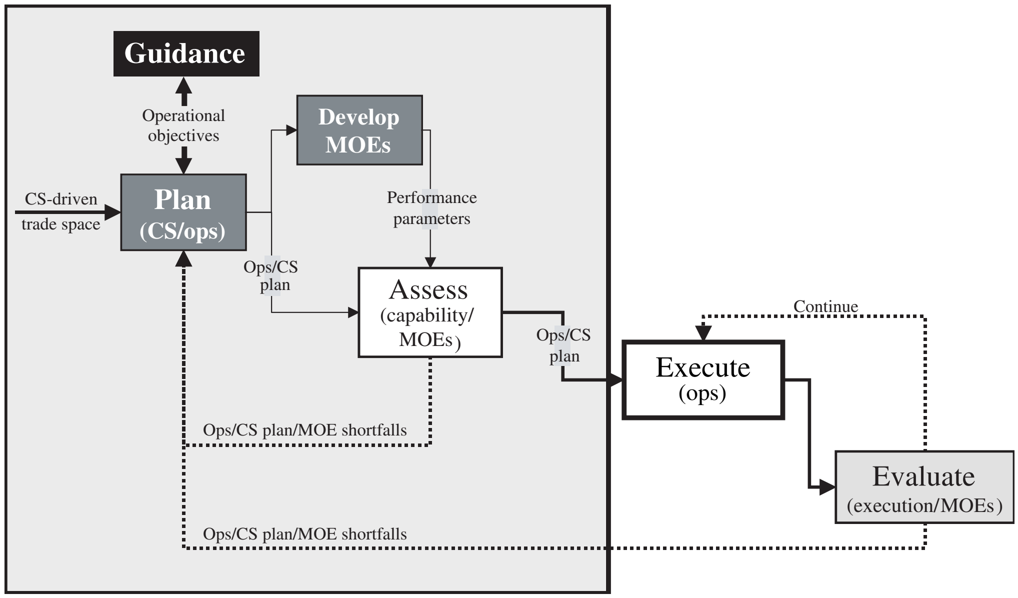

Figure 4.1—CS Execution Planning and Control *TO-BE* Concept

more refined through each phase. For example, in the *TO-BE* environment, theater and unit capability is constantly being assessed, beginning in peacetime. The assessment results are input to the budgeting and planning processes to allocate funds to programs and redistribute other resources to support Air Force plans. The global-level assessment results will contribute to strategic resourcing decisions. As a world situation develops, the CS-driven trade space of operational capabilities feeds into the crisis action planning process and the development of a suitable COA. Based on new information (e.g., refined operational requirements, known threats, better known theater capabilities), the CS plan is refined and the infrastructure configured to support a new COA. As a result of the chosen COA and CS configurations, the trade space is refined to feed into the development of the JAOP and MAAP and eventually the ATO. Assessment capabilities and a feedback loop enable iterative planning. This process continues into employment and sustainment, and can be observed for the other blocks in the planning and execution process.

The detailed *TO-BE* process diagrams are found in Appendix C and associated compact disks. The HTML diagram and supporting database on the disk incorporate the essential process and organizational elements of the *TO-BE* operational architecture. The diagram shows primary CS execution planning and control activities, each of which is depicted in greater detail, including tasks and information flows, in the database.

We will now discuss the *TO-BE* architecture and its application in support of planning and execution.

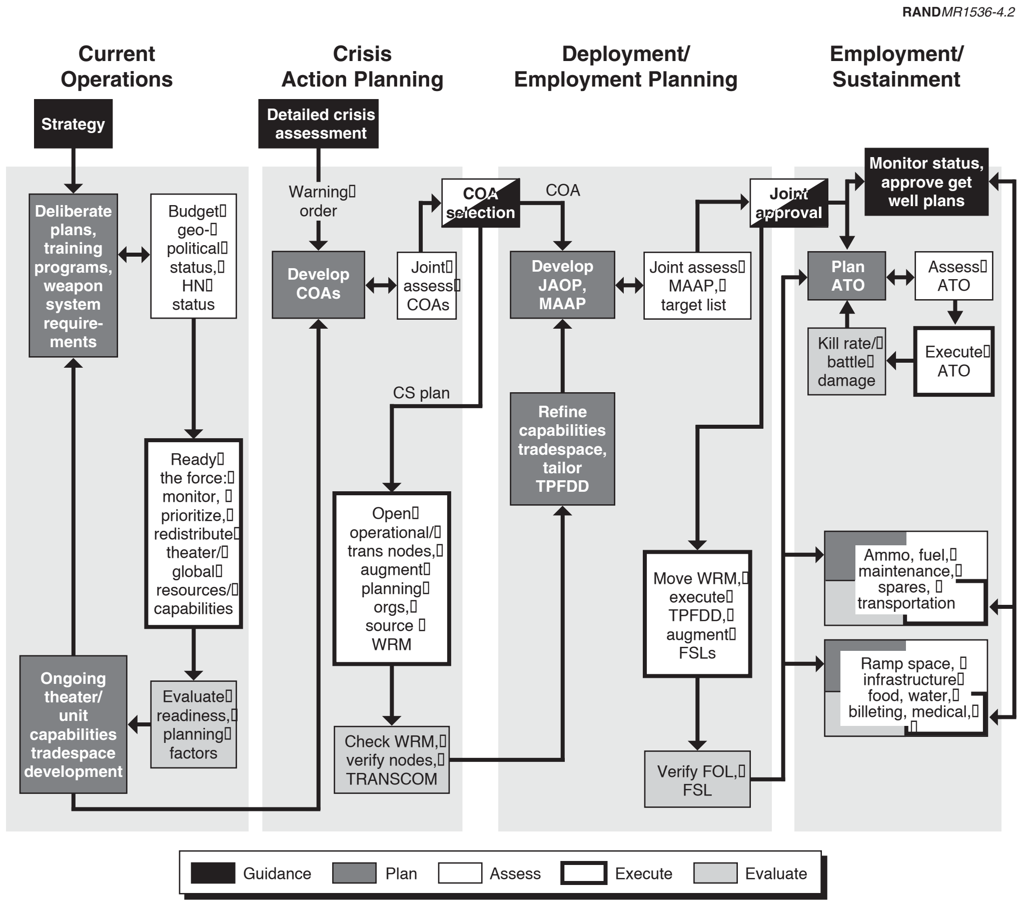

Figure 4.2—Mid-Level Detail of *TO-BE* Process

STRATEGIC PLANNING

The planning activities reflected in Figure 4.2 occur across the spectrum of operations. During day-to-day operations, planning supports programmed flying hours to achieve training objectives and prepare for combat. Planning products are flying schedules and air campaign plans for the operators. For logistics support, they include depot maintenance repair plans, spares allocation plans, and war reserve materiel distribution to support the flying program and air campaign plans. On the installation support side, planning products center around infrastructure operation and maintenance, utility operations, and personnel service activities such as billeting and dining. Exceptions are emergency response activities such as fire, Explosive Ordnance Disposal (EOD), and medical. During wartime or contingency operations, combat execution is prepared in the crisis action planning process, with similar products and plans produced quickly. For both peacetime and wartime planning, we focus on the CS aspect and identify interaction with operators.

The first step in planning is to estimate CS resource (e.g., fuel, munitions, personnel, facilities, equipment, etc.) needs based on the operational requirements, which are typically defined in terms of required sorties by weapon system type. Care must be taken to incorporate uncertainty into the planning process.

Given an uncertain set of operational scenarios and strategic goals, an agile, robust CS system for execution planning and control should be able to meet a wide range of potential outcomes. Figure 4.3 demonstrates the operations planning closed-loop system and identifies the various products of each phase of the process at the operational level of war. Each of those products will identify factors for the CS plan. Sortie rates and durations by weapon system and location are the operations data most critical to the support plan. With those data, CS planning can proceed.

Support planners need to know U.S. capabilities at both the theater and global level, which requires centralized CS information to track each commodity resource level and support tools and trained personnel to aggregate the resource reports and convert them to operational capability measures. With the capability measures, CS personnel can assess the feasibility and implications of each operational and support option, and present a trade space of feasible support options to operational planners. With this trade space, the planners can select a strategy with a full understanding of its support implications and determine how the CS network should be tailored to best fit the chosen scenario. This is essential to developing an effects-based operational plan.

Combat support infrastructure tailoring actions can take many forms. Configuration actions can address the use of CIRFs, development of the distribution network, or the identification of sources of supply (SOSs), to name just a few. The support plan should establish inventory levels for such commodities as spare parts, munitions, and fuel, including safety stocks, at each node of the CS infrastructure, and it should provide protection against uncertainty.

Other elements of the CS plan are the expected performance of the CS infrastructure and the expected consumption of resources based on the planned operational tempo. Planning factors include parking capacity of aircraft ramps, potential fuel consumption versus available fuel storage, critical water and power capacities, expected removal rates for reparables, expected repair times for commodities through the various repair facilities, expected response times at various points within the distribution network, and expected munitions expenditure rates. These planning factors become critical inputs to the decision support tools that provide the "look-ahead" capability that enables combat support to be proactive.[2]

[2]Recently, 7th Air Force has developed a modeling capability, using an Air Force model called THUNDER, to determine the effect of critical munitions availability on their war plan. This capability is a positive step for incorporating combat support modeling into OPLANs, as discussed above. In their assessments, 7th Air Force planners will examine how reallocation of smart munitions from the Korean AOR to the air war over Afghanistan will affect movement of the Forward Edge of the Battle Area and additional aircraft and sorties that might be needed to compensate for the lower effectiveness of fewer smart bombs used against targets. They then will explore bedding down the additional aircraft on the Korean Peninsula.

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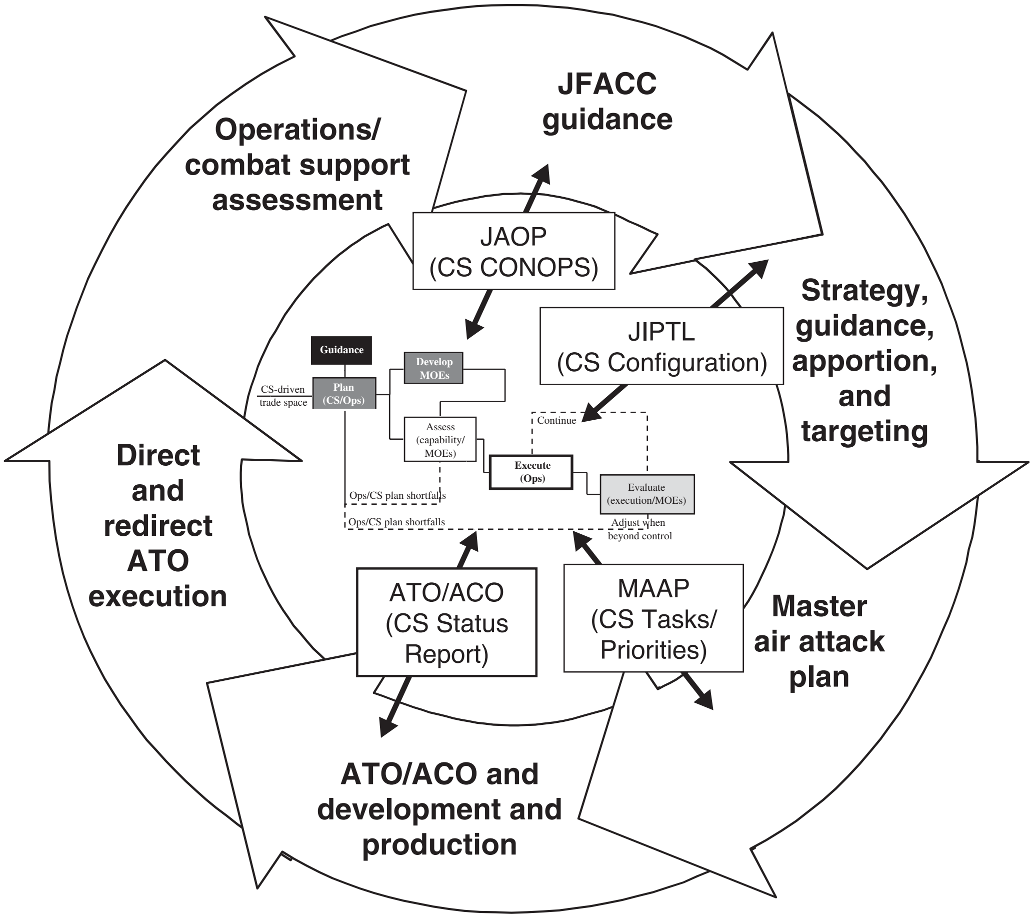

SOURCE: Air Force Instruction 13-1AOC, Vol. III, *Operational Procedures*, Air Operations Center, Washington, D.C., June 1,1999.

Figure 4.3—Integrated Operations/CSC2 Processes

The support network is configured from these plans. Most configuration takes place at the start of the execution phase, although some preparation of the battlefield for contingencies are carried out during strategic planning. Consolidating beddown of like aircraft types, resourcing theater distribution assets, prepositioning war reserve materiel, creating standing centralized maintenance facilities, or establishing command and control nodes are just a few examples of strategic configuration.

In some cases, the Air Force is not responsible for configuring elements of the infrastructure and requires capabilities managed by other services or agencies. The *TO-BE* concept supports Air Force requirements by providing information to the resource executive agent (e.g., the requirement for intratheater transportation to support movement of parts to and from centralized maintenance facilities). Similarly, the need for host nation resources in support of base access and force beddown should be communicated to the authority managing the allocation of those resources. In the *TO-BE* concept, Air Force requirements for the resources will be communicated to the appropriate agency to be considered when configuring those resources.

The next step is to assess the capability of the configured infrastructure. Staff determine whether airfield capacity (ramp, fuel, munitions, power, water), inventories, supply sources, repair facilities, and the distribution network can support operational requirements. Anticipated shortfalls will require retailoring the infrastructure configuration plan.

The plan is assessed against a set of metrics tied to goals such as sortie production capability. If no feasible CS plan can be created within reasonable cost, CS leaders must provide alternatives. The alternatives should provide the same or similar effects as in the original plan. The plan-assess-replan iterations continue until a feasible solution is found.[3]

The final step is to define any further configuration actions as the plan is executed. As mentioned earlier, configuration actions in the support plan are expected to consider the dynamic nature of operational requirements and the resources needed to mitigate the risk of variability in forecasted demands and in the CS processes.

Safety measures to mitigate these risks will be dependent on the scenario and commodity. For instance, increased inventory at strategic locations can serve as safety stock. Additional Line Replaceable Units (LRUs) at the FOL would alleviate the burden on the transportation system if intermediate repair is at a central location. For installation support, increased backup storage for fuel, water, or food can add days to a safety reserve. Increasing capacity at an intermediate repair location would accommodate higher than expected LRU removal rates. Forward positioning of intratheater lift capacity would ensure transportation to move low-demand, high-value parts. If intratheater transportation is the critical resource and might be a potential CS bottleneck, forward resource positioning at the FOL can alleviate demands on the distribution system. (That would be unnecessary, however, if there is an abundance of intratheater transportation and low demand from other services.) Each of these safety measures should be considered and an appropriate set worked into plans. CS planners need tools to assess these types of safety measures.

PLAN EXECUTION AND PROCESS MONITORING AND CONTROL

Plan execution includes peacetime activities (flying training missions or moving materiel within CONUS) and wartime activities (carrying out the air campaign plan, and deploying CS materiel to the theater). These activities are dictated by operational objectives, resource requirements, and configuration actions developed in the planning phase.

[3]The 7th Air Force munitions example in the previous footnote provides an insight into the type of assessments required here. We note that this type of assessment is needed for contingencies and unplanned wars and is not limited to canonical planning scenarios.

Once combat operations commence, the logistics and installations support infrastructure must be regulated to ensure continued support for dynamic operations. The system must monitor actual CS performance against that planned. The performance parameters and resource buffers established during execution planning will provide advance warning of potential system failure. When CS performance diverges from the desired level, the system must be able to detect the change, modify the original plan, develop a get-well plan, and reassess the modified plan's feasibility. Plan feasibility is assessed continuously. Safety measures, inventories, and high-level metrics are key elements in CS monitoring and control.

High-level metrics are shown in Table 4.1. Metrics at the command echelon can warn of a pending inability to meet operational requirements. Metrics at the mid- and lower level are tied to the higher-level metrics but enable adaptive planning at the lower echelons and should provide earlier warning of potential problems. The linkage of metrics across command echelons ensures that performance at the lower echelon is tied to higher-level operational requirements. At the same time, it allows lower echelons to monitor subsystem metrics and make corrections that do not suboptimize at the lower level at the expense of higher-level requirements.

Within the metrics hierarchy are a few key decision measures: operational cost of CS performance shortfalls and CS cost of operational objectives. The CSC2 system must support metrics for the operational/combat support tradeoff. The look-ahead analysis must address the long-range impact of near-term decisions from both an operational and a CS perspective.

As the system monitors performance, it must indicate when key operational measures are out of control and then facilitate get-well planning. When early warning of an impending failure to support operational requirements is received, the system should be able to drill down to the element or infrastructure component that

Table 4.1

Hierarchy of CS-Related Operations Metrics

Command Level	CS Performance Measure	Decision Measure (Ops/CS tradeoff)	Ops Performance Measure
High Level (JFC/JFACC/AFFOR)	Fleetwide MTW readiness Theater infrastructure preparedness	Operational cost of CS shortfalls Combat support cost of achieving operational objectives	Strategies accomplished: Centers of gravity Selected force availability
Mid Level (AOC Dir/A3/A4)	Weapon system availability Critical asset inventories		Tasks accomplished
Low Level (Wing/Depot/AFMC/Battlestaff)	Order & ship times Expected back order Depot repair cycle time Base repair cycle time Inventory levels		Targets killed per sortie Missions launched Other

NOTE: JFC = Joint Forces Command; AFMC = Air Force Materiel Command.

is contributing to the general failure. While the system is being monitored at the higher level against key operational measures, the lower levels are monitoring the performance of component processes against the planning parameters and thresholds established during execution planning. Because of the breadth of the resources and processes at the lower levels, system performance must be monitored with a few key high-level indicators, supplemented by a detailed metrics hierarchy at all echelons. After drilling down to the root cause of a problem, each echelon can manage effectively.

Finally, the *TO-BE* concept permits allocation of critical resources among competing demands. Resource arbitrations are carried out by the allocating authority. The request and associated cost/benefit trade space will be presented in operational terms related to the strategies and objectives initially communicated by the guidance authority.

AN EXAMPLE OF CS EXECUTION PLANNING AND CONTROL IN A SMALL-SCALE CONFLICT SCENARIO

We use an example of a small-scale conflict to discuss the *TO-BE* concept in both planning and execution.

In this scenario, Iraq attempts a lightning strike to seize key objectives in Kuwait and Saudi Arabia. The United States will attempt to defend Saudi Arabia and Kuwait using the predeployed Southern Watch force, augmented with an additional AEF on Day 3. We will apply the *TO-BE* concept in selecting, deploying, and sustaining the AEF.

Planners are considering two force mixes that are both capable of providing the desired results. The first is a force composed of four fighter squadrons (each with 24 aircraft) and three B-1 bombers deployed to bases in Saudi Arabia. The other force consists of a 24-aircraft squadron of fighters and 24 B-1 bombers operating from bases outside the theater. Given that both forces can achieve similar, acceptable effects (the first force can likely halt the attack at Kuwait City, the second force can likely halt the attack at the Saudi border), other factors such as deployment response time, beddown infrastructure requirements, and munitions and fuel requirements might enter into the force selection.

With weapon system selections derived from operational strategies and objectives, CS planners will review a list of beddown sites. Up-to-date knowledge of FOL and host nation capabilities will help determine which sites have sufficient runway length, aircraft parking space, tarmac load-bearing capacity, fuel and munitions storage capacity, and munitions and fuel inventory (if applicable). From the initial list of potential beddown sites that can support a variety of aircraft, options narrow; however, additional information is needed on sortie rates and munitions types to evaluate the sites' ability to support mixes of force types and weapons systems. This iterative exchange of requirements and capabilities information between operations and CS planners is characteristic of the future environment, which will demand a system able to quickly assess force-mix beddown requirements against available intra- and intertheater beddown capabilities.[4]

As planners analyze the force mix, they may arrive at different combinations and numbers of weapon systems that can meet the operational objectives within politically acceptable strategies. In this example, force employment analysis reveals two force packages that can provide the needed firepower: one requires three beddown sites and the other requires two. In continuing the iterative force beddown planning analysis, a CS execution planning and control system must be able to examine site capabilities and their ability to support the operational planners' force mixes. Critical to the analysis is the ability to drill down into specific capabilities and commodity inventory levels (e.g., fuel and ammunition, fuel distribution, ammunition build-up and distribution, etc.) at each site and to analyze the various force-mix demands against the capabilities over a specified period of operations. This additional, more detailed analysis again requires more information from operations planners with respect to the intended sortie rate and sortie duration for the different force mixes, as well as some general idea of the types and quantities of munitions to be used over the planning horizon.

Given the additional operational planning factors, the system must be able to again quickly compute estimates of resource requirements for force employment options and assess their feasibility against available resources, both in place at the beddown locations and potentially available as part of the force deployment and sustainment plan. A key output is the translation of CS resources and capabilities in terms reflective of operational goals (e.g., sortie rates). As reflected in Figure 4.4, it is important to view the beddown feasibility assessment from both a resource perspective (e.g., gallons of fuel and number of munitions required and available) over time and an operational perspective (e.g., sortie production required and capable) over time. This analysis will contribute to the final selection of the force mix that will be deployed to support operational objectives.[5]

Parallel beddown analysis considerations for installation planners extend beyond sortie production and sustainment to include base support infrastructure/resources to support the population growth associated with force deployment. Base infrastructure analysis must consider the requirement for and availability of resources such as lodging, meals, power, water, and sanitation. As with the sortie production and sustainment analysis, the base infrastructure analysis should be conducted over the time horizon specified by the operators and include both in-place resources and those that can be made available through the deployment and sustainment plan.

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[4]ACC and PACAF developed a remote beddown assessment capability called GeoReach that was unveiled at CORONA, fall 2000. It relies on ISR assets and a five-step process to locate, image, assess, map, and enable a 70 percent to 80 percent planning solution for potential beddown sites. The GeoReach capability was used in the early days of Enduring Freedom to assess and prioritize potential beddown locations in two to three days versus the two to three weeks it took in earlier contingencies.

[5]The operational assessment should reflect the integration of CS resource assessments. In our example, shortfalls in sortie production are projected on Days 4–5 and 10–15 because of insufficient munitions inventory, and on Days 6 and 12 as a result of insufficient POL (petroleum, oil, and lubricants) inventory.

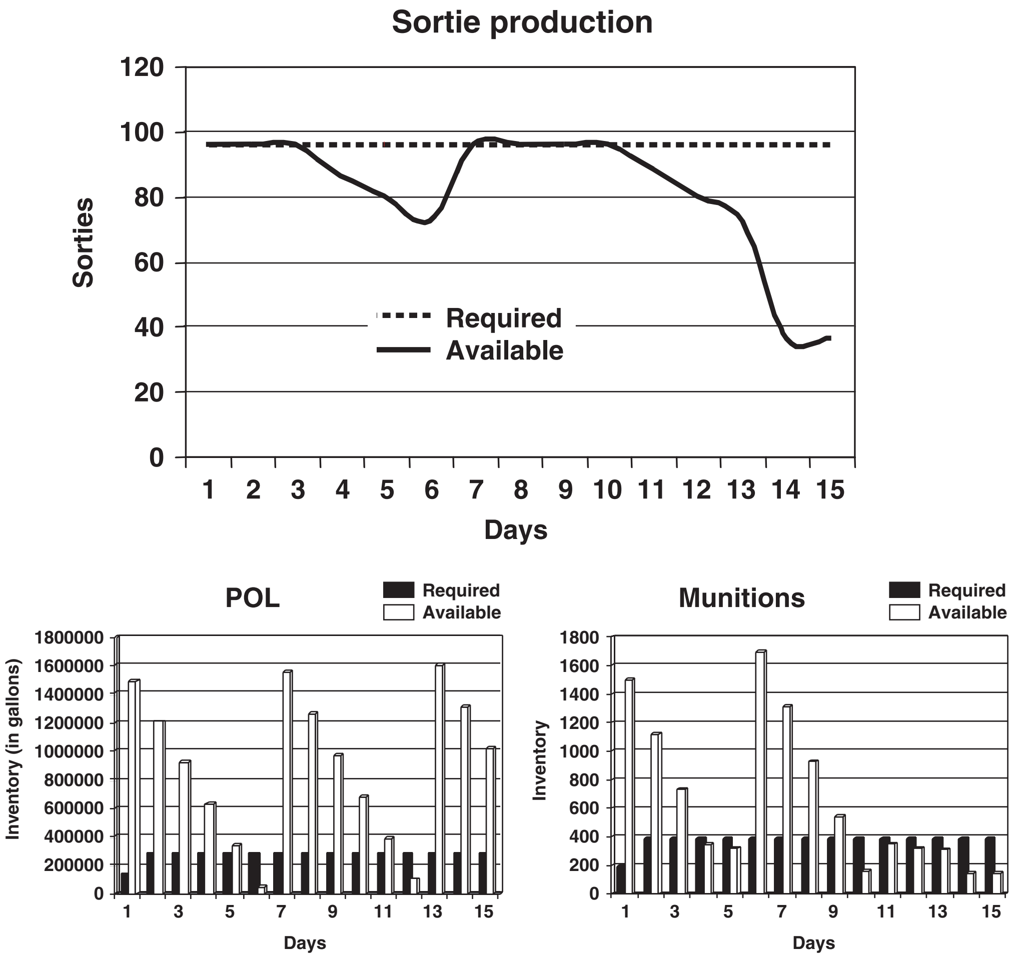

Figure 4.4—Sortie Production and Resource Views

Force and beddown analysis will result in (1) a feasible plan for the placement of forces at FOLs, employment of those forces, and sustainment of both the weapon systems and associated support personnel or (2) an infeasible plan. As shown in Figure 4.5, the sustainment plan should address where and how maintenance operations will be conducted, how inter- and intratheater transportation will be provided, as well as infrastructure configuration and expansion actions to ensure timely support of operations.

As the plan is executed, the focus shifts to resource and process monitoring and control. Our example continues by looking at the role of CS during execution.

In this example, a set of inventory levels has been established for LRUs that cross a common test station at a CIRF. There are only two LRUs that use a common test station, LRU #1 and LRU #2. The LRU levels at the CIRF are dependent on demand rate, resupply time from the intermediate repair facility, repair cycle time at the

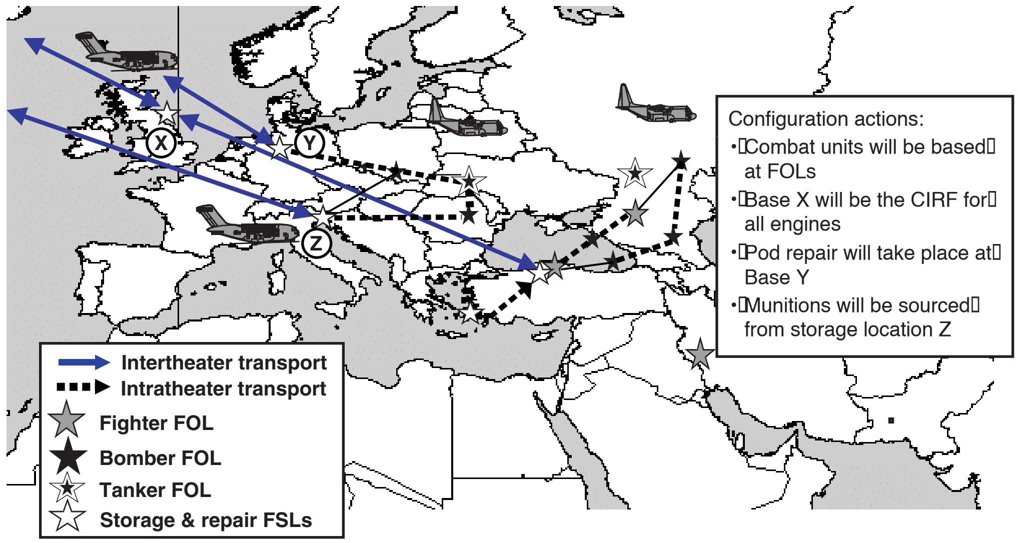

Figure 4.5—Configuration Actions Resulting from CS Planning Analysis

repair facility, and so forth.[6] In this case, the inventory levels are based on best estimates of the expected 30-day flying-hour profile of the weapon system that uses the LRUs. Thus, the inventory levels of these LRUs can be monitored, as can the input parameters used to establish levels, to determine if the flying-hour program is likely to be supportable. Assume an inventory level has been established for LRU #1 that would support "normal" variations in removal rates at the flight line, normal or expected resupply times, and repair cycle times, among other parameters. In the example in Figure 4.6, the level at the CIRF for LRU #1 is projected to drop below its threshold level based on scenario planning, as shown on the upper right side of the chart. Given this projection, the FOL inventory for LRU #1, shown on the lower right side, will go to zero on Day 15, which will result in reduced sorties shown on the left side of Figure 4.6. In this way, the CS execution planning and control system indicates how CS lower-level metrics can be monitored and threshold shortfalls related to combat performance in advance of effects of the shortfalls being realized.

The scenario reflected in Figure 4.6 shows that at Day 15, the fully mission capable (FMC) aircraft percentage is projected to be below acceptable operational thresholds, resulting in required sorties not being flown. Continuing our example, Figure 4.7 illustrates drill-down of LRU #1 performance from the CIRF perspective. This illustration shows how a C2 system component at the CIRF could track key parameters that drive the LRU inventory level, including shop replaceable unit (SRU) levels, repair cycle time, and removal rates at the FOL. The removal rate for LRU #1 is underestimated, given the sortie production surge on Days 11–14, and as a result the FOL

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[6]See Richard Hillestad, *Dyna-METRIC: Dynamic Multi-Echelon Technique for Recoverable Item Control*, RAND, R-2785-AF, 1982; and Raymond Pyles, *The Dyna-METRIC Readiness Assessment Model: Motivation, Capabilities, and Use*, RAND, R-2886-AF, 1984.

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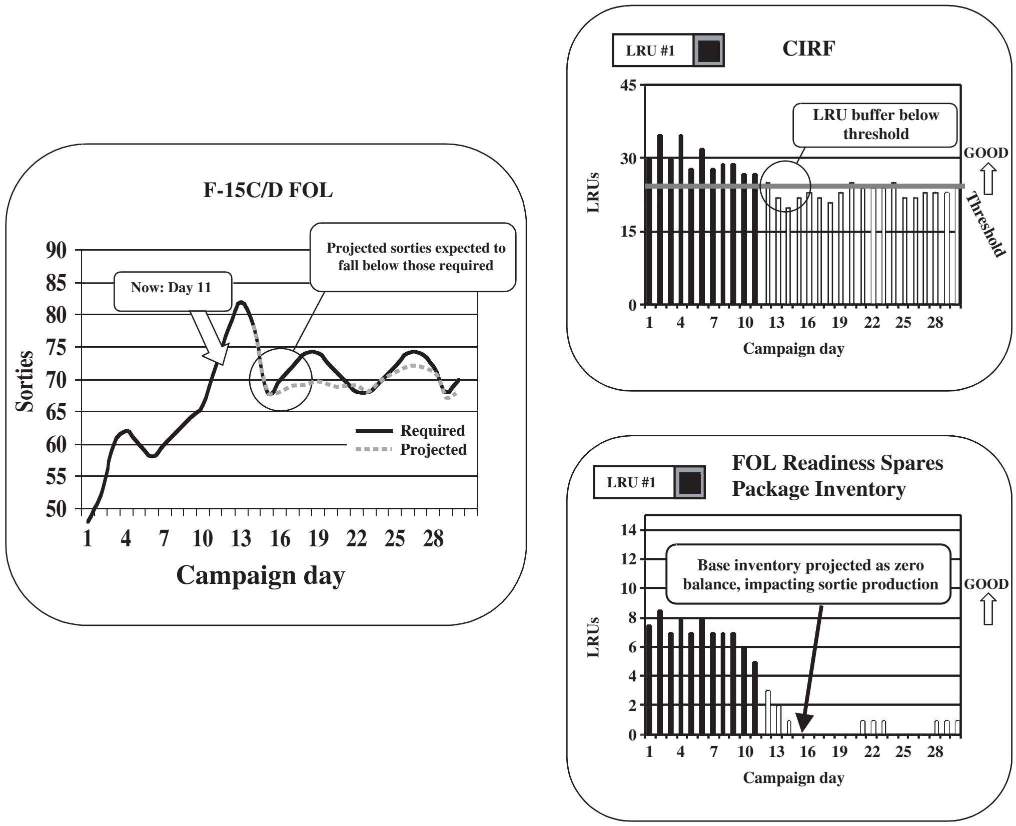

Figure 4.6—Sortie Production Capability and LRU Inventory Level

inventory for LRU #1 is projected to go to zero. The quantity of LRUs #1 at the CIRF will fall below their threshold buffer level, as shown on the left side of the figure (replicated from Figure 4.6).

There are many possible causes for the LRU #1 removal rate to exceed its buffer threshold level. The initial failure rate estimation for this LRU could have been flawed, external factors such as operating in a harsh environment may not have been fully considered, or the failure rate may vary from that planned with respect to the total number of sorties flown. In this case, the removal rate increase was a result of higher-than-expected sortie requirements.

The cause for the decrease in LRUs #1 below the buffer threshold can now be expressed in terms of the effect on projected performance for both operational and logistics decisionmakers. Get-well plans can be developed and implemented. In this case, the level for LRU #1 at the FOL could be adjusted upward and more stock moved from the CIRF to the FOL to protect against the unexpected rise in the removal rate.

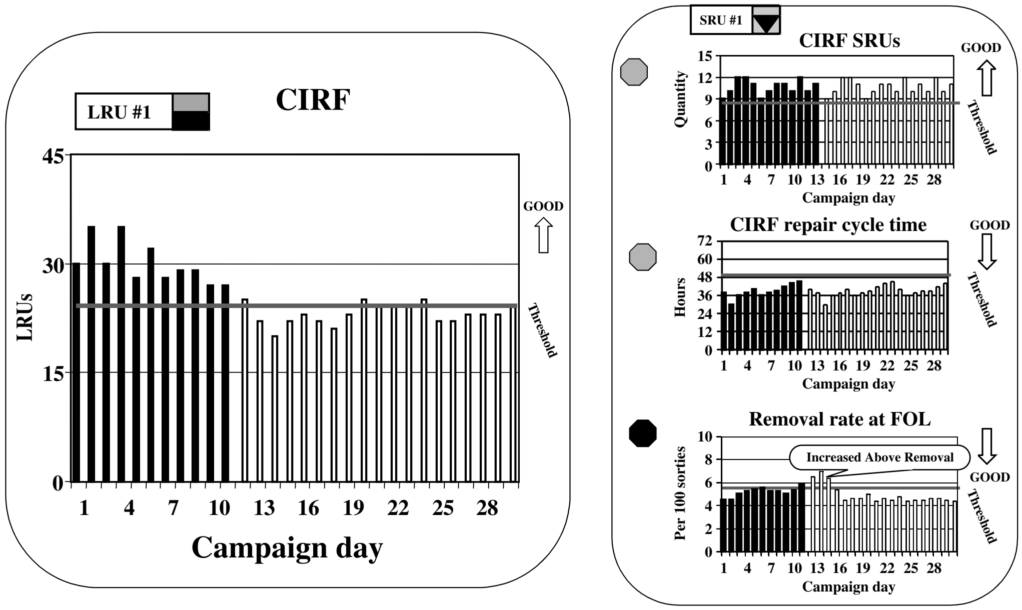

Figure 4.7—CIRF Capacity Drill-Down

By establishing thresholds on performance and appropriate safety-level stocks to respond to changes in operational capabilities, the ability to drill down and pinpoint the potential and actual causes of sortie-generation problems, and a feedback loop to communicate with operations and CS planning organizations, the C2 for combat support system can detect and resolve CS disconnects and enable continued operations.

Although this example deals with a single repair location problem and has a short-term, easily implemented solution, the system and decisionmaking methodology can be used to monitor all aspects of a campaign. For any operational problems discovered during a status evaluation, the execution planning and control system should have tools and personnel to identify the CS shortfalls responsible. These shortfalls can include any aspects of combat support, from repair prioritization to theater distribution or infrastructure configuration. For any problem or proposed solution, the system should be able to project its effects on overall operational effectiveness. Planners must be equipped to choose a solution that addresses the problem at hand, while considering the impact on future risk and capabilities.