



SCRL-Model for Human Space Flight Operations Enterprise Supply Chain

2010 IEEE Aerospace Conference
Big Sky, Montana
March 6-13, 2010

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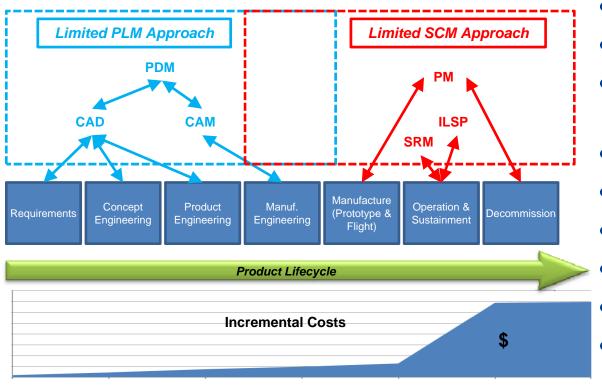
The Need

- Standard approach to evaluate and configure adaptable and sustainable program and mission supply chains at an enterprise level
 - End-to-end view
 - Total Lifecycle
- Evaluate the readiness of the supply chain during the supply chain development phases





Enterprise Supply Chain Management



How do we measure SC readiness? How do we construct this type of SC?

- Total Visibility
- Total Lifecycle
- Meeting Mission Requirements
- On time & at cost
- Sustainable
- Adaptable
- Optimized
- Mitigated Risks
- Continuous Improvement
- Viable Suppliers





SCRL Model Development

Systems Engineering and Manufacturing

TRL

Technology Readiness

MRL

Manufacturing Readiness

MRA

Manufacturing Readiness Assessment

Life Cycle Framework

Acquisition Life Cycle Project Life Cycle

PDM / PLM

Product Life Cycle Management

Enterprise Supply Chain Development

Enterprise Supply Chain

- End-to-end
- Total life cycle
- Supportability

SCM Best Practices

Industrial Base Sustainment

Risk Management Economic Stability Prime Supplier

Modeling and Simulation

Standard Metrics SCOR®

SCRLModel benefits

- Standard development process
- Standard evaluation criteria
- Proactive collaboration
- Method to continually monitor and improve
- Framework for contract / data requirements

- ➤ Merge systems engineering project development process with enterprise supply chain development best practices and metrics (e.g. SCOR®)
- ➤ Correlate to current MRL, MRA and TRL standards and expand to encompass total supply chain
- Utilize a standardized assessment-based measurement model





SCRL Model

SCRL 1

Immature High Risk High Cost

- Early phases of development
- Limited to next tier relationship
- Communication and information limited to single orders
- Modeling and Simulation technologies not used

2 3

Developing
Moderate Risk
Lower Cost

Increasing Maturity

SCRL 5

Mature
Risk Mitigated
Lowest Costs

- Advanced SCM practices in place and validated
- Relationship with all upstream entities
- Communication with all downstream entities and lifecycle phases included
- Utilization of modelbased design and manufacturing





MRL 10

Utilize SCRL with TRL & MRL

Defense Acquisition Framework and Relationship to TRL and MRL IOC **FOC** Pre Materiel Technology **Engineering and Production &** Operations & Materiel Solution Development Manