



**DLA-ARN Final Technical Report**

**Phase 0: Feasibility Study for  
ARN Balanced Flow NOMEX Supply Chain**

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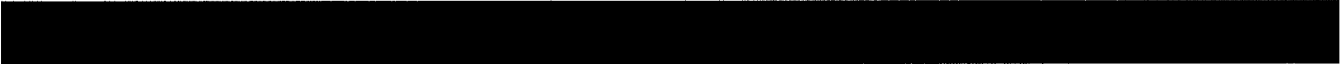


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# Table of Contents

<b>Executive Summary</b> .....	<b>1</b>
Problem Statement .....	1
Scope .....	1
Technical Discussion.....	1
Conclusion .....	3
<b>Introduction</b> .....	<b>3</b>
Problem Statement .....	3
Proposed Solutions .....	4
Scope of Project.....	6
<b>Technical Discussion</b> .....	<b>7</b>
Project Description .....	7
One ARN System.....	7
Upstream Manufacturing Segments .....	8
DSCP Wholesale SC Segment.....	8
Military Service Retail Segments .....	8
Economic Feasibility Study For The Entire NOMEX Supply Chain .....	9
Task Summary .....	9
Evaluation of Technical Feasibility .....	10
Task 1. Identify Information and Business Process Needs.....	10
Task 2. Evaluate Information and Business Process Requirements .....	13
Task 3. Design of the Information, Security and Communication Layers of the Extended AAVS Datamart .....	16
Evaluation of Economic Viability.....	29
Business Case Summary .....	29
Simulation Assumptions and Limitations .....	31
Business Case Assumptions and Limitations .....	32
Simulation Examples.....	33
<b>Conclusion</b> .....	<b>35</b>
Accomplishments .....	35
Benefits .....	36
Lessons Learned .....	36
Recommendations.....	37
<b>Appendices</b> .....	<b>38</b>
Appendix A: Acronyms List.....	38
Appendix B: NOMEX Supply Chain Member Survey .....	40
Appendix C: Data Model for the Extended ARN Operational System .....	48
Appendix D: Cost & Benefit Analysis Results.....	49
Appendix E: Procedure for Running the Simulation for the NOMEX .....	51
Appendix F: Data Extraction Logic.....	53

## List of Figures

Figure 1. Nomex SC Project Plan Overview.....	5
Figure 2. Extended ARN Operational System.....	6
Figure 3. The Structure of the NOMEX supply network.....	11
Figure 4. Actual and Simulated Inventories during the First 90 Days.....	33
Figure 5. Multi-year Oversupply.....	34
Figure 6. An Example of a Low Supply Item.....	35

## List of Tables

Table 1. Primary and Selected NOMEX Items.....	7
Table 2. List of NOMEX SC Member Receiving the Final Questionnaire.....	12
Table 3. List of NOMEX SC Members who responded to the final questionnaire.....	12
Table 4. Summary of Information Usefulness Gathered from the Questionnaire.....	15
Table 5. Summary of Willingness to Share Information Gathered from the Questionnaire.....	15
Table 6. Summary of Business Requirements and Opportunities for Improvement.....	16
Table 7. Company Level Privileges.....	27
Table 8. Company Level Privileges.....	27
Table 9. Supply Chain Members Method to Communicate.....	29

## Executive Summary

### Problem Statement

The overall objective of the DLA is to have an effective supply chain to supply the war fighter. To accomplish this they are establishing systems to integrate and manage their supply chain's critical components to supply what they need, when they need it, where they need it, while constrained by budgets. Historically, DLA has focused on the supply chain only from the primary government contractor to their downstream military Service customers. Since DLA does not have visibility of assets that belong to their customers, their retail focus has been only on fulfilling retail requisitions rather than optimizing the overall performance of entire supply chains. In addition, the upstream tiers of the extended supply chains have been left to the management capabilities of end-item contractors, most of which are not capable of managing upstream partners in a manner to optimize SC performance.

The supply chain inefficiencies illustrated above cause two core problems that must be addressed to optimize total SC performance. They are the variations in replenishment orders that originate at retail and the variations in customer wait times that originate at the first raw material producers. Both of these variations are increased by each SC partner and passed on to the next partner.

Real-time total asset visibility, supply chain execution rules, and efficient automated decision support systems need to be established so the SC partners can minimize or eliminate these two core problems. The existing ARN system should be expanded downstream and upstream to attain total asset visibility across the DLA C&T supply chain. Once the total asset visibility is achieved, the existing ARN Supply Chain Solution with new enhanced functionalities could provide automated supply chain planning and execution support to all SC partners. The extended ARN system would then be able to create a flow of downstream retail replenishment orders and enable upstream suppliers to launch manufacturing earlier at their own risk, thereby crating a flow of products to significantly reduce lead-times and inventories.

### Scope

The ARN NOMEX Supply Chain project focuses on optimizing the operations of the NOMEX supply chain from end to end. This can be realized by providing total asset visibility, decision support, and process improvements across the entire C&T SC from downstream retail Services to the upstream fiber producers. The project extends the ARN System Operational Scenario from the current wholesale and end-item contractor focus to retail and all upstream SC partners using the Nomex family of items with the emphasis on information exchange and decision support through the AAVS DataMart and VIM tools. The Extended ARN Operational System could provide supply chain system wide decision support capable of delivering "end-to-end" recommendations for ordering, sourcing, production, wholesale control and retail management of inventories across the extended the Nomex Supply Chain.

In phase 0, the team evaluated the technical feasibility and economic viability of the Extended ARN Operational System. We developed a Data Model for secure and timely exchange of information throughout the Nomex supply chain from fabric and fiber manufacturers to wholesale. A business case analysis was conducted to investigate potential cost benefits to DLA. Although the project benefits all of the NOMEX supply chain participants, phase 0 efforts focused primarily on the benefits at the C&T wholesale level, especially expected reductions in lead-times, stockouts and inventories.

### Technical Discussion

- Task 1. Identify information & business process needs
- Task 2. Evaluate information and business process needs
- Task 3. Design of the information, security and communication layers of the extended AAVS Datamart

The primary deliverable of Tasks 1, 2, and 3 was the **design of a Data Model** for extending the AAVS Datamart to the complete DLA C&T SC. We sent out a pilot questionnaire to key SC members via email on May 23, 2003. The SC members provided us constructive suggestions regarding possible amendments to the pilot questionnaire. We revised the questionnaire accordingly. The final version questionnaire is provided in Appendix B. The team distributed the final questionnaire to NOMEX Supply Chain members and received responses from eight companies.

Based on the collected information requirements, the team developed a comprehensive Data Model for extending the AAVS Datamart to provide total asset visibility across the entire NOMEX Supply Chain. We worked with Modulant to validate the Data Model. The Data Model is presented in Appendix C.

The design document of the Data Model is provided in the Technical Discussion section of this report and was sent to Modulant for review. The design document identifies the data requirements for the NOMEX supply chain. For each data element, it provides a short description and a potential match with a field in the AAVS Datamart (if any).

Task 4. Cost & Benefit analysis

Task 4a. Pilot Demonstration

Task 5. Discounted cash flow analysis

Task 6. Sensitivity analysis

The deliverable of Tasks 4, 4a, 5, and 6 was a business case evaluating the economic viability of the Data Model and its enabling tools. The potential benefits to the Nomex Supply Chain include:

- Reductions in lead-times from initial raw material to retail operations,
- Reductions in stockouts, shortages and backorders,
- Reductions in inventory investments across the entire supply chain,
- Reductions in operating expenses, and
- Reductions in cost of capital.

These benefits were validated during our Phase 0 project in which we constructed a business case based on simulation runs of the 7 selected PGCs for year 2003. The simulation used a version of the VIM-BIFRS software. The simulation inputs were actual product delivery and customer requisitions for just the C&T portion of the extended supply chain. This represented a fraction of the total benefits because the business case did not address all the other C&T items or the retail, prime contractor, textile supplier, and fiber supplier sections of the extended C&T supply chains.

The business case analysis considered a series of measurable benefits and costs of providing total asset visibility and decision support through the NOMEX family of products. Seven key PGCs from the Nomex family as requested by C&T Item Managers were included in the analysis. The analysis was assumed to begin in 2004 and extended for three years. The costs and benefits were discounted over ten years. The results indicated the present value of \$17,383,445 net benefit (i.e., benefits minus costs), an ROI of 8.21% and a 53% reduction in stock-outs.

The summary of Cost & Benefits Analysis is shown in Appendix D. The summary was divided into three sections; Undiscounted Flows, Discount Factors, and Discounted Flows. The top two rows of the Undiscounted Flows section showed costs and benefits from the two following tables. The third row calculated the net benefit by subtracting the costs from the benefits by year. The Net Total Value for all 10 years was \$17,964,572.

The Discount Factors section applied discount factors for each fiscal year beginning with the base year of 2004. The discount factors were based on a discount rate of 4.2%. The Discounted Flows section showed the results of applying the Discount Factors. The discounted costs and benefits were calculated as original costs and benefits multiplied by the discount factors. A cumulative total was calculated for each year with the previous years net added to the current year's net. The business case showed a Net Present Value of \$17,383,445 and an ROI of 8.21.

## **Conclusion**

The project's Phase 0 effort has provided a validated Data Model for the integration of existing ARN systems with the downstream retail military and upstream commercial systems of fiber and fabric sections of the Nomex Supply Chain. The results from Phase 0 study indicate that extending the ARN concepts and systems across entire supply chains for non-recruit items beginning with Nomex items could generate significant additional improvements for the DLA. The questionnaire responses suggested that to optimize the operations of the NOMEX supply chain from end to end, it is essential to provide total asset visibility, decision support, and process improvements across the entire C&T SC from downstream retail Services to the upstream fiber producers. The total asset visibility has to be established first to support the implementations of decision support and process improvements. To establish total asset visibility, the existing ARN Operational System needs to be extended to include retail and all upstream SC partners.

During the Phase 0, we developed a Data Model for secure and timely exchange of information throughout the Nomex supply chain from fabric and fiber manufacturers to wholesale. A business case analysis was conducted to investigate potential cost benefits of the Data Model and its enabling tools to DLA. The analysis considered a series of measurable benefits and costs of providing total asset visibility and decision support. Seven key PGCs from the Nomex family as requested by C&T Item Managers were included in the analysis. The analysis was assumed to begin in 2004 and extended for three years. The costs and benefits were discounted over ten years. The results indicated an anticipated net benefit (i.e., benefits minus costs) of \$17,383,445, an ROI of 8.21% and a 53% reduction in stock-outs.

## **Introduction**

### **Problem Statement**

The overall objective of the DLA is to have an effective supply chain to supply the war fighter. To accomplish this they are establishing systems to integrate and manage their supply chain's critical components to supply what they need, when they need it, where they need it, while constrained by budgets. The critical components are those that constrain capacity, have long lead times, high costs, inventories, and uncertainties anywhere in the supply chain. Historically, DLA has focused on the supply chain only from the primary government contractor to their downstream military Service customers. Since DLA does not have visibility of assets that belong to their customers, their retail focus has been only on fulfilling retail requisitions rather than optimizing the overall performance of entire supply chains. In addition, the upstream tiers of the extended supply chains have been left to the management capabilities of end-item contractors, most of which are not capable of managing upstream partners in a manner to optimize SC performance.

Because of the lack of retail asset visibility, today DSCP is forced to react to downstream customer requisitions rather than real retail end item demand. Previous ARN work identified that the manner in which retail replenishment requisitions are generated is the primary core problem limiting supply chain performance. There are two parts to solving this problem. The first part is converting infrequent, large-quantity orders into a flow of smaller orders. This has a significant positive impact up the entire SC. However, retail sites often are prohibited from creating this optimum flow of replenishment orders for any number of reasons. The second part is, once TAV is established, Wholesale Item Managers basing their replenishment decisions on the most pressing downstream requirements rather than requisitions and maintaining a smoother flow of demand to end-item and other upstream SC partners. This predictable-smoothed demand schedule is essential to

improved performance of contractors and their upstream partners. It is the basis for their collaboration in this process.

Additionally, the current C&T Item Manager focus is only one level upstream to the end-item contractors. This focus would be sufficient if end-item contractors were using only readily available commercial raw materials. Military specification components that frequently extend all the way upstream to initial fiber and fabric manufacturing are not readily available and are, in the case of Nomex, a sole source item. This upstream portion of the extended supply chain is important in peacetime, but absolutely vital in wartime. The vast majority of the functional performance characteristics of sewn products originate in textile fiber manufacturing and finishing – not end-item manufacturing. More importantly, end-item manufacturing can be accelerated in wartime much easier and faster than textile manufacturing. Thus, the textile and fiber end of the military C&T supply chain is vital to wartime performance, but relatively un-addressed historically.

Implicit in today's DSCP focus is a reliance on the government contractor to manage the upstream portion of the supply chain from their operation to initial raw materials. While this approach may work in other procurement areas, the structure of the organizational clothing industry has historically placed the prime contractor in a position too weak to manage their upstream supply chain. However, the performance of DLA C&T supply chains is highly dependent on these upstream components. They are characterized by constrained capacity, single sources of supply, long lead times, and quality issues. They are manageable but remain unmanaged. This results in operational inefficiencies: high safety stocks, abrupt stockouts, line imbalances, line shutdowns – all of which result in stock outs and increased costs for the suppliers, the contractors, and the military at wholesale and retail.

The DLA Nomex supply chain is an example of the apparel industry's structure for a mission critical, high cost product that consists of military unique raw materials. Lead and cycle times are long with a single source provider for military specification Nomex fibers. A few large companies do yarn spinning and weaving. The actual government contractors are mostly typical for the apparel industry - small, poorly capitalized, and incapable of managing their suppliers. The upstream players in this chain, DuPont, Milliken, Springfield, and Pharr Yarn are interested in and capable of participating in this project. They understand the problems and will cooperate but lack the information and connectivity to government systems that would allow for supply chain cooperation and integration.

## **Proposed Solutions**

The Apparel Research Network has demonstrated through its work with recruit clothing the level of improvements that can be realized just by creating asset visibility across end-item manufacturing, DSCP wholesale operations, and retail operations. Extending the ARN concepts and systems across entire supply chains for non-recruit items can generate significant improvements. This overcomes the three major remaining barriers to optimal C&T supply chain performance – integrating downstream and upstream SC partners and providing them with decision support tools.

There are two core problems that must be addressed to optimize total SC performance. They are the variations in replenishment orders that originate at retail and the variations in customer wait times that originate at the first raw material producers. Both of these variations are increased by each SC partner and passed on to the next partner. By integrating all upstream and downstream SC players in a truly collaborative improvement process, the project sets the stage to eliminate both of these core problems.

Real-time total asset visibility, supply chain execution rules, and efficient automated decision support systems must be established so the SC partners can minimize or eliminate these two core problems. Existing ARN Supply Chain Solution with new functionalities can provide automated supply chain planning and execution support to all SC partners. The existing ARN system can be expanded downstream to create a flow of retail replenishment orders and upstream to enable suppliers to launch manufacturing earlier at their own risk, thereby creating a flow of products to significantly reduce lead-times and inventories.

Current VIM tools that comprise the ARN developed Supply Chain Solution (ARN System Operational Scenario) were designed to operate within the military wholesale and prime contractor arena. The AAVS DataMart and associated VIM tools were not tasked to have total asset visibility nor do they extend across any entire supply chains. Thus, this project proposes to extend the scope of current and proposed components of the ARN Supply Chain Solution, as illustrated in Figure 1.

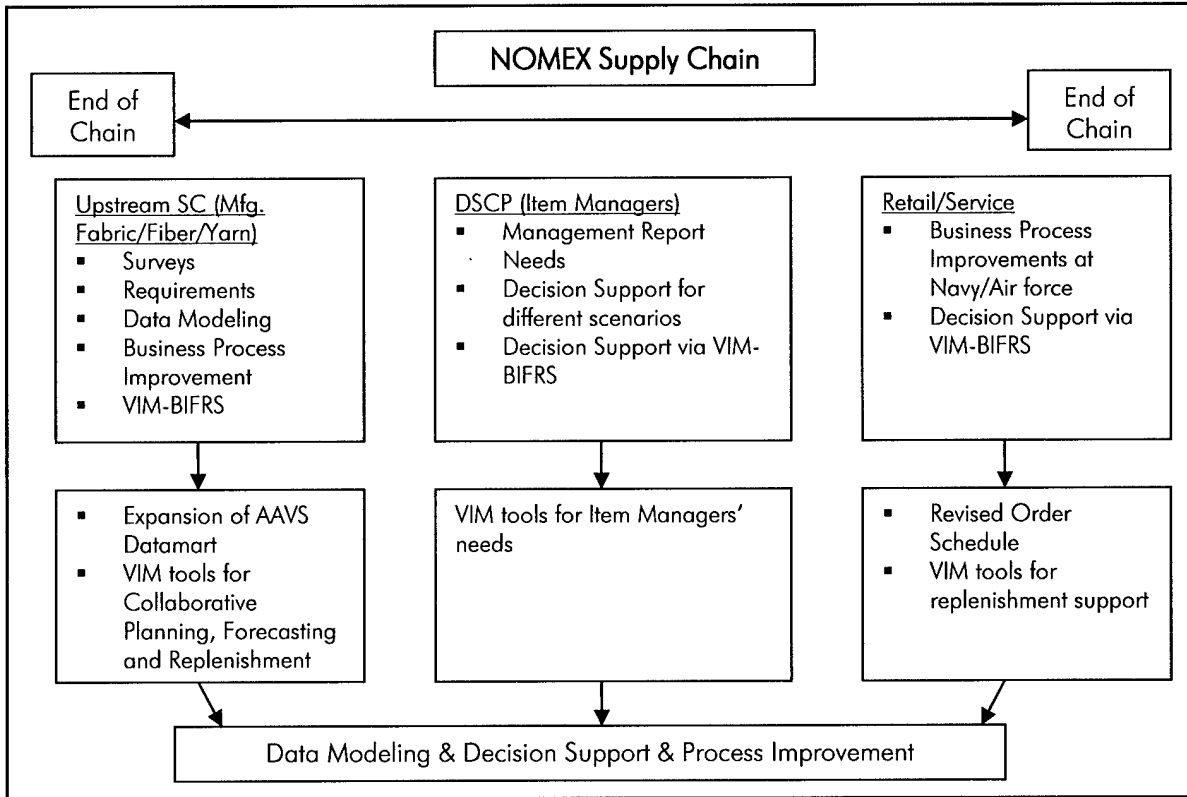


Figure 1. Nomex SC Project Plan Overview

Figure 2 below illustrates the Extended ARN Operational System that extends the capabilities of the current ARN SC tools (AAVS DataMart, VIM/BIFRS-W, VIM/ASAP, and VIM/QLM-Central). With the addition of the supply collaborative planning decision tools in VIM-BIFRS for the upstream supply chain members, the downstream retail execution tools in VIM-BIFRS for retailers, and the expanded delivery order decision support tools in VIM-BIFRS for DSCP we have expanded the ARN Operational System to its full scope, from raw material production to retail sales.

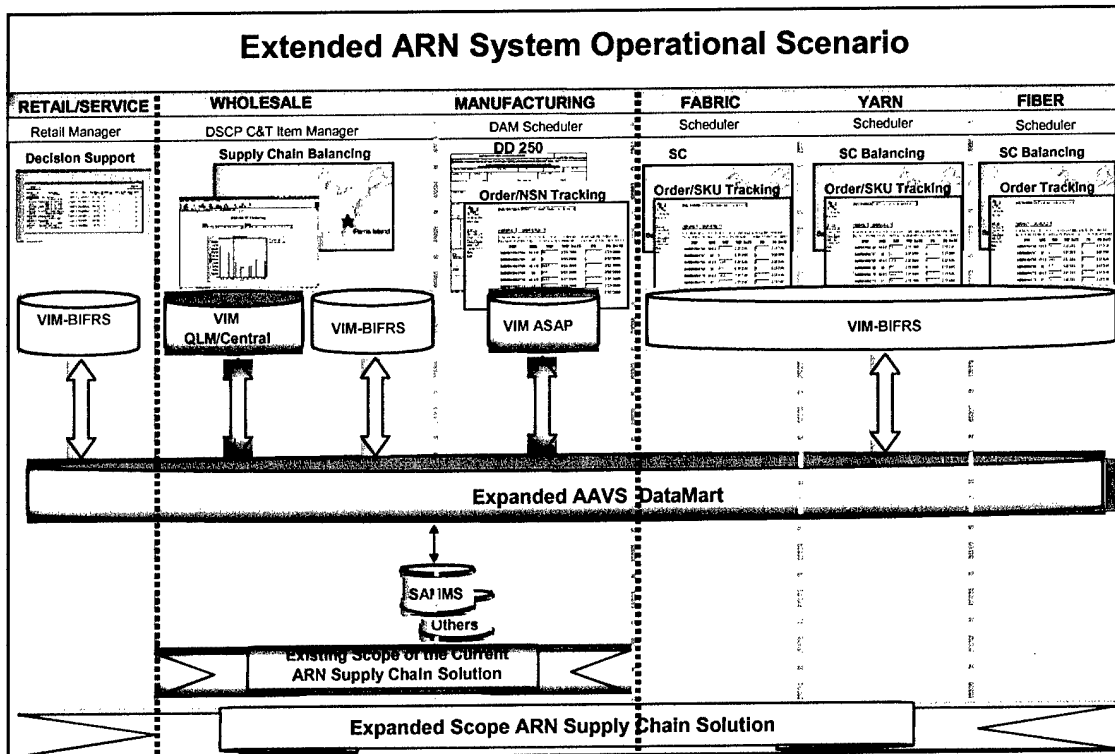


Figure 2. Extended ARN Operational System

The Phase 0 effort provided a validated Data Model for the integration of existing ARN systems with the downstream retail military and upstream commercial systems of fiber and fabric sections of the Nomex Supply Chain. Implementation of this Data Model (during Phase 1) will enable the integration of the complete Nomex Supply Chain - from retail through wholesale to fiber and fabric manufacturers. This will provide opportunities for other ARN partners to enhance the current scope of their databases. The new decision support services offered by the enhanced ARN VIM tools will include Total Asset Visibility, contract tracking, status reports, inventory recommendations, etc., for the downstream and upstream members of the supply chain. Since the existing ARN Operational Scenario has previously optimized performance of only the retail recruit training sections, this project completes the entire integrated SC for organizational clothing by encompassing retail and upstream partners.

When the Extended ARN Operational Scenario has visibility across the entire supply chain and shares relevant information with the partners as visualized in Figure 2, four groups of players will benefit. First, DLA through the Item Managers at DSCP will be able to dramatically improve peacetime and wartime service levels, customer wait times, inventory investments, manufacturing costs, and operational costs. Second, the prime contractors will be able to improve service levels and control costs. The upstream suppliers will be able to better manage capacity, plan production, and reduce uncertainty, with the potential to reduce supply chain costs and lead times. Finally, the primary beneficiary of these improvements will be DSCP's customers because they will be supported better at significantly lower total costs.

### Scope of Project

The objective of this project is to extend the ARN System Operational Scenario from the current wholesale and end-item contractor focus to retail and all upstream SC partners using the Nomex family of items with the emphasis on information exchange and decision support through the AAVS DataMart and VIM tools.

In phase 0, the team evaluated the technical feasibility and economic viability of this model. We developed a Data Model for secure and timely exchange of information throughout the Nomex supply chain from fabric and fiber manufacturers to wholesale. A business case analysis was conducted to investigate potential cost benefits of the Data Model and its enabling tools to DLA. The participants of the Nomex supply chain included

wholesale operations, end-item manufacturing, fabric manufacturing, and Nomex fiber manufacturing. Although the project benefits all of the NOMEX supply chain participants, phase 0 efforts focused primarily on the benefits at the C&T wholesale level, especially expected reductions in lead-times, stockouts and inventories. The following table shows the major Nomex end-items and the seven initially selected for implementation in phase 1:

Primary and Selected (Highlighted) Nomex Items		
PGCs	Description	Services
470	Coveralls, Flyers 27/P Green (Men's)	AF, N, MC
491	Drawers, Flyers, Aramid, body CWU-43/P	
526	Gloves, Flyers, Summer, Green	
621	Jacket, Flyers, Winter, 45/P (Lead Item)	AF, N
622	Jacket Flyers, Summer, 36/P	AF, N
1656	Gloves, CVC	
1755	Body Armor, CVC, Outer Shell / Body Armor, CVC, Ballistic Inserts	
1931	Coverall, Flyers, Cold Weather, CWU-64/P	
2164	Coat, Combat, Tan (ABDU)	
2165	Trousers, Combat, Tan (ABDU)	
2204	Trousers, Combat, Woodland (ABDU)	
2205	Coat, Combat, Woodland (ABDU)	
2259	Jacket, Flyers, ACWCS, Woodland, Shell	Army
2260	Jacket, Flyers, ACWCS, Jacket Lining	Army
2442	Coveralls, Flyers 27/P Tan (Men's)	AF, N, MC
2456	Suit, Aiti-G, Green	
2578	Gloves, Flyers, Summer Tan	
2579	Gloves, Flyers, Summer, Black	
2773	Jacket, Cold Weather, Navy	Navy

Table 1. Primary and Selected NOMEX Items

The Nomex family of items was selected because of the high cost of Nomex, the critical wartime nature of Nomex items, the convergence of all branches of this supply network at DuPont's single Nomex fiber production facility, and the strong support of all the Nomex end-item, fiber, and textile manufacturers.

## Technical Discussion

### Project Description

As illustrated in Figure 1, the NOMEX supply chain consists of three segments, 1) upstream manufacturing (Fabric/Fiber/Yarn), 2) DSCP wholesale and 3) Retail or military Services. The following paragraphs describe what we have accomplished for each segment.

#### One ARN System

To provide end-to-end asset visibility, the AAVS Datamart will be expanded to incorporate operational data from upstream fabric and fiber manufacturers as well as downstream retail sites. The AAVS Datamart will be the only database for collecting and maintaining all C&T SC data. The decision support tools developed based on this data will be provided to Modulant totally consistent with current ARN programming, VIM functionality, and VIM screens. We provided Modulant a Data Model for expanding the AAVS Datamart. Expanded AAVS Datamart will provide total asset visibility and serve as the foundation for the development and integration of a new generation of VIM tools that provide end-to-end support to the C&T supply chain.

## Upstream Manufacturing Segments

We completed the identification of upstream data, security, communication requirements, and potential savings based on our questionnaires and discussions with key upstream Nomex SC players.

### *Tasks for Upstream SC Segments*

- Developed a Data Model capturing the data elements and security needs required for the NOMEX Supply Chain. The development of the Data Model was completed based on the information and business process requirements collected through the questionnaires.
- Validated the developed Data Model with Modulant. As we completed the operational Data Model all the way upstream to initial fiber producers, we validated it with Modulant.

## DSCP Wholesale SC Segment

During Phase 0, we developed a Data Model based on Item Managers' information and business process needs. Clemson/UL Lafayette collected information and business process requirements from Item Managers through direct discussions. Modulant will expand the AAVS Datamart (if required), set up the data collection mechanism and store this additional DSCP data in the AAVS Datamart.

### *Tasks at DSCP*

- Developed a Data Model capturing additional data elements according to DSCP Item Managers' needs.
- Validated the developed Data Model with Modulant and DSCP Item Managers.
- Conducted a pilot implementation in support of the business case through simulation runs of selected Nomex items.

## Military Service Retail Segments

At the retail end of the supply chain, Clemson/UL Lafayette brought NAS Pensacola that operates on the Navy retail system and Hulburt Field that has contracted out its retail mission to LC Industries into the Nomex SC effort. LC Industries has contracts at over 20 different bases and uses modern retail software that appears to work very well. We visited both parties to provide a briefing of our project, model their replenishment processes, understand their needs, determine data requirements and interface requirements. We obtained retail-level data to complete the base analysis and the business case at retail.

This effort brought these bases fully into the advanced SC improvement effort to create a flow of replenishment orders as well as to provide asset visibility. In addition, this provided the ARN with an operational understanding of the work required to acquire asset visibility at the Service bases and an understanding of the replenishment processes for these Services.

### *Tasks at Retail/Service*

- Briefed the purpose of the ARN Nomex project, identified the local replenishment processes, determined the data interfaces, and brought these bases fully into the ARN Nomex effort.
- Developed a Data Model according to information and business process needs at retail.
- Validated the Data Model with Modulant.

## Economic Feasibility Study For The Entire NOMEX Supply Chain

We revised our initial approach for the final economic feasibility study. Based on our meeting at ULL with the ARN, the revised feasibility study consisted of a base case analysis and the development of a comprehensive business case based on the base case analysis. The feasibility study was based on the following tasks:

- Collected data for base case analysis. The CAR/ULL team worked with DSCP Item Managers to obtain data for the baseline analysis. We did the same with each of the selected retail bases.
- Conducted multiple simulation runs of VIM-BIFRS at DSCP for a group of high volume end items.
- Performed the base case analysis based on the data gathered from the previous tasks.
- The results from the simulation were compared with those from the base case analysis to show how much improvement we can reasonably expect from each SC segment in terms of inventory reduction, lead-time reduction, and elimination of backorders. The comparison concentrated on the benefits and improvement at the DSCP wholesale portion of the extended SC.

### Task Summary

The objective of this project is to extend the ARN System Operational Scenario downstream to the Air Force and possibly Navy and upstream to textiles and fiber using the Nomex family of items with the emphasis on information exchange. In this phase 0 investigation, Clemson Apparel Research (CAR) and the University of Louisiana at Lafayette (UL Lafayette) studied the technical feasibility and economical viability of establishing a Nomex supply chain partnership supported by the extended ARN systems. In this feasibility study, we performed two sets of tasks and deliverables; technical and business-case related.

### *Evaluation of Technical Feasibility*

- Task 1. Identify critical information needed to be exchanged and business processes needed to be provided to optimize supply chain performance
- Task 2. Evaluate information and business process requirements
- Task 3. Design of the information, security and communication layers of the extended AAVS Datamart

Tasks 1, 2 and 3 of the original phase 0 proposal were unchanged, but according to the ARN review at ULL, the scope was expanded to cover Air Force and possibly Navy retail operations in order to create end-to-end visibility for the entire NOMEX supply chain. We also eliminated the concept of establishing a separate research platform to focus on the expansion of the AAVS Datamart as the sole data warehouse for the extended C&T supply chain. The deliverable of Tasks 1, 2, and 3 was **the design of a Data Model** for extending the AAVS Datamart to the complete DLA C&T SC.

### *Evaluation of Economic Viability*

- Task 4. Cost & Benefit analysis
- Task 5. Discounted cash flow analysis
- Task 6. Sensitivity analysis

Tasks 4, 5 and 6 of the original phase 0 proposal were the same, but we revised our strategy in conducting the feasibility study. The revised feasibility study focused solely on DSCP benefits and stock-outs and did not consider the upstream supplier benefits from our supplier survey. The business case included multiple

simulation runs of VIM-BIFRS to demonstrate the benefits to DSCP in terms of *reduction of inventory, reduction of lead-time, and elimination of backorders* through:

- Total asset visibility across the entire SC,
- Business process improvements to flow orders and product at all SC levels, and
- The deployment of additional VIM decision support tools at all SC levels.

Since the business case included multiple simulation runs of piloted VIM-BIFRS, we added a new task for the pilot implementation to the original Phase 0 proposal.

#### Task 4a. Pilot Demonstration

This is a completely new task inserted to validate the business case plus introduce all SC partners to the potential improvements that can be realized through optimized supply chain processes. The simulation output of VIM-BIFRS was provided to DSCP and Logistics Management Institute (LMI) for evaluation and feedback. In addition, the benefits of the full SC collaboration were stressed at participated retail bases and their operational needs were assessed to bring them fully into the ARN partnership for the next phase of the Nomex SC project.

### **Evaluation of Technical Feasibility**

#### Task 1. Identify Information and Business Process Needs

We developed the NOMEX supply chain map identifying supply chain members from upstream at fabric and fiber manufacturers to downstream at wholesale (the military depot). The team also contacted the primary NOMEX SC members to solicit support and commitment to participate and supply the information for this project. Figure 3 displays the supply chain map of the NOMEX supply chain.

As part of Task 1, Clemson and UL Lafayette developed a questionnaire for gathering both information/business process requirements and numerical data for business case. The questionnaire was designed to determine:

- Problems in managing the supply chain inventory,
- Opportunities for improvement,
- Required data and business processes,
- Confidentiality concerns,
- Benefits the NOMEX SC members can achieve from total supply chain visibility, and
- Numerical data of expected costs and benefits of establishing the total asset visibility.

The Nomex Supply Chain Network

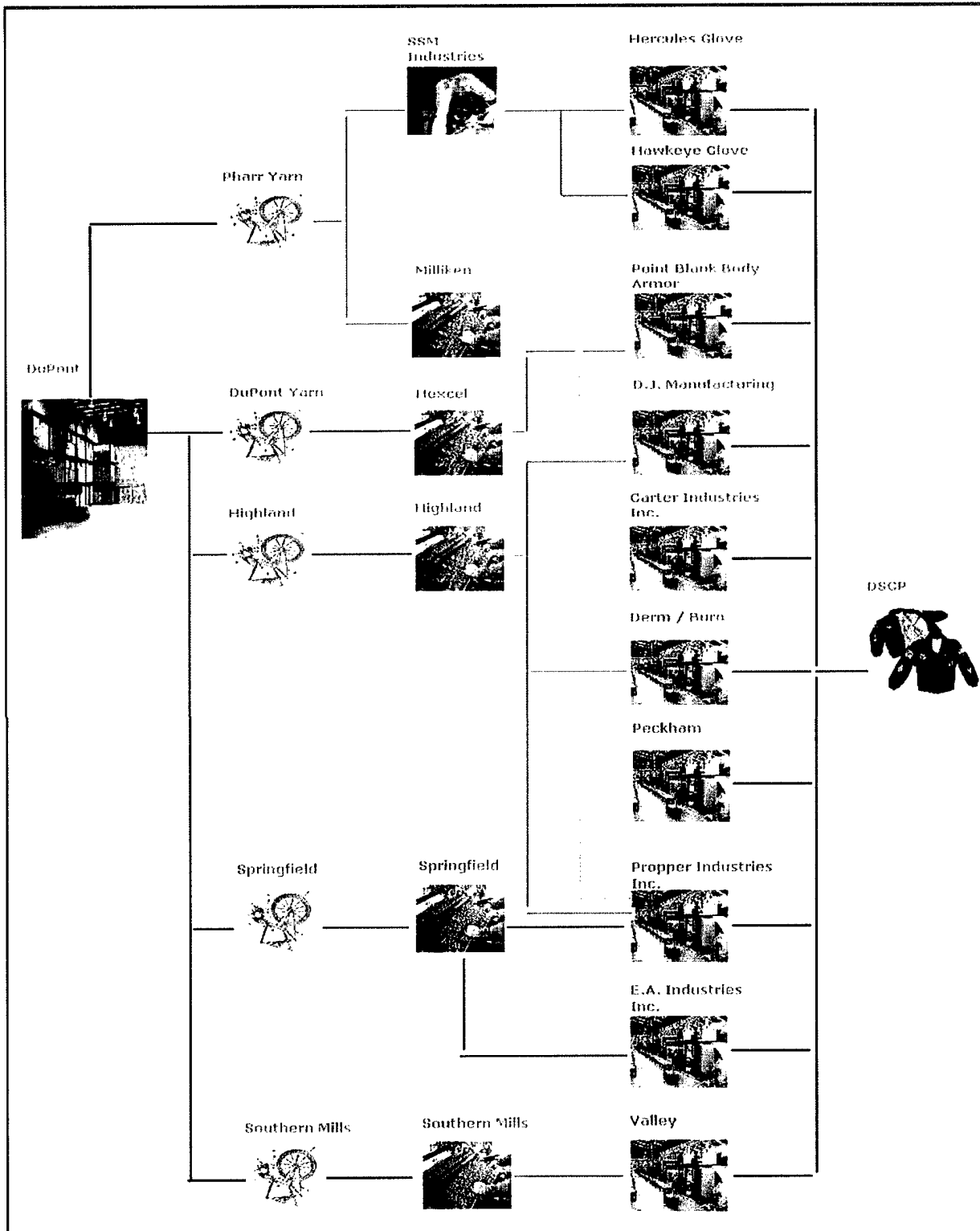


Figure 3. The Structure of the NOMEX supply network

We sent out the pilot questionnaire to key SC members via emails on May 23, 2003. Key SC members provided us constructive suggestions regarding possible amendments to the pilot questionnaire. We revised questionnaire accordingly. Additionally, the team made amendments to the pilot questionnaire according to recommendations gathered from brainstorming workshops at the June GOCC meeting. The final version questionnaire is provided in Appendix B.

Clemson and UL Lafayette then sent out the final questionnaire to all NOMEX SC members. Table 2 lists the NOMEX SC members who received the questionnaire.

SC Member (Firm)	Point of Contact	Phone
Atlantic Thread	Vincent Diaz	800/287-4624
Belleville Shoe Mfg. Co.	David Herr	618-233-5600 x122
Carter Industries	Saul Wolf	718-851-9700
Creative Apparel Associates	George Rybarczyk	207-342-5830
D.J. Manufacturing	Diego Jacobson	787-746-5004 ext 221
DuPont	A.T. Hahn	804-383-2984
EA Industries	Enrique Arsuaga	787-736-8921 x223
Emsig Buttons	N/A	N/A
Hawkeye Glove	Jim Rodenborn	515-573-2751
Hercules Glove	Arvind Joshi	716-663-1949
Highland Industries, Inc.	Randy Lippard	336-547-1617
Milliken & Company	Doug McMullen	864-503-1997
Peckham	Karen Jury	517-319-6042
Pharr Yarn	Charles Holland	704-823-2208
Point Blank Body Armor	Ronda Graves	800-413-5155
Propper International	Denny Martinez	787-834-4300 x1651
Southern Mills	Tom Langdon	770-969-1000
Springfield, LLC	Dan Shogan	917-421-6020
SSM Industries	Scott Hilleary	423-365-4048
Valley Apparel, LLC	John Niethammer	865-577-2923
YKK (USA)	David Goodman	610-667-5589

Table 2. List of NOMEX SC Member Receiving the Final Questionnaire.

We received questionnaire responses via emails and faxes. The team received the responses from eight companies listed in Table 3. These companies include the major players at every tier of the NOMEX Supply Chain. Bill Kernodle also gathered information regarding cost and information/business process needs from brainstorming workshops at the June GOCC meeting.

SC Member (Firm)	Point of Contact	Phone
Atlantic Thread	Vincent Diaz	800/287-4624
DuPont	A.T. Hahn	804-383-2984
EA Industries	Enrique Arsuaga	787-736-8921 x223
Highland Industries, Inc.	Randy Lippard	336-547-1617
Peckham	Karen Jury	517-319-6042
Propper International	Denny Martinez	787-834-4300 x1651
Springfield, LLC	Dan Shogan	917-421-6020
Valley Apparel, LLC	John Niethammer	865-577-2923

Table 3. List of NOMEX SC Members who responded to the final questionnaire

## Task 2. Evaluate Information and Business Process Requirements

### *Analysis of Data Collected From The June GCC Meeting*

Bill Kernodle conducted two workshops on the Nomex supply chain (SC) during the AAFA Government Contracts Committee Meeting on 9 and 10 June, 2003. A total of approximately 40 people attended representing about 25 companies.

At each workshop a very brief description of the Nomex SC was presented with emphasis on the complete SC. In order to preclude influence on the participants concerning issues and opportunities for improvement across the SC, a classical brainstorming session was then conducted before details of the Nomex Feasibility Study were explained. Finally, the draft questionnaire was distributed to generate additional discussion of problems and ways to improve these problems.

Detailed results of the workshop follow:

1. The one thing that matters most to every SC player is attaining and maintaining continuity of production. Everyone agreed that breaking the continuity of production is the core problem today. Anything we can do to keep the work flowing gets to this core problem.
2. Specific problems identified are repetitive delays and extensions in awarding new contracts, delays in invoking options, and unreasonable differences between minimums and maximums on indefinite delivery quantity contracts. Once orders are in place there are huge pushes for early delivery of large quantities and then demand drops off severely.
3. An accurate forecast (or any timely forecast) would encourage most upstream manufacturers to launch to a forecast rather than only to firm orders. However, some suppliers have policies in place to take no risk until they have a firm order that can be tied directly to a specific delivery order.
4. They would like to have an electronic means of communicating with the DSCP managers about SC problems - and this includes getting feedback. Everyone feels they are in the dark as to what is happening outside of their company and they would like a lot more status than just delivery orders.
5. First delivery time requirements are too short. Gives total advantage to those players who inventory fabric at their own expense and risk as a strategic business policy. This is a large barrier to developing other sources of supply.
6. All players across the SC feel they must be able to ship early under any new system. Cash flow is one driver, but spreading and cutting efficiencies are the others. Contractors are not flexible in marker-making and cutting so they must minimize the frequency of making low demand sizes. Stated differently, full bundles must go down the sewing line for minimum manufacturing costs. They state this is a fact that can not be negotiated. There is some flexibility in planning cuts and cutting, but not much in terms of time and even this is very costly. They want to retain permission to ship early so they can pull in the total delivery order requirements for low demand sizes and maximize bundle sizes.
7. No one wants to do special measurements because of the time required by key people to get them to the production line. Bundle boys then hand carry them through manually and this disrupts sewing.
8. Emergency orders are acceptable if they are large enough and only have to be moved to the front of the cutting queue.
9. There is no significant problem in general with the amount of time DLA testing takes today. The problem is that lots of fabric tests are required that have nothing to do with the use of the fabric in specific end-items. Shade evaluations and physical testing results are e-mailed to everyone very quickly from the DLA

lab today. (It was clear that testing times meet historical expectations very well now. This does not mean they could not be shortened significantly to reduce inventory requirements.)

10. Upstream suppliers feel like they are always being pushed to deliver as quickly as possible because lines are closed or DSCP is out of stock. Need to do a better job of planning, use some buffers, and reduce the pressure to hurry up. Need to find ways to put inventory buffers in the entire SC. No one wants to make before an order is placed, but DSCP puts extreme pressure on the SC to deliver as quickly as possible after they finish with their delays. DSCP should finance upstream buffers to off-set the delays they cause if they want products faster than they are now getting them.
11. Everyone needs to understand what minimum manufacturing batch sizes are and honor them when they place orders. The weakest links in the SC relationship always have to eat the leftover inventory. This is especially true with the makers of components such as collars and waistbands for flight suits.
12. Standardization would help the upstream SC partners greatly. Different buying centers have different requirements for items that should be identical. This includes requirements and testing methods and testing results.
13. Mil-spec components are just as important to the SC as the primary fabric. One missing component can completely shut downstream production lines down.
14. When the SC is many months long and someone wants to make a design change or quality improvement, DSCP must not demand an immediate change and ignore all the inventory investment – especially the investment in unique MIL SPEC products upstream of the end-item contractor. This happens too frequently and is extremely costly.
15. Manufacturing capacity constraints exist primarily because of the demand for large quantities quickly and then long periods of limited or no demand. Manufacturers can ramp up production much easier from a “hot” line than they can from a cold start.
16. Everyone indicated they had no problems or opportunities with business transactions between customers and suppliers or with shade matching of rolls of fabric. However, no one reported having fast-turn capabilities in this area, so they may not know what ideal standards should be.
17. These workshops clearly validated we are on the right track with our questionnaire. We were not surprised that continuity of production was the top priority, but we were surprised how strongly everyone felt about this. Accordingly, the survey addresses all possible causes of breaks in production.
18. The suppliers did vocalize two other concerns. They are worried that they may lose the ability to pull work in and ship early and they are worried that they will be asked to reduce production batch sizes. They have bid contracts based on the ability to ship early and large production bundles. They believe very strongly that changes in any of these areas would significantly increase their costs.

### *Analysis of Data Collected From the Questionnaire*

#### **Information Requirements**

In the questionnaire, we asked twelve questions regarding how useful different types of information would be to each supply chain member on a scale of 1-5 (1 = Very useful, 5 = Not useful at all, N/A = not applicable). The responses from eight companies were received. Table 4 displays the average scores of information usefulness for each type of the information.

Information	Average Scores of Information Usefulness		
	From Suppliers	From Customers	From DLA
DLA Delivery Orders on Open Contracts	3.5	1	1.75
DLA Planned Deliver Orders for Open Contracts	4	1.5	2
DLA Contracts Awarded	4.5	1.25	1.25
DLA Solicitations for Bids	4	2.2	1.5
DLA Planned Solicitations for Bids	3.5	2	1.75
Order Status (Shipping Information)	1.5	2.33	3
Inventory Levels	1.66	1.66	1.66
Lead Times	1	1.83	2.33
Capacities	2	2.5	2
Planned Orders	2.5	2	1.66
Production Schedules	3	1.83	1.33
Forecasts	2.66	1.6	1.33

Table 4. Summary of Information Usefulness Gathered from the Questionnaire

### Information Sharing

From the questionnaire, we collected the data regarding how willing a supply chain member would be to share different types of information with its suppliers, customers or the DLA, on a scale of 1-5 (1 = Very willing, 5 = Not willing at all, N/A = not applicable). The responses from eight companies were received. Table 5 displays the average scores of willingness to share different types of the information.

Data	Average Scores of Willingness to Share		
	With Suppliers	With Customers	With DLA
DLA Delivery Orders on Open Contracts	2	1.13	1
DLA Planned Deliver Orders	1.57	1.42	1
DLA Contracts Awarded	1	1.5	1
DLA Solicitations for Bids	1.28	1.42	1
DLA Planned Solicitations for Bids on Contracts	1.33	1.28	1
Order Status (Shipping Information)	2	1.25	1
Inventory Levels	2	1.63	1
Lead Times	1.42	1.38	1.33
Capacities	2	1.75	1.75
Planned Orders	2	1.38	1.38
Production Schedules	2.14	2	2
Forecasts	1.57	1.63	1.63

Table 5. Summary of Willingness to Share Information Gathered from the Questionnaire

### Business Process Requirements

NOMEX SC members were asked to evaluate and identify opportunities for improvement in the operation and execution of their parts of the Military Nomex Supply Chain, on a scale of 1-5 (1 = Very useful, 5 = Not useful at all or harmful). The responses from eight companies were received. Table 6 displays the average scores of the significance of each opportunity for improvement. Since certain business process requirements are required to realize each opportunity for improvement, the business process requirements can be derived from the opportunities for improvement.

Opportunities for Improvement	Significance (1-5)
Increase order frequency	2.38
Order in smaller batch (lot) sizes	3.85
Faster notification of contract award and termination	2.13
Provide total asset visibility across the supply chain	1.5
Provide automated color and quality approval procedures	1.5
Provide supply chain wide inventory recommendations	1.42
Provide a forum for supply chain discussions (message board, etc.)	2
Plan for Level Production Schedules During Year	1.42
Plan for Level Production Schedules Over Life of a DLA Contract	1.28
Ability to Ship Early	2.5

Table 6. Summary of Business Requirements and Opportunities for Improvement

We refined collected requirements from the questionnaire according to the information gathered from two workshops on the Nomex supply chain (SC) during the AAFA Government Contracts Committee Meeting.

### Task 3. Design of the Information, Security and Communication Layers of the Extended AAVS Datamart

#### *Information Layer*

The team worked with Modulant to validate the design of the information layer. The design document provided below was sent to Modulant for review. The design document identifies the data requirements for the NOMEX supply chain. For each data element, it provides a short description and a potential match with a field in the AAVS Datamart (if any). The Data Model of these data requirements is provided in Appendix C.

#### *DLA Data Requirements for the Nomex Supply Chain*

##### 1. Table – name reference: User

This set of data provides information pertaining to the user i.e. name/password, the associated company and privileges. It also provides an option for the user to define the path where he would like to save his files. An identifier is thereby provided to identify him.

- a. The Name of the user
  - i. E.g. – Jon Smith
- b. The corresponding identifier to refer it to for short hand purposes.
  - i. E.g. – user~1
- c. The Password assigned to this user for logging-on
- d. The Company Identifier (refer to company table below)
- e. The Path where the user would like to save his input files for VIM-BIFRS software
- f. The Permission identifier assigned to him/her (refer to Permission table below)

##### 2. Table – name reference: Trading Partner Agreement (TPA) Policy

This table provides information about the relationship between two companies in reference to data-sharing.

- a. Policy Identifier: Gives the identifier to each policy.
- b. Companies A and B agreeing to share data at a certain level.
- c. Type of information shared: (refer to Type of information shared below). Give the identifier to the information that company A wants to share with company B.

##### 3. Table – name reference: Type of information shared

This table provides information regarding various types of information can be shared among supply chain members.

- a. Type Identifier: Gives the identifier to each type of information.
- b. Information description: Gives the description about each type of information.

4. Table – name reference: Permissions

As mentioned above each user has certain privileges that he is allocated. These may be permissions to view/enter data and permissions to execute BF etc. This dataset is provided by Permissions.

- a. The Name of the Permission
  - i. E.g. – DataEntry Functionary, Planners and
- b. The corresponding identifier to refer it to for short hand purposes.
  - i. E.g. – 1~DataEntry
- c. The description of the permission
  - i. E.g. – This permission refers to entry of data – permitted

5. Table – name reference: Supply Chain (SC)

The introductory information regarding a SC such as its name and an identifier to identify it is maintained in this table. It refers to a complete supply chain as defined by Part Numbers (PNs) processes, buffers and sections.

- a. The Name of the Supply Chain
  - i. E.g. – Nomex Textile Supply Chain
- b. The corresponding identifier to refer it to for short hand purposes.
  - i. E.g. – Nomex~1

6. Table – name reference: COMPANY

This provides the preliminary introductory information regarding a company that is part of a SC such as its name and an identifier to identify it.

- a. We need the Name of the Company
  - i. Mapping to AAVS Datamart
    - 1. PDIT ID – 2726
    - 2. Attr\_Full\_Name - Sources
    - 3. Table Name - SPTD
- b. The corresponding identifier to refer it to for short hand purposes.
  - i. Description: Codifies the relationship between companies and child sections (refer below: Supply Chain Section).
  - ii. Mapping to AAVS Datamart
    - 1. PDIT ID – 3034
    - 2. Attr\_Full\_Name - affiliate
    - 3. Table Name – CageCodes

7. Table – name reference: Supply Chain Section (SCS)

This entity is the primary operational unit of a BF SC. It gives the preliminary information regarding a SCS such as its name and an identifier to identify it. A company which is a partner in the SC can be further sub-classified among Sections as SCS.

- a. The Name of the Supply Chain Section
  - i. E.g. – Milliken, DSCP
- b. The corresponding identifier to refer it to for short hand purposes.

- i. Description: May use the DODAAC Number for retail sections
- ii. Mapping to AAVS Datamart
  - 1. PDIT ID – 3071
  - 2. Attr\_Full\_Name - Customer ID
  - 3. Table Name - RetailCustomers, RetailRequisitions, RetailSummary, RetailReceipts
- iii. E.g. – 1~DSCP
- c. The corresponding Company Identifier of which this Supply Chain Section is a part of.
  - i. Description: Codifies the relationship between sections and the parent company.
  - ii. Mapping to AAVS Datamart
    - 1. PDIT ID – 3034
    - 2. Attr\_Full\_Name - affiliate
    - 3. Table Name - CageCodes

8. Table – name reference: Product Group Code (PGC)

This dataset elaborates about the PGC under consideration i.e. its name and identifier. An optional identifier is used to group individual items.

- a. The Name of the Product Group
  - i. E.g. – 27/P ABDU
- b. The corresponding identifier to refer it to for short hand purposes.
  - i. Description:
  - ii. Mapping to AAVS Datamart
    - 1. PDIT ID – 2513
    - 2. Attr\_Full\_Name - Procurement Group Code A(5)
    - 3. Table Names – Size Tarrif File, Supply Control File (SCF), SALES2, Back Order File (BORF), National Inventory Record (NIR), POI End Item PGC Program Requirements (RF299), Supply Control File (SCF), Back Order File (BORF), NIR, ACF, APRF, Manufacture Status

9. Table – name reference: Product

This entity contains a Part Number or Stock keeping unit (SKU) of a product; normally a retail number used to uniquely identify a basic item in a SC. The PN for a single item may change from supply chain section to section due to transformation as a result of shipping / production.

- a. The Name of the Part Number
  - i. E.g. – 27/P Tan Trousers and
- b. The corresponding identifier to refer it to for short hand purposes.
  - i. Mapping to AAVS Datamart
    - 1. PDIT ID – 2000
    - 2. Attr\_Full\_Name - National Stock Number of the garment.
    - 3. Table Name - Asset File, Active Purchase Request File (APRF), Size Tarrif File, SRSC, SDFI, AAVS, National Inventory Record2 (NIR2), SAMMS, ARCS1, ARCS2, ACF,

10. Table – name reference: SC\_SCS

This data fulfills the requirement regarding a section’s properties such as capacities / lead times, whether it is a Production Section or not, etc. It also implicitly gives knowledge regarding what SCS belong to this SC, as well as the positions of this SCS in the SC (tier- retail etc.).

- a. The corresponding Tier-number to refer to the position of the SCS in the SC.
  - i. E.g. – Retailer = Tier 1 i.e. POPE

- b. The total capacity available for this SCS.
  - i. E.g. – 10,000
- c. The Basic inventory Objective: The inventory objective or target stockage requirement expressed in quantity of items or days-of-supply without consideration of inventory protection for seasonal, promotional or surge demand for a SCS.
- d. The Lead Time for a SCS

\*Note: The Lead Times in Days of Supply (DOS) are specifically for a PN. However they can be specified at a SCS level in the case if PN – level Lead Time DOS are not available / not desired.

- i. Mapping to AAVS Datamart
  - 1. PDIT ID – 2396
  - 2. Attr\_Full\_Name - DIC Leadtime Date
  - 3. Table Name - Active Contract File (ACF)

- e. An indicator whether the section under consideration is a production Section
  - i. E.g. – yes for Pharr Yarn, No for DSCP

11. Table – name reference: PGC\_Product

It implicitly describes what PNs constitute this PGC.

- a. The PN - identifier
  - i. E.g. – 8414141001001
- b. The PGC identifier
  - i. E.g. – 0470

12. Table – name reference: SC\_SCS\_Product

This data set fulfills the requirement regarding a PN's property such as required capacities / lead times, unit cost, inventory handling cost, stock-out cost and batch issues etc. It also implicitly provides knowledge regarding what PNs belong to which SCS in which SC.

- a. Required Capacity: The amount of capacity required to produce or ship one PN in a Supply Chain Section.
- b. The Lower batch Quantity Size for a PN – this specifies the lowest batch size in which a PN can be shipped or produced.
- c. The Upper batch Quantity Size for a PN – this specifies the highest batch size in which a PN can be shipped or produced.
- d. The Batch increment Size for a PN – this specifies the batch size in which a PN can be incremented.
- e. The Basic inventory Objective: The inventory objective or target stockage requirement expressed in quantity of items or days-of-supply without consideration of inventory protection for seasonal, promotional or surge demand for a PN.
- f. The Lead Time in DOS for a PN.
  - i. E.g. – 180 days
- g. The PN Price
  - i. Description: The unit price of a PN.
  - ii. Mapping to AAVS Datamart
    - 1. PDIT ID – 2747
    - 2. Attr\_Full\_Name - Current Stocked Items
    - 3. Table Name - blank
- h. The Inventory Handling cost at PN – level
- i. The Stock-out cost incurred at PN – level

- j. unitOfMeasure
  - i. Description: Measurement unit corresponding to a PN. (The unit of measurement is different for different supply chain sections)
  - ii. Mapping to AAVS Datamart
    - 1. PDIT ID – 2866
    - 2. Attr\_Full\_Name - Unit Pack Quantity
    - 3. Table Name - National Inventory Record (NIR)
- k. Yield
 

Yield is the fraction of a PN coming into a SCS that is expected to exit that section as first quality finished goods.

13. Table – name reference: Product\_Connectivity

This particular dataset indicates the physical structure of the SC, SCS and the manner in which the PNs are connected, and change across sections between downstream and upstream as a consequence of passing through (for e.g.) production section etc. (specific to a Chain Connectivity Identifier and NSN Connectivity Identifier.)

- a. The Upstream PN - identifier
  - i. E.g. – 8414141001001
- b. The Downstream PN - identifier
  - i. E.g. – 8414141001001
- c. The Conversion-Factor (bilaterally between downstream and upstream sections)
  - i. Description: This indicates the number of upstream PNs required to produce one downstream PN (obtained from the bill of materials).
  - ii. Mapping to AAVS Datamart
    - 1. PDIT ID – 2904
    - 2. Attr\_Full\_Name - Unit of Issue Conversion Factor
    - 3. Table Name - Active Contract File (ACF)
- d. The Allocation-Factor (bilaterally between downstream and upstream sections)
 

This indicates the fraction of the total requirement for an incoming PN that goes to each supplier of that PN.

14. Table – name reference: Chain\_Connectivity

This dataset describes the structure of a supply chain.

- a. The corresponding Upstream SCS identifier
  - i. E.g. – 2~Milliken
- b. The corresponding Downstream SCS identifier
  - i. E.g. – 1~DSCP
- c. The corresponding Chain Connectivity-ID for the record above
  - i. E.g. – 1

15. Table – name reference: Demand

This dataset captures the demand for a particular PN for a particular SCS for a SC. This demand is weekly and needs to be for a year (52 weeks).

- a. The Demand per week (52 – weeks for an year)
  - i. Description: Demand quantity in units
- b. The corresponding week number

- i. Description: Date of Last Demand
- ii. Mapping to AAVS Datamart
  - 1. PDIT ID – 2299
  - 2. Attr\_Full\_Name - DATE\_OF\_LASTDMD
  - 3. Table Name - Supply Control File (SCF)
- c. The year (w.r.t. above)
  - i. Description: Date of Last Demand
  - ii. Mapping to AAVS Datamart
    - 1. PDIT ID – 2299
    - 2. Attr\_Full\_Name - DATE\_OF\_LASTDMD
    - 3. Table Name - Supply Control File (SCF)

16. Table – name reference: Inventory

This dataset captures the status of inventories (of a particular PN in a particular SCS of a SC) that are allocated to a contract at a particular time. The inventory status includes on-hand balance / Work-In-Process etc.

- a. The Work in Process (in units) for a PN – quantity of work in process two supply chain sections.
  - i. Mapping to AAVS Datamart
    - 1. PDIT ID – 3069
    - 2. Attr\_Full\_Name - WorkInProgressQty
    - 3. Table Name - WorkInProgressQty
- b. On-Hand Quantity – indicates the on-hand Quantity of a PN in a specific supply chain section for a contract.
  - i. Mapping to AAVS Datamart
    - 1. PDIT ID – 3086
    - 2. Attr\_Full\_Name - Quantity On Hand N(Long Integer)
    - 3. Table Name – Retail Summary
- c. Allocation - used to indicate the quantity of a PN that has been assigned to a firm order. This effectively removes this quantity from the on-hand balance, as it cannot be used to satisfy established targets.
  - i. Mapping to AAVS Datamart
    - 1. PDIT ID – 3149
    - 2. Attr\_Full\_Name - Quantity issued N(8,2) Double
    - 3. Table Name – ITEM\_MSTR
- d. PN connectivity identifier  
Connectivity of the Supply Chain Section according to which the inventory is allotted;
- e. Contract identifier  
Inventory for a particular Contract, desired because each contract may be dealt in a different way, and the information provided for a specific contract is used for the system to give recommendations.
- f. Stock Out Qty  
Stocked-out Quantity.

17. Table – name reference: Usage\_Forecast

The dataset mentioned here captures the forecast for a particular PN for a particular SCS of a SC. This forecast is weekly and needs to be for a year (52 weeks).

- a. The Forecast per week (52 – weeks for an year)
  - i. Description: Demand forecast in units.
  - ii. Mapping to AAVS Datamart
    - 1. PDIT ID – 2552
    - 2. Attr\_Full\_Name - Quarterly Forecast Demand.
    - 3. Table Name - Supply Control File (SCF)
- b. The corresponding week number
- c. The year (w.r.t. above)

18. Table – name reference: Product\_Cumulative\_Surge\_Quantity

This dataset stores the surge quantity for a particular PN for a particular SCS for a particular SC. This surge quantity is weekly and needs to be for a year (52 weeks).

- a. The Surge weekly quantity (in units) per week (52 – weeks for an year) - Quantity of items that should be in a SCS for a particular week to meet the forecasted surge quantity requirement for that week.
- b. The corresponding week number
- c. The year (w.r.t. above)

19. Table – name reference: Recommendations

The dataset mentioned here holds the recommendation for a particular PN for a particular SCS of a SC. This recommendation gives in units the quantity needed to be shipped / produced depending on the type of section the PN belongs to.

- a. The Recommended Quantity (in units) per week (52 – weeks for a year)
  - i. Description: this is the quantity to be produced or shipped depending on what SCS it is (production Section etc...). This is the output of the VIM-BIFRS software.
  - ii. Mapping to AAVS Datamart
    - 1. PDIT ID – 2755
    - 2. Attr\_Full\_Name - Quantity Requisitioned
    - 3. Table Name - SLTF
- b. The corresponding week number
- c. The year (w.r.t. above)

20. Table – name reference: YPT

The forecasted demand for a particular PGC at DSCP corresponding to a solicitation. The description helps rest of the chain to get prepared, but when this YPT transforms into a contract is questionable.

- a. YPT Identifier: YPT Identifier.
- b. Start date: Date at which the YPT specifies the requirement of a PGC.
- c. End date: Date at which YPT ends (Transforms to other phase or dead).
- d. Minimum Quantity: The minimum quantity of the PGC required.
- e. Maximum Quantity: The maximum quantity of the PGC.
- f. Estimated price: The amount the can be awarded for the Supply.
- g. YPT status Id: The current status of the YPT.

21. Table – name reference : YPT\_STATUS

The dataset represents the different statuses for a YPT, and their description. One YPT later can be transformed into multiple solicitations.

- a. YPT\_Status Id: Status Identifier.
- b. Description: Description of the status.

22. Table – name reference : Solicitation\_Product

Solicitation attributes at Product level.

- a. Minimum Quantity: Minimum Quantity of PN required.
- b. Maximum Quantity: Maximum Quantity of PN required.

23. Table – name reference: Solicitation

- a. Solicitation Identifier: Identifier for the Solicitation
- b. Date: Date at which solicitation is open.
  - i. Description:
  - ii. Mapping to AAVS Datamart
    - 1. PDIT ID – 2775
    - 2. Attr\_Full\_Name - Asset Solicitation Date
    - 3. Table Name - Active Contract File (ACF), APRF

24. Table – name reference: Contract

Contract details for a set of PNs in a particular Solicitation.

- a. Minimum Quantity: Minimum Quantity for the contract
  - i. Description: Indicate the acceptable limits of quantity variance as stated in the procurement instrument on a Contract Line Item basis.
  - ii. Mapping to AAVS Datamart
    - 1. PDIT ID – 2358
    - 2. Attr\_Full\_Name - Asset Transfer Status Codes
    - 3. Table Name - found on net
- b. Maximum Quantity: Maximum Quantity for the contract.
  - i. Description: Indicate the acceptable limits of quantity variance as stated in the procurement instrument on a Contract Line Item basis.
  - ii. Mapping to AAVS Datamart
    - 1. PDIT ID – 2358
    - 2. Attr\_Full\_Name - Asset Transfer Status Codes
    - 3. Table Name - found on net
- c. Start date : The start date for the contract
- d. End date: The end date for the contract.
- e. Price: The price associated with the particular contract & PN.
  - i. Description: The dollar value amount contracted for, procured, purchased, or requisitioned.
  - ii. Mapping to AAVS Datamart
    - 1. PDIT ID – 1859
    - 2. Attr\_Full\_Name - Acquired Dollar Value
    - 3. Table Name - SALES2
- f. Status: Status of the contract.
  - i. Description: Closed contract code. Identifies a contract as being open or closed.
  - ii. Mapping to AAVS Datamart
    - 1. PDIT ID – 1883
    - 2. Attr\_Full\_Name - Closed contract code
    - 3. Table Name - Active Contract File (ACF)

25. Table – name reference: Contract\_Connectivity

How a Contract is related to different PNs in different Supply Chain Sections is described in this relationship.

26. Table – name reference: Contract\_Product

The contract level split of the products in a Supply Chain Section, the minimum quantity and the maximum quantities in a Supply Chain Section are described in this relationship.

- a. Minimum Quantity: Minimum Quantity for the Contract
- b. Maximum Quantity: The maximum Quantity for the Contract.

27. Table – name reference : Delivery\_Order

Delivery order issued by DSCP for a particular Contract and gives the details at PN level.

- a. Due Date: The due date for the order.
  - i. Description: The date when a contracting-agreement-line-item is scheduled to be delivered.
  - ii. Mapping to AAVS Datamart
    - 1. PDIT ID – 2305
    - 2. Attr\_Full\_Name - Delivery Date Old.
    - 3. Table Name - Active Contract File (ACF)
- b. Delivery Order Date: Actual delivery date, at which the order is fulfilled.
- c. Quantity:
  - i. Description: Number of Units of a PN.
  - ii. Mapping to AAVS Datamart
- d. PDIT ID – 2231
- e. Attr\_Full\_Name - Award Quantity
- f. Table Name - Active Purchase Request File (APRF)

28. Table – name reference: Purchase\_Order

Purchase order is the order issued for a specific contract, and starts from the end item contractor through the whole Supply Chain. It is used mainly to keep track of the Orders between two supply chain sections for a specific contract.

- a. Due Date :
  - ii. Description: Due date of a purchase order
  - iii. Mapping to AAVS Datamart
    - 1. PDIT ID – 2572
    - 2. Attr\_Full\_Name - Required Delivery Date
    - 3. Table Name - SLTF, Back Order File (BORF), ARCS1, ACF
- b. Purchase Order Date: Actual purchase order date, at which the order is fulfilled.
  - i. Description: Contract Line Item Number. A six digit number from the contract which is entered into the Materiel Receipt Card (MRC).
  - ii. Mapping to AAVS Datamart
    - 1. PDIT ID – 2273
    - 2. Attr\_Full\_Name - Contract Line Item Number
    - 3. Table Name - Active Contract File (ACF), Due-In File (DUE), Contract History File (CHF)
- c. Quantity: Number of Units of a PN.
  - i. Mapping to AAVS Datamart
    - 1. PDIT ID – 2798

2. Attr\_Full\_Name - Quantity Shipped, Shipped Quantity
3. Table Name - Active Contract File (ACF), Due-In File (DUE)

29. Table – name reference: option\_Year

Option Year describes the year-wise requirements for a contract.

- a. OptionYear Identifier:
  - i. Mapping to AAVS Datamart
    1. PDIT ID – 2387
    2. Attr\_Full\_Name - Indefinite Delivery Type Contract.
    3. Table Name - Active Purchase Request File (APRF)
- b. Start Date: start date for the Yearly contract.
- c. End Date: End date for the Year contract.
- d. Minimum Quantity: minimum quantity required for a particular year.
- e. Maximum Quantity: maximum quantity required for a particular year.

30. Table – name reference: Shipment

The information about each shipment between supply chain sections in the supply chain is stored.

- a. Shipment date: day on which the shipment is sent to another supply chain section.
  - i. Description: Shipped Date
  - ii. Mapping to AAVS Datamart
    1. PDIT ID – 2589
    2. Attr\_Full\_Name - Due In Shipped Date
    3. Table Name - Due-In File (DUE), Contract History File (CHF)
- b. Shipment Mode: mode of the shipment.
  - i. Description: mode of the shipment
  - ii. Mapping to AAVS Datamart
    1. PDIT ID – 2428
    2. Attr\_Full\_Name - MODESHP.
    3. Table Name - (ARCS4) Active Requisition Control File, Active Contract File (ACF), Due-In File (DUE)
- c. Planned receiving date: planned receiving date of the shipment.
- d. Actual receiving date: actual receiving date of a shipment.
- e. ReceivedYN: used to check whether shipment is received or not.

31. Table – name reference: ShipmentLine

The information about each shipment at PN level corresponding to a particular contract, purchase order, and delivery order is stored in this table.

- a. Shipment Identifier: Shipment Identifier
  - i. Mapping to AAVS Datamart
    1. PDIT ID – 2802
    2. Attr\_Full\_Name - CONTROL NUMBER
    3. Table Name - SAMMS fields for the SDS
- b. Shipment Line : shipment line Identifier
  - i. Mapping to AAVS Datamart
    1. PDIT ID – 1955

- 2. Attr\_Full\_Name - FUND\_CLIN
- 3. Table Name - HFUN (Fund History File)
- c. Shipment Line Quantity: Quantity of a PN in Shipment line
  - i. Mapping to AAVS Datamart
    - 1. PDIT ID – 2592
    - 2. Attr\_Full\_Name - Shipped Quantity.
    - 3. Table Name - SAMMS
- d. Actual received quantity: actual received quantity of a PN in the shipment
  - i. Description: Received Quantity
  - ii. Mapping to AAVS Datamart
    - 1. PDIT ID – 2557
    - 2. Attr\_Full\_Name - Due In Received Quantity
    - 3. Table Name - Due-In File (DUE)
- e. Source: the source of the Shipment
- f. Destination: Destination for the shipment
- g. Backorder: used to check whether the shipment sent is corresponds to a back order or not.
  - i. Description: Back order signature. Approval. Item may be on backorder due to item being out of stock, PN forced on backorder by Item Mgr, PN isn't a stocked item, etc.
  - ii. Mapping to AAVS Datamart
    - 1. PDIT ID – 2232
    - 2. Attr\_Full\_Name - Back order signature
    - 3. Table Name - BACK\_ORD\_SIG

### **Security Layer**

Security layer incorporates security/trust management, security policies/protocols and security mechanisms based on protocols used for communication. It provides authentication, authorization, data integrity, non repudiation and delegation services across the supply chain.

### **Authentication and Authorization Services**

The team developed the privilege control exercised on a user that decides the accessibility/visibility of information in the NOMEX SC. The privilege control also specifies type of user (for instance: Planner Manager, System Administrator etc.) and predefined privileges authorize / limit him access to specific information.

The database should have user identifiers, passwords and the related permissions pre-populated in to the system. These identifiers / permissions are used to demonstrate access / privilege control. We classified user privileges into two levels, company level and user level.

### **Company Level Privileges**

This level of security control specifies the Asset Visibility based on a Company / Section Level. This is detailed below in Table 7.

No.	Type of SC Network Member	Asset Visibility Allowed
1.	Supply Chain Manager (e.g. DSCP)	Total Asset Visibility
2.	Basic Supply Chain Member (e.g. Milliken)	Partial Asset Visibility (Will have access to immediate upstream and downstream)

Table 7. Company Level Privileges.

### User Security Privileges

The Security Layer has five different User security privileges which are depicted in Table 8.

Type	Functionality permitted	Example
<b>Administrators</b>		
Supply Chain Administrator (Supply Chain Manager level)	Edit the Supply Chain Structure and view data pertaining to entire SC	Person designated on a consensus by the all SC partners (Item manager at DSCP)
Sub-ordinate Administrator (Supply Chain Manager level)	Edit the Supply Chain Structure	Designated person at DSCP
Company Administrator (may have multiple SCS) (any level)	<ul style="list-style-type: none"> <li>▪ Allow to view data related to own section and maybe immediate upstream and downstream on the basis of the TPA</li> <li>▪ Change of the operational parameters for the company</li> <li>▪ Change of Capacities</li> <li>▪ Change of batch sizes</li> </ul>	Person designated by Company Management
<b>Planners</b>		
Planner Manager (any level)	Allows Simulation on the Supply Chain	Person designated by a SCS / Company
Retail Planner (any level)	Forecast modeling at the retailer	Person designated by a SCS / Company
<b>Data and Report Handlers</b>		
Data Handler (any level)	Can import files and change data pertaining to this SCS and Company	Person designated by a SCS / Company
Report/Charts Handler (any level)	Can view Reports and Charts and communicate them	Person designated by a SCS / Company

Table 8. Company Level Privileges.

### Data Integrity Services

These services prevent eavesdropping, tampering or message forgery. The security layer should specify the use of appropriate protocol to facilitate secure client/server communication by providing reliable and private communication and preventing eavesdropping, tampering or message forgery.

### Non Repudiation Services

These services provide the ability to hold trading partners responsible for the transactions they commit. Non-repudiation of origin and delivery may be accomplished using digital signatures, extensible using the web of trust model.

## **Delegation Services**

Trust Management Services enable delegation of credentials that is necessary for communications across NOMEX supply chains. Through delegation, the user provides the called component with access to its authentication context, enabling the called component to impersonate the user in subsequent calls. With delegation services, the Item Manager at DSCP will be able to access information of upstream supply chain members who don't have contracts with DSCP.

## **Communications Layer**

Communication layer contains data transfer, directory, messaging, and data presentation services. It enables flow of the information across the various SC members within the NOMEX SC.

### **The ARN Data Transfer Services**

#### Upload Data

This functionality would enable the Supply Chain member to upload input data files to the server database. This data would comprise of all significant parameters (operational objectives included) pertaining to the Supply Chain and the individual supply chain section.

#### Publish Data

This option provides the SC member to edit / configure particular data pertaining to the individual section through input forms. This data would permit modification of operational parameters.

#### Remote Communication

Supply chain members would be able to communicate with other members of the chain remotely through invoking remote applications. This approach allows the supply chain members to obtain real time data and event/alert messages.

### **The Directory Services**

The Extended AAVS Datamart should maintain a directory of all active and approved vendors/suppliers that can be looked up by potential trading partners as well as DSCP. This directory can be developed in accordance with the Lightweight Directory Access Protocol (LDAP), and Universal Description, Discovery and Integration (UDDI).

### **The Messaging Services**

#### Non Real-Time

The Messaging Service should provide a message board allowing supply chain members to publish alert messages to all supply chain members. Messages posted by the user or alerts generated by remote client systems will interface with the Supply Chain Health Monitoring System (SCHMS). This SCHMS runs periodically to alert of any existing or impending problems at any node in the chain. Messages incorporate levels of alert identifying whether they can be contained locally, absorbed by the chain, or result in an impact to the customer – DSCP.

#### Real-Time Message Services

These services could be based on the distributed event subscription model where a supply chain member expresses a desire to be notified of certain events within its trading partners' domain. When such events take place, the Messaging Service will use Internet-based event notification technologies to communicate the alert to appropriate trading partners.

## Existing Communication Methods in NOMEX SC

In the questionnaire, we asked seven questions regarding how a supply chain member communicates internally, with its suppliers, and with its customers. The responses from eight companies were received. Table 9 displays the number of supply chain members who communicate with their suppliers and customers using a particular method of communication.

Method of Communication	Internally	With Suppliers	With Customers
Face-to-face	6	7	7
Phone	5	7	8
Fax	3	7	7
E-mail	6	6	8
Public Website	0	2	2
Private Intranet	2	0	0
EDI	0	1	2

Table 9. Supply Chain Members Method to Communicate

## Evaluation of Economic Viability

Task 7. Cost & Benefit analysis

Task 8. Discounted cash flow analysis

Task 9. Sensitivity analysis

Task 4a. Pilot Demonstration

The deliverable of Tasks 4, 4a, 5, and 6 was the business case evaluating the economic viability of the Data Model and its enabling tools. The potential benefits to the Nomex Supply Chain include:

- Reductions in lead-times from initial raw material to retail operations,
- Reductions in stockouts, shortages and backorders,
- Reductions in inventory investments across the entire supply chain,
- Reductions in operating expenses, and
- Reductions in cost of capital.

These benefits were validated during our Phase 0 project in which we constructed the following business case based on simulation runs of the 7 selected PGCs for year 2003. The simulation, addressed in detail later, used a pilot version of the VIM-BIFRS software. The simulation inputs were actual product delivery and customer requisitions for just the C&T portion of the extended supply chain. This represented only a very small fraction of the total benefits because the business case did not address all the other C&T items or the retail, prime contractor, textile supplier, and fiber supplier sections of the extended C&T supply chains.

## Business Case Summary

The Summary of Cost & Benefits Analysis is shown in Appendix D. The summary is divided into three sections; Undiscounted Flows, Discount Factors, and Discounted Flows. The top two rows of the Undiscounted Flows section show costs and benefits from the two following tables. The third row calculates the net benefit by subtracting the costs from the benefits by year. The Net Total Value for all 10 years is \$17,964,572.

The Discount Factors section applies discount factors for each fiscal year beginning with the base year of 2004. The discount factors are based on a discount rate of 4.2%. The Discounted Flows section shows the results of applying the Discount Factors. The discounted costs and benefits are calculated as original costs and benefits multiplied by the discount factors. A cumulative total is calculated for each year with the previous years net added to the current year's net. The business case shows a Net Present Value of \$17,383,445 and an ROI of 8.21. *In addition, the simulation showed VIM-BIFRS, applied only at the C&T portion of the supply chain, would have reduced the stock outs by 53% based on the wartime conditions that existed in year 2003.*

### **The Cost Analysis**

The summary of project costs is shown in Appendix D. The funds required by each partner and the training/implementation costs are shown for each partner and year. The total estimated cost from 2004 – 2014 is \$2,320,000. The estimated project costs for year 1, year 2 and year 3 are \$640,000, \$840,000 and 840,000 respectively. These are the costs required to implement the Phase I project.

### **The Benefits Analysis**

The summary of benefits analysis is shown in Appendix D. All benefits are based on total asset visibility and the core competency of the VIM-BIFRS system that minimizes the variations in downstream demand and upstream supply for each section of the extended supply chain. The combined amount of these two variations is reflected in the variations in NSN-level inventories owned by C&T and they are the drivers of stockage policy levels. Our simulation, upon which the following benefits are based, only included 7 Nomex PGCs at the C&T section of the total Nomex supply chain. These are extremely conservative benefit estimates for these 7 PGCs because the upstream and downstream supply chain sections must be activated and included to fully minimize demand and supply variations.

**Over Target Policy Reductions:** The top row of the table shows the expected over policy target inventory reductions. Excess or Over Target inventories are those that are above the 180-day of supply stockage policy. Our simulation projects a \$13,341,028 reduction by 2005 and we project a total reduction of \$14,648,545 as shown by 2008. The savings gradually decline as the overstock of very long supply NSNs is consumed.

**Downstream and Upstream Integration:** These two rows show the expected inventory reductions resulting from reduced policy stockage targets once our 7 PGCs are activated downstream at retail and upstream for all the suppliers. Downstream activation will minimize demand variation and effectively provide C&T with two additional months of accurate forecasting data that equates to two months of lead-time reduction. However, we will be activating these items only for Air Force bases and that is about half of the total demand. Upstream activation will minimize supply variation and reduce lead-times by a conservative one-month for each item because all upstream partners will be participating. The inventory reductions shown here are calculated using the actual days of supply calculated from last year valued at the retail unit prices less the C&T surcharge.

**Cost of Capital Savings:** The Cost of Capital Savings is calculated using the official discount rate applied to the aggregate savings from over target and lead-time driven stockage target policy reductions. The Total Cost of Capital Savings for 10 years is \$7,132,738.

**Net Dollar Benefits:** The Dollar benefits shown in the last row are calculated as a percentage of total expected dollar benefits (Total Benefits). This percentage is our Confidence Factor of 75% that we will achieve the level of benefits discussed above. Thus, our net total expected benefits (Dollar Benefits) for the ten-year period is \$20,284,572 after reducing the original Total Benefits by the Confidence Factor.

Our business case is based on the results of our Nomex Phase 0 simulation that is the product of a series of assumptions with accompanying limitations. These are addressed in the following two sections. The first set of assumptions and limitations discussed is for the simulation, and the second is for the business case itself.

## Simulation Assumptions and Limitations

**Scope:** The simulation was run for seven key PGCs from the Nomex family as requested by C&T Item Managers. The highest demand PGCs are the tan and green 27P coveralls. They represent situations of high oversupply for PGC 470 (green) and normal inventory levels for PGC 2442 (tan). The remaining five PGCs were selected because they each have a history of significant shortages caused primarily by supply variations. Thus, the seven selected PGCs consists of a significant proportion of the total Nomex demand and includes specific examples of inventory levels above, at, and below the policy target of 180 days-of-supply. The procedure for running the simulation for the NOMEX Supply Chain is documented in Appendix E.

**Data:** Data extraction logic is provided in Appendix F. C&T level inventory management actions (generating new delivery orders and filling customer requisitions at the NSN level) were simulated for only one year because detailed data required by the VIM-BIFRS software was not available for more than one year. The simulation was run from September 2002 through August 2003 using actual weekly demand and supply transactions. Inventory levels were captured as of the first transaction of the week. Weekly deliveries were limited to the actual deliveries received by C&T. It was assumed that the lead-time for changing the mix of sizes (NSN's) through the generation of new delivery orders was 90 days and that the wartime inventory target was 180 days of supply. (Although the Item Managers made adjustments through expedite actions during the year, our simulation made no changes between the 90-day delivery order periods.) The usage rates used to compute target days of supply for the simulation were taken from SAMMS since they were the best available data at the beginning of the period. Starting with C&T's beginning inventories, each week the simulation took the beginning inventory, added arrivals and subtracted deliveries to compute the next weeks beginning inventory.

Another limitation of the data is that while SAMMS transactions capture true supply accurately, they do not do as well for demand. Demand is only reflected as requisitions filled, not as requisitions received. It is quite obvious when looking at the charts and data of C&T supply and demand that, for NSNs in short supply, there is pent up demand in the system that does not show up in the transaction set when an item has been out of stock for some time. Item managers reserve some of their safety level stocks for high priority customers and build backorders. Services don't commit funds and order when they can see that there is no chance of delivery, instead they use their funds elsewhere. When supplies arrive, all of the sudden many months of demand suddenly get turned into orders. While the simulation was still able to improve on actual results, had the system been provided actual demand it would have been able to respond and better balance inventories. This is an issue that retail integration will help solve for C&T and that upstream integration will help solve for C&T's suppliers. These undocumented improvements will result in further improved service levels, reduced lead times and lower target levels.

The accuracy of these assumptions and of the simulation's inventory book keeping can be seen in a graph of the first 90 days of every simulation run, and in the NSN's with multi-year overstock. (see attached graphs). During this first 90-day lead-time period no changes in ordering can affect delivery mix or volume. During this period the simulation's estimates of C&T inventory and actual C&T inventory match quite well. The same logic is seen in the NSN's with multi year overstock. All the simulation can do is not order and wait for the overstock to be used up. In this situation the simulation and actual inventories may well be the same for quite some time, unless even more excess is delivered. (See attached charts)

**Simulation Results:** The results of the simulation can be seen in the attached charts and summaries. The simulation was run under scenarios of high, medium and low target levels to test the sensitivity of stock-outs to inventory levels. We elected to define stock-outs as inventory levels below 95% of the 180-day target because we could not measure stockouts directly. This definition was chosen because at these levels C&T is effectively out of inventory and unable to fill normal orders. At these levels special processing must be done for each order and orders of normal size must be backordered if customers even bother to commit funds to them. A limitation to the savings that were achievable in the time frame of the simulation is the usage rate of some items in very long supply. For some items, the length of the simulation was not sufficient to use up the

oversupply. Indeed some items in multiyear oversupply received additional deliveries in the first 90 days of the simulation period. This can be seen in the charts of the NSN's in PGC 470. While the simulation used the SAMMS estimates of usage rates to calculate days of supply and targets, the analysis of the results and business case use the actual usage rates calculated from the actual data for the year.

A limitation of using the simulation results to project future savings is that they analyze what could have been saved had VIM-BIFRS been used last year. This is not just a problem of last year not being average. Looking backward from Iraq II, to Afghanistan, Bosnia, Iraq I, and various build ups and scale downs, what year would be average? The basic problem is since VIM-BIFRS was not used last year, those savings are not going to be recoverable, and the ending inventory levels are not what were projected. Any business case for a project starting now must start with today's inventories and usage rates. It is important to understand that the purpose of the simulation was not to directly calculate the business case, but to provide proof of concept and estimates of parameter values that can be used to generate a business case based on current data. The simulation results showed that overages can be eliminated and that stock-outs can be reduced. These are the results that we applied at a conservative rate to the current data for our business case.

### Business Case Assumptions and Limitations

The business case is based on the template provided by LMI, the current DLA inventory, last year's actual usage rates, the simulation findings, and the proposed scope of work and costs. The project is assumed to begin in 2004 and extend for three years. The costs and benefits are discounted over ten years.

The benefits of using VIM-BIFRS in the Nomex supply chain are many and come in many forms. Different benefits can be quantified but not always in dollars and even in the cases where dollar amounts of these benefits can be used they may represent different types of savings. Examples of these issues can be seen in stock-outs, overage reduction savings, lead-time and target reduction savings, and opportunity costs.

Our key underlying assumption is that our Phase I project will do as well in the first year of implementation as applied to the C&T inventory positions at the beginning of 2004 as the simulation did for the inventory levels at the beginning of 2003.

We have taken the conservative approach in addressing every assumption and limitation.

**Over Target Reductions:** This figure is found on the top row of the benefits page of our business case spreadsheet. Subtracting the ending inventories of the simulation at the NSN level from the actual ending inventories is how we estimated the anticipated savings from implementing VIM-BIFRS at C&T. This assumes that the Phase I project can do as well next year as the simulation did last year. There remains the problem of how to estimate the projected improvements for NSNs in multi-year overstock. While most of the over target reductions occur in the first year of the project, you can project those saving into future years if you assume usage rates for high inventory NSNs. This is where the projected savings after the first year of the project come from and why they gradually decline as the overstock is used up.

Excess inventories can be measured in dollars, but this must not be done at the PGC level. The issue is that at the PGC level an aggregated picture of excesses and shortages cancels each other out when they are netted together. In the extreme case, a one-year supply of one NSN and a stock out of another yields a perfect 180-day supply. This is certainly not the same as having a 180-day supply of both. Continuing this example, if VIM-BIFRS leveled the inventories of these two NSNs to the 180 day target for both, it might not appear to have reduced invested capital at the PGC level, but there would certainly be benefits in stock outs and investment. In this case the excesses were wasted funds that could have been put to productive use. The stocked out NSN also probably already has capital committed to it in contracts and delivery orders although this is not seen in the inventory balances. In our business case we measure the benefits of the excess reduced in dollars and the shortage reduction in stock outs.

**Lead Time and Target Reductions:** The lead time and target reduction savings are calculated using the actual days of supply calculated from last year valued at the unit prices less C&T surcharge. The sensitivity analysis of the simulation shows that these can both be accomplished at the same time as stock-outs are reduced. The second and third years of the project will accomplish this through lead-time reductions resulting from better information flow and re-balancing actions from "fiber to fighter." The benefits here do not have to come just from lowering target inventories. A reduction in lead times also reduces the capital tied up in "On Order" goods. Our conferences with and surveys of supply chain partners support these assumptions.

**Stock-out Reductions:** We have no dollar measures for costs of stock-outs, although during wartime this is the most crucial metric. Certainly there are costs involved in backordering and operating costs increase significantly for expediting anywhere within the supply chain. The simulation managed to reduce stock-outs 53% on average. In reality this improvement will be improved significantly because the simulation was limited by the lack of true demand data due to orders not being placed for items known to be stocked-out. This problem of the data not reflecting true demand was discussed earlier. Balancing inventories and demand along with better retail and upstream integration will improve this situation and further improve the backorder, expedite, and stock-out situations.

**Cost of Capital Savings:** These standard savings are calculated using the official discount rate applied to the cumulative savings of overages, lead time, and target reduction savings.

**Confidence Factor:** This factor reflects the reality that nothing is certain and that this is a demonstration and research project and not a repetitive implementation of a proven management approach and software program. We feel very confident that 75% of the projected savings will be achieved.

### Simulation Examples

Figure 4 shows an example of how the actual and simulated inventories tracked exactly during the first 90 days because the actual due-ins were fixed and could not be changed by the simulation. It also shows that the simulation ordered no more of this excess stockage item and let consumption pull it down over the year. In contrast, the current C&T system continued to grow the inventory of this item. The difference at the end of the year is reported in the benefits table as a Over Target Reduction.

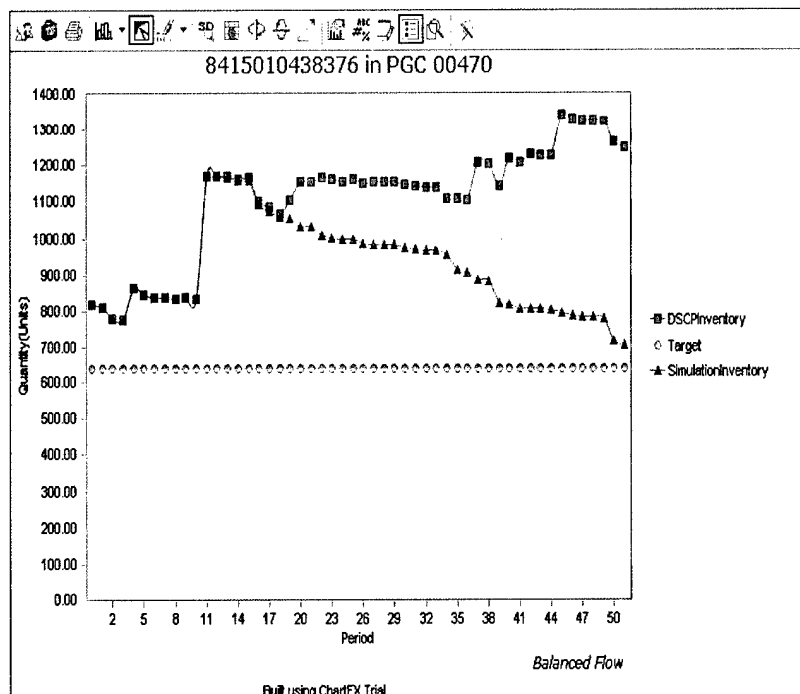


Figure 4. Actual and Simulated Inventories during the First 90 Days

Figure 5 demonstrates an example of an item in multi-year oversupply where the simulation and actual inventories matched most of the year until in week 37 when the C&T system further increased the excess inventory. The difference at the end of the year is also included in the Over Target Reduction.

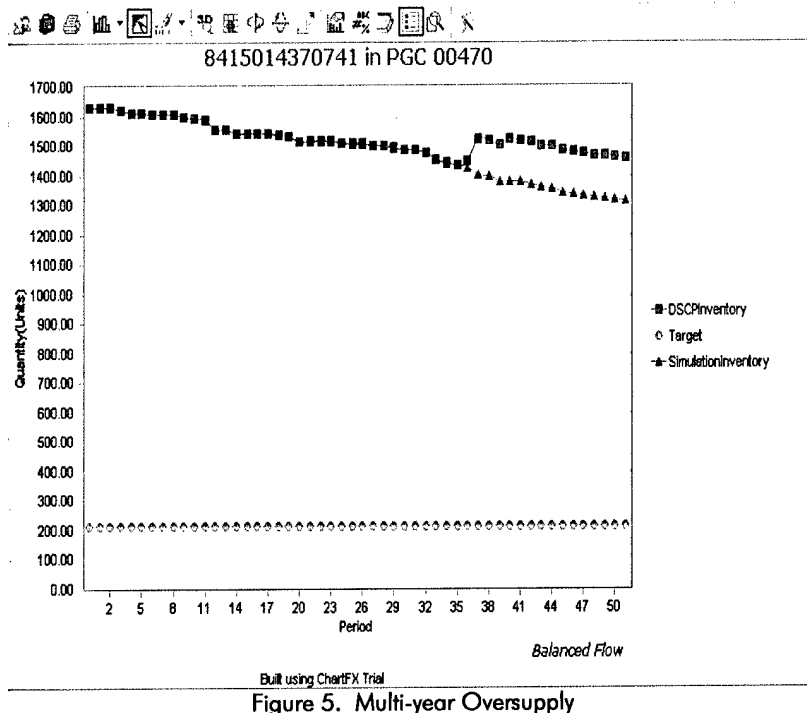


Figure 5. Multi-year Oversupply

Figure 6 is an example of a low supply item where the simulation reduced stock-outs and backorders significantly after the first 90 days lead-time. We did not quantify this benefit in dollars, but a logical argument could be made that funds committed on open delivery orders to cover backorders are the same as excess inventory. Upon receipt of the backordered items, they are shipped and billed thereby generating funds for other purchases.

This example also shows why VIM-BIFRS will enable C&T to reduce inventory targets. Clearly, with the current system an average of 180 days-of-supply is insufficient because of the high variation reflected in on-hand inventories. Had VIM-BIFRS been in use, the stockage policy for this NSN could have been about 30 days or 800 items lower with no stockouts. And this is in the first year before the upstream and downstream variations are minimized through the activation of retail and prime contractor supply chain sections.

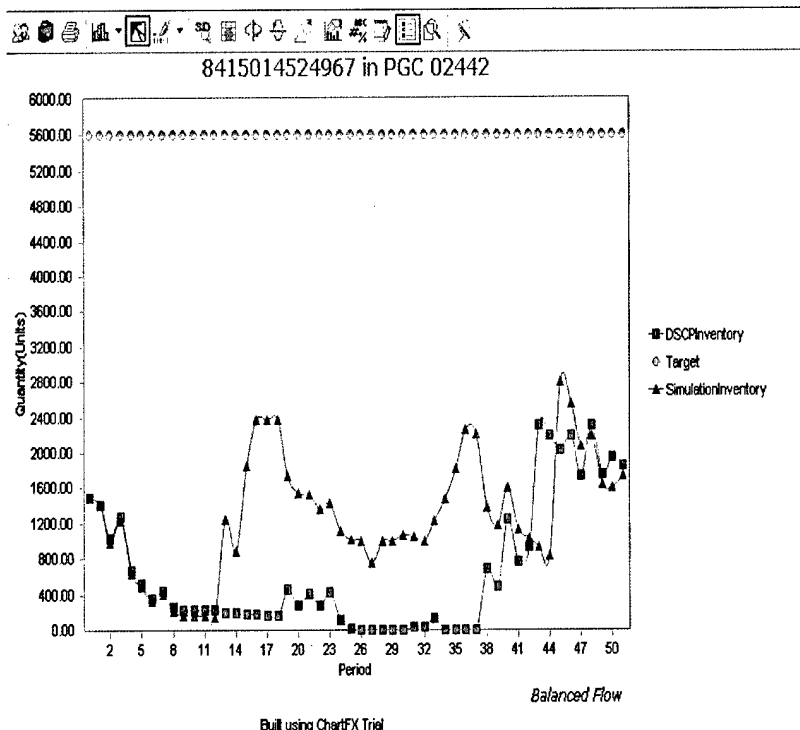


Figure 6. An Example of a Low Supply Item

## Conclusion

### Accomplishments

The project's Phase 0 effort has provided a validated Data Model for the integration of existing ARN systems with the downstream retail military and upstream commercial systems of fiber and fabric sections of the Nomex Supply Chain. The results from Phase 0 study indicated that extending the ARN concepts and systems across entire supply chains for non-recruit items beginning with Nomex items could generate significant additional improvements for DLA C&T Supply Chain. The questionnaire responses suggested that to optimize the operations of the NOMEX supply chain from end to end, it is essential to provide total asset visibility, decision support, and process improvements across the entire C&T SC from downstream retail Services to the upstream fiber producers. Total asset visibility has to be established first to support the implementations of decision support and process improvements. To establish total asset visibility, the existing ARN Operational System needs to be extended to include retail and all upstream SC partners.

During the Phase 0, we developed a Data Model for secure and timely exchange of information throughout the Nomex supply chain from fabric and fiber manufacturers to wholesale. A business case analysis was conducted to investigate potential cost benefits of the Data Model and its enabling tools to DLA. The analysis considered a series of measurable benefits and costs of providing total asset visibility and decision support. Seven key PGCs from the Nomex family as requested by C&T Item Managers were included in the analysis. The analysis was assumed to begin in 2004 and extended for three years. The costs and benefits were discounted over ten years. The results indicated an anticipated net benefit (i.e., benefits minus costs) of \$17,383,445, an ROI of 8.21% and a 53% reduction in stock-outs.

Furthermore, by including Air Force and Navy bases in this Phase 0 study, the team learned the interface requirements and needs of the retail stock control systems and, most importantly, set the stage to bring them into full partnership with DLA C&T.

## Benefits

When the Extended ARN Operational System has enhanced decision support with total asset visibility across the entire supply chain and shares relevant information with the partners, the following benefits to the Nomex Supply Chain could be achieved:

- Reductions in lead-times from initial raw material to retail operations,
- Reductions in stock-outs, shortages and backorders,
- Reductions in inventory investments across the entire supply chain,
- Reductions in operating expenses, and
- Reductions in cost of capital.

These benefits were validated through the cost and benefit analysis conducted during the Phase 0 study. Four groups of players would gain these benefits. First, DLA through the Item Managers at DSCP could dramatically improve peacetime and wartime service levels, customer wait times, inventory investments, manufacturing costs, and operational costs. Second, the prime contractors would be able to improve service levels and control costs. The upstream suppliers would be able to better manage capacity, plan production, and reduce uncertainty, with the potential to reduce supply chain costs and lead times. Finally, the primary beneficiary of these improvements could be DSCP's customers because they would be supported better at significantly lower total costs. Although the project benefits all of the NOMEX supply chain participants, it focuses primarily on the benefits at the C&T wholesale level, especially expected reductions in lead-times, stockouts and inventories to be achieved from Phase 1 implementation.

## Lessons Learned

1. To optimize NOMEX supply chain from end to end, it is essential to provide total asset visibility, decision support, and process improvements across the entire C&T SC from downstream retail Services to the upstream fiber producers. The total asset visibility has to be established first to support the implementations of decision support and process improvements. Once the total asset visibility is established, the existing ARN decision support software needs to be evaluated to determine what decision support functions and process improvements still need to be developed in order to optimize performance of the NOMOX Supply Chain.
2. The one thing that matters most to every SC player is attaining and maintaining continuity of production. Everyone agreed that breaking the continuity of production is the core problem today. Anything we can do to keep the work flowing gets to this core problem.
3. Specific problems identified are repetitive delays and extensions in awarding new contracts, delays in invoking options, and unreasonable differences between minimums and maximums on indefinite delivery quantity contracts. Once orders are in place there are huge pushes for early delivery of large quantities and then demand drops off severely.
4. An accurate forecast (or any timely forecast) would encourage most upstream manufacturers to launch to a forecast rather than only to firm orders. However, some suppliers have policies in place to take no risk until they have a firm order that can be tied directly to a specific delivery order.
5. First delivery time requirements are too short. Gives total advantage to those players who inventory fabric at their own expense and risk as a strategic business policy. This is a large barrier to developing other sources of supply.
6. Upstream suppliers feel like they are always being pushed to deliver as quickly as possible because lines are closed or DSCP is out of stock. Need to do a better job of planning, use some buffers, and reduce

the pressure to hurry up. Need to find ways to put inventory buffers in the entire SC. No one wants to make before an order is placed, but DSCP puts extreme pressure on the SC to deliver as quickly as possible after they finish with their delays. DSCP should finance upstream buffers to off-set the delays they cause if they want products faster than they are now getting them.

## **Recommendations**

The phase 1 project should implement the Data Model developed and validated in the phase 0 study. The implementation will be carried out through the extension and enhancement of the past and ongoing ARN lessons learned, concepts, systems, and tools. Phase 1 will provide total asset visibility and decision support, as well as facilitate process improvements across the entire C&T SC from downstream retail Services to the upstream fiber producers. The total asset visibility will be established first to support the implementations of decision support and process improvements. Once the total asset visibility is established, the existing ARN decision support software will be evaluated to determine what decision support functions and process improvements still need to be developed to optimize performance of the NOMOX Supply Chain. The phase 1 project will consist of three stages.

First, retail services will be brought in as supply chain partners as we establish retail-level asset visibility. The purpose of this is two-fold. First, the ARN learned that one of the two core problems of poor SC performance is that variation in retail orders causes even larger variations in wholesale inventories and C&T purchases. This is commonly known as the bullwhip effect. Acquiring full collaboration and retail asset visibility will provide the means of eliminating this core problem. Second, by including Air Force, Navy, Army, Marine Corps, and Coast Guard bases, the ARN will learn the interface requirements and needs of the retail stock control systems and, most importantly, set the stage to bring all Services into full partnership with C&T.

Second, C&T Item Managers and the existing Nomex supply chain partners upstream of the Item Managers will be included as full supply chain partners as upstream asset visibility is established.

Third, once the total asset visibility is established, the existing ARN decision support software will be evaluated to determine what decision support functions and process improvements still need to be developed. The determined supply chain planning and execution supports will be provided to all SC partners through the enhancement of the existing ARN decision support software and the development of a new set of VIM tools.

## Appendices

### Appendix A: Acronyms List

AAFA	American Apparel and Footwear Association
AAVS	ARN Asset Visibility System
ABDU	Aircrew Battledress Uniform
ACF	Active Contracts File from SAMMS
AF	Allocation Factor
APRF	Active Purchase Request File
ARCS	Active Requisition Control/Status from SAMMS
ARN	Apparel Research Network
BCA	Business Case Analysis
BIFRS	Balanced Inventory Flow Replenishment System
BORF	Back Order File
CAR	Clemson Apparel Research
CHF	Contract History File
C&T	Clothing and Textile
DLA	Defense Logistics Agency
DSCP	Defense Supply Center Philadelphia
DODAAC	Department of Defense Activity Address Code
DOS	Days of Supply
DUE	Due-In Table from SAMMS
GOCC	Government Contracts Committee
HFUN	Fund History File
IEP	Information Exchange Platform
LDAP	Lightweight Directory Access Protocol
LMI	Logistics Management Institute
LCI	Logical Channel Identifier / Logical Channel Identification
LLC	Limited Liability Company
MIL SPEC	Military Specification
MRC	Materiel Receipt Card
NAS	Naval Air Station
NIR	National Inventory Record from SAMMS
NOMEX	A man made fiber resistant to heat, flame and chemicals
NSN	National Stock Number
PDIT	Product Data Integrated Technologies, Inc.
PGC	Product Group Code
PN	Part Number
ROI	Return On Investment
SAMMS	Standard Automated Material Management System
SC	Supply Chain
SCF	Supply Control File from SAMM

SCS	Supply Chain System
SCHMS	Supply Chain Health Monitoring System
TAV	Total Asset Visibility
TPA	Trading Partner Agreement
VIM	Virtual Item Manager
UDDI	Universal Description Discovery and Integration
ULL	University of Louisiana at Lafayette
VIM-BIFRS	Virtual Item Manager - <u>Balanced Inventory Flow Replenishment System</u>
VIM/BIFRS-W	Virtual Item Manager - <u>Balanced Inventory Flow Replenishment System</u> at Wholesale
VIM/ASAP	Virtual Item Manager - ARN Supply-chain Automated Processing
VIM/QLM-Central	Virtual Item Manager - Quality Logistics Management - Central

## Appendix B: NOMEX Supply Chain Member Survey

### DLA Feasibility Study: NOMEX Supply Chain Member Survey

In order to improve the peacetime and wartime operations of the military Nomex supply chain, the Defense Logistics Agency (DLA) has authorized Clemson University and the University of Louisiana at Lafayette to conduct a feasibility study for an Information Exchange Platform. The DLA Apparel Research Network (ARN) is considering building a complete Internet-based system that all players in the military textile and apparel supply chain can use to make doing military business as positive as possible - all the way to fiber producers. This system is intended to create real-time availability of all information that could resolve issues or take advantage of opportunities.

Our goal is to develop an information exchange platform for the Nomex supply chain that will help your company in:

- The elimination of stock outages.
- The reduction of inventories and customer wait times.
- The leveling of manufacturing requirements and the elimination of expediting.
- The reduction of operational and item costs.

We need your help in identifying all the problems and opportunities that we should consider including. We anticipate the expansion of the information exchange platform into non-Nomex items, based on the success of this pilot project.

The following survey will help us begin this process by understanding who you are, what your role in the supply chain is, and identifying the problems and opportunities for improvement in the Nomex supply chain. Your data will only be used as part of this research project and will not be shared with customers, suppliers or competitors of your company. Our findings will be reported to the Apparel Research Network of DLA. Our findings, based on summarized data only, will be reported to the Apparel Research Network of DLA. General conclusions of the survey will be available on request. You may leave blank any questions that you consider too confidential.

We intend to give every commercial member of the extended military NOMEX supply chain an opportunity to identify issues and opportunities even if they only use a small amount of NOMEX fiber, yarn, or fabric. This is the reason we ask for points of contact for your customers and suppliers in Part 2. You do not need to provide contact data for DSCP or the following commercial firms:

Belleville Shoe Mfg. Co.	Peckham
Carter Industries	Pharr Yarn
Creative Apparel Associates	Point Blank Body Armor
D.J. Manufacturing	Propper International
DuPont	Southern Mills
EA Industries	Springfield, LLC
Hawkeye Glove	SSM Industries
Hercules Glove	Valley Apparel, LLC
Milliken & Company	YKK (USA)

**Please Note: All input will be consolidated. All data will be stored by a secured Company ID and no data will be released in individual or identifiable form.**

Please email or fax responses to Dr. Ramesh Kolluru at kolluru@louisiana.edu or 337-482-0621. For support, Dr. Ramesh can be contacted at 337-482-0611.

**1. Company Information**

Company Name \_\_\_\_\_

Contact Person \_\_\_\_\_ Title \_\_\_\_\_

Phone \_\_\_\_\_ Email \_\_\_\_\_

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Would you like the results of this survey? Circle One:      Yes      No

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

**FOR OFFICE USE ONLY**

Assign Company ID using the list of ID's in the Company ID folder. Code all pages with the ID in the space indicated at the top of the page. Separate this page from the following pages. Record date and initial in the space indicated. File it in the Company ID folder. Staple pages 3 through 8 and send to data entry.

Assigned Company ID \_\_\_\_\_

Date Input \_\_\_/\_\_\_/\_\_\_ Initials \_\_\_\_\_

## 2. Supply Chain Information

Information about materials/contracts you produce that go into Military Nomex products:

Item Descriptions (not to NSN/SKU Level of Detail)	Approximate Average Annual Sales (\$)	Average Total Inventory RM +WIP+FG (\$)
1.		
2.		
3.		
4.		
5.		
6.		
7.		

If you have more products, additional sheets may be attached.

Information about your Supply Chain Partners that we know about are printed here for you to verify and correct if necessary. List any significant items, suppliers and customers for your Nomex related products not listed here. For each provide a point of contact with his/her email address and/or telephone number *if not listed on Page 1.*)

Items/Suppliers	Items/Customers
1. NA	
2. NA	
3. NA	
4. NA	
5. NA	
6. NA	
7. NA	

If you have more customers and suppliers, additional sheets may be attached.

### 3. SUPPLY CHAIN ISSUES

We would like to ask you about problems that you have had in the past two years. Please estimate how many times the following events have occurred in the operations of your part of the Military Nomex Supply Chain and how significant they were to your company, on a scale of 1-5 (1 = Very significant, 5 = Not significant at all).

Events	Frequency in the last 2 years	Significance (1-5)
Unavailability of Raw Materials		
Incoming or Outgoing Rush Orders (Expedites)		
Back orders/ Stock Outs to Customers		
Excess Inventory		
Capacity Constraints		
Line Stoppage		
Unanticipated Design Changes		
Quality Problems		
Approval Delays for changes, shade, tests, etc.		
Ordering Delays and Errors		
Billing Delays and Errors		
Shipping Delays and Errors		
Payment Delays and Errors		
<i>Other (Please specify)</i>		

Please elaborate on the significant problems that you have indicated above.

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#### 4. SUPPLY CHAIN COLLABORATION

1. How do you communicate internally, with your suppliers, and with your customers? (Check all that apply)

Method of Communication	Internally	With Suppliers	With Customers
Face-to-face			
Phone			
Fax			
E-mail			
Public Website			
Private Intranet			
EDI			
<i>Other (Please specify):</i>			

2. How useful would the following information be to your company? On a scale of 1-5 (1 = Very useful, 5 = Not useful at all, N/A = not applicable).

Data	From Suppliers	From Customers	From DLA
DLA Delivery Orders on Open Contracts			
DLA Planned Deliver Orders for Open Contracts			
DLA Contracts Awarded			
DLA Solicitations for Bids			
DLA Planned Solicitations for Bids			
Order Status (Shipping Information)			
Inventory Levels			
Lead Times			
Capacities			
Planned Orders			
Production Schedules			
Forecasts			
<i>Other (Please specify):</i>			

3. Given a confidentiality agreement, how willing would you be to share the following information with suppliers, customers or the DLA, on a scale of 1-5 (1 = Very willing, 5 = Not willing at all, N/A = not applicable).

Data	With Suppliers	With Customers	From DLA
DLA Delivery Orders on Open Contracts			N/A
DLA Planned Deliver Orders			N/A
DLA Contracts Awarded			N/A
DLA Solicitations for Bids			N/A
DLA Planned Solicitations for Bids on Contracts			N/A
Order Status (Shipping Information)			
Inventory Levels			



## 6. COSTS AND BENEFITS

1. We would like to ask you about the economic impact of the operating problems and issues in your part of the Military Nomex Supply Chain that you have encountered in the past two years. For each item please indicate how eliminating that event or activity would have impacted **any or all** of four economic factors:
- Your raw material and direct labor costs. For this factor give us your best estimate how unit cost would decline as a percentage of your current unit cost.
  - Your operating costs. For this factor estimate the **dollars** you would save annually in expenses that are not direct materials and direct labor costs.
  - The annual direct costs in **dollars** for penalties you pay or discounts you must absorb related to late or incomplete deliveries when you stock out of a product
  - The value of inventories in **dollars** that you normally hold as a safety stock to prevent the activity or eliminate the effect of the event.

Eliminating each event or activity may not have an impact on all four factors. Data is not required for boxes marked in grey. If the factor does not apply to you, put Not Applicable (NA) in the space for that item. If it does apply but you do not have detailed numbers for that item use your expertise and give us your best estimate of the percentage or dollar value

Event or Activity	A Unit Cost of product you sell (%)	B Operating Costs (\$)	C Stock-out Cost / Penalties(\$)	D Inventory Carried as Safety Stock (\$)
Expediting of Raw Materials to Prevent Stock-out				
Resolving Back orders/ Stock Outs to Customers				
Carrying Inventory to Shorten Order to Delivery Lead time				
Write off of Finished Goods or WIP Due to Unanticipated Design Changes				
Failing to make Order Deliveries Due to Capacity Constraints				
Carrying Excess Production Capacity/Personnel to Handle Peak Demand in a Contract				
Line Stoppage/Shutdown and Restart Due to Order Delays				

Event or Activity	A Unit Cost of product you sell (%)	B Operating Costs (\$)	C Stock-out Cost / Penalties(\$)	D Inventory Carried as Safety Stock (\$)
Line Stoppage/Shutdown and Restart Due to Approval Delays				
Expediting of Customer Rush Orders				
Resolving Quality Problems				
Management of Delays and Errors Related to/Caused by:				
Purchasing				
Order Processing				
Shipping				
Billing				
Reporting Systems				
Other (Please specify)				

**7. SUMMARY COST SAVINGS**

Assume all members of the entire Nomex military supply chain received sufficient and timely forecasts and orders to maintain a stable flow of level production. Considering all of your current costs that would be eliminated or reduced, by what percentage do you estimate your total costs would be reduced? Check One

- |                                     |   |
|-------------------------------------|---|
| <input type="checkbox"/> No Savings | <input type="checkbox"/> 11-15 %          |
| <input type="checkbox"/> 0-1 %      | <input type="checkbox"/> 16-20 %          |
| <input type="checkbox"/> 2-5 %      | <input type="checkbox"/> 21-25 %          |
| <input type="checkbox"/> 6-10 %     | <input type="checkbox"/> Greater than 25% |



# Appendix D: Cost & Benefit Analysis Results

## COST & BENEFIT ANALYSIS: SUMMARY

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
<b>Undiscounted Flows</b>													
Costs	\$0	-\$640,000	-\$840,000	-\$840,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$2,320,000
Benefits	\$0	\$0	\$10,005,771	\$3,253,469	\$2,615,692	\$646,016	\$627,271	\$627,271	\$627,271	\$627,271	\$627,271	\$627,271	\$20,284,572
Net	\$0	-\$640,000	\$9,165,771	\$2,413,469	\$2,615,692	\$646,016	\$627,271	\$627,271	\$627,271	\$627,271	\$627,271	\$627,271	\$17,964,572
<b>Discount Factors</b>													
Discount Rate	4.2%												
Base Year	2004												
Year Index (for calc.)	0	0	1	2	3	4	5	6	7	8	9	10	
Discount Factor	1.0000	1.0000	0.9597	0.9210	0.8839	0.8483	0.8141	0.7813	0.7498	0.7195	0.6905	0.6627	
<b>Discounted Flows</b>													
Costs	\$0	-\$640,000	-\$806,142	-\$773,649	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	-\$2,219,791
Benefits	\$0	\$0	\$9,602,467	\$2,996,479	\$2,311,977	\$547,989	\$510,642	\$490,059	\$470,307	\$451,350	\$433,157	\$415,698	\$18,230,125
Net	\$0	-\$640,000	\$8,796,325	\$2,222,830	\$2,311,977	\$547,989	\$510,642	\$490,059	\$470,307	\$451,350	\$433,157	\$415,698	\$16,010,334
Cumulative	\$0	-\$640,000	\$8,156,325	\$10,379,155	\$12,691,132	\$13,239,121	\$13,749,763	\$14,239,823	\$14,710,129	\$15,161,479	\$15,594,636	\$16,010,334	
Net Present Value	\$17,383,445		ROI		8.21								
Stock-out Reduction	53%												

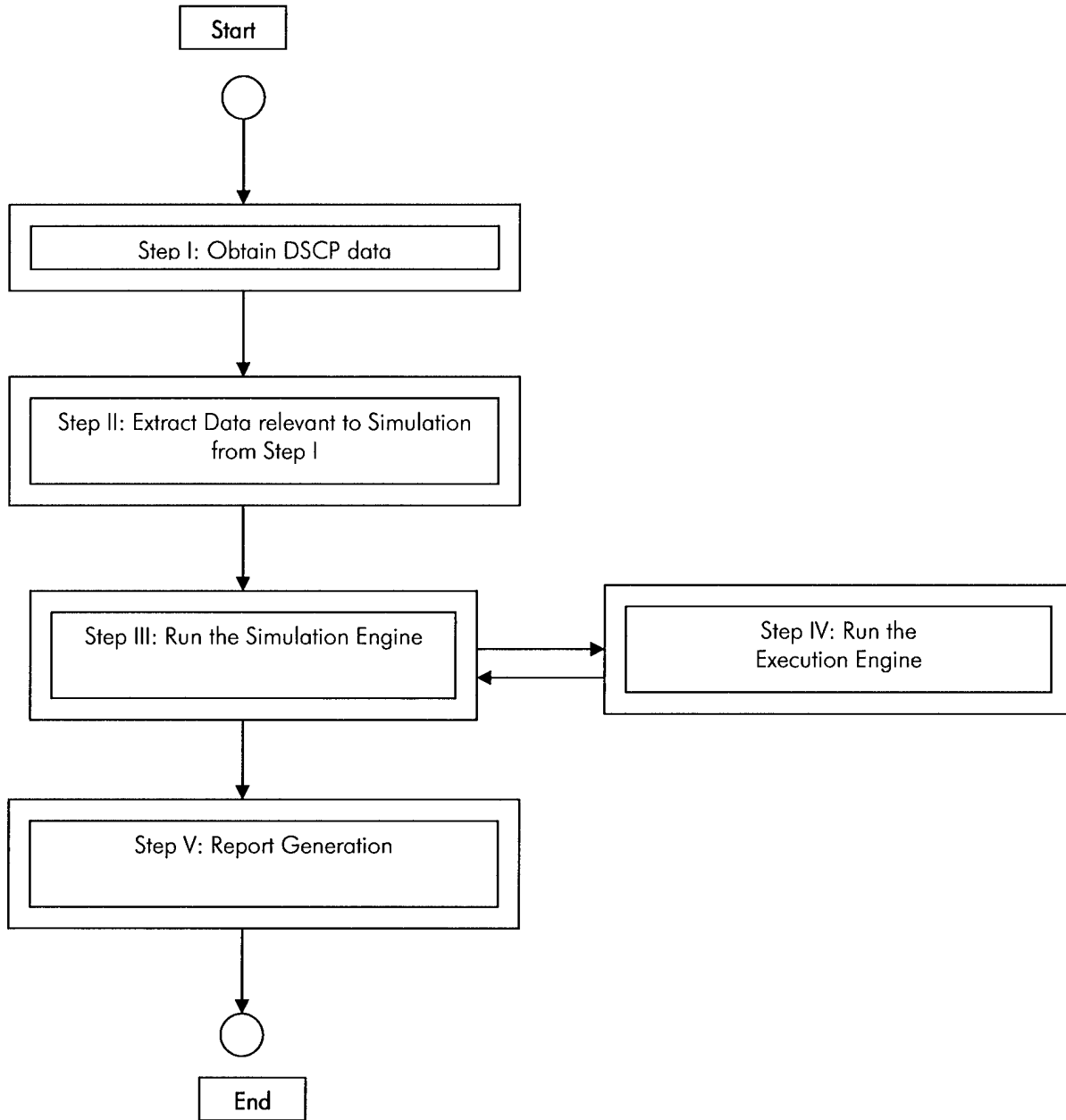
### COST & BENEFIT ANALYSIS: COSTS

Category	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	TOTAL
R&D Costs:													
UL Lafayette	\$0	\$300,000	\$300,000	\$300,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$900,000
Clemson	\$0	\$220,000	\$220,000	\$220,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$660,000
Modulant	\$0	\$100,000	\$300,000	\$300,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Implementation Costs	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Operating Costs	\$0	\$20,000	\$20,000	\$20,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$60,000
Training	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Program Total By Year	\$0	\$640,000	\$840,000	\$840,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$2,320,000

### COST & BENEFIT ANALYSIS: BENEFITS

Category	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	TOTAL
Over Target Reduction	\$0	\$0	\$13,341,028	\$1,145,229	\$136,199	\$26,089	\$0	\$0	\$0	\$0	\$0	\$0	\$14,648,545
Retail Integration	\$0	\$0	\$0	\$2,632,406	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$2,632,406
Upstream Integration	\$0	\$0	\$0	\$0	\$2,632,406	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$2,632,406
Cost of Capital Savings	\$0	\$0	\$0	\$560,323	\$718,984	\$835,265	\$836,361	\$836,361	\$836,361	\$836,361	\$836,361	\$836,361	\$7,132,738
Total Benefits	\$0	\$0	\$13,341,028	\$4,337,959	\$3,487,589	\$861,354	\$836,361	\$836,361	\$836,361	\$836,361	\$836,361	\$836,361	\$27,046,096
Confidence Factor	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Dollar Benefits	\$0	\$0	\$10,005,771	\$3,253,469	\$2,615,692	\$646,016	\$627,271	\$627,271	\$627,271	\$627,271	\$627,271	\$627,271	\$20,284,572
Stock-out Reduction													53%

## Appendix E: Procedure for Running the Simulation for the NOMEX



## Explanation of the Flow Chart

### Step I: Obtain DSCP data

The DSCP data required for running the Simulation was obtained from databases provided by Ms. Donna Pointkouski, DSCP who in turn had obtained this data by querying the SAAMS database.

### Step II: Extracting data relevant to Simulation from Step I

From the databases provided by DSCP, we extracted specific data (parameters) that were necessary to run the Simulation. The extraction logic, presented in detail in Section III (Appendix) used a number of different queries to identify nodes in the Nomex Supply Chain, the orders/requisitions, demand, as well as inventory status for each node.

### Step III: Run the Simulation Engine (specific to data from Step II)

The simulation engine holds the model's parameters and databases for the run. It also holds the business logic for updating the current inventory status by adding arrivals and deducting demand. The simulation engine calls the execution engine to compute the order for each simulation cycle.

The following alternatives were selected within the Simulation Engine:

- a. **Constraints:** Available Capacity limited to actual weekly arrivals
- b. **Specific parameters:** Lead Time = 90 DOS for changes in size selection

### Step IV: Run the Execution Engine

The execution engine estimates the days of supply (DOS) of each NSN in each PGC. For each PGC it then allocates capacity by repeatedly adding a batch (case) quantity to the NSN in lowest DOS until the capacity is exhausted or the stockage target is attained. It requires the beginning inventory, and demand from the simulation engine. Its output to the simulation engine is the recommended delivery order. It attempts to balance all the NSN's of each PGC at the same number of days of supply and reach the inventory target subject to capacity constraints.

### Step V: Report generation

The results generated by the simulation engine include the orders and inventory levels for DSCP. These inventory levels are reported for every cycle and can be graphed against the actual DSCP inventories.

## Appendix F: Data Extraction Logic

### 1. Logic for extracting DSCP demand for the Simulation

Description: For simulation, we are picking following types of demand transactions:

- a) D7A
- b) D7B
- c) D7C
- d) D7E
- e) D7J
- f) D7K
- g) D7M
- h) D9A
- i) D9B
- j) D9C
- k) D9D

SQL: Any transaction that has any of the above transaction document identifier codes (DICs) is taken as a demand record. The data extraction period is between September 1, 2002 and August 31, 2003.

### 2. Logic for extracting orders by DSCP for the Simulation

Description: For the purpose of simulation, DSCP orders are assumed to include all arrivals. Therefore, we include following type of arrival transactions to represent orders:

- a) D4S
- b) D6A
- c) D6B
- d) D6K
- e) D6Z
- f) D8A
- g) D8B
- h) D8C

SQL: A transaction that has `orig_dic = 'D4S'` and positive transaction quantity.

Assumptions: There are some D4S transactions with negative quantity, which we are ignoring as of now.

### 3. Logic for extracting demand rates from SAMMS for the Simulation

Description: SAMMS website displays monthly historical monthly demand forecast at the NSN level. However, for simulation we need a weekly demand rate forecast at the NSN level. In order to get that, we multiply by 12 and then divide by 52.

### 4. Logic for extracting inventory for the Simulation

Description: In the database, weekly inventory at NSN/location level is extracted by taking the opening balance at first transaction day of given week.

SQL for weekly inventory:

Step 1: Find opening balance for a given NSN, location and first transaction of the day. (Minimum sequence number identifies first transaction on any given day).

Step 2: Convert days into weeks and select first transactions of weeks.

Step 3: Group the records from Step 2 by 'NSN and week' and sum the opening balance across all locations.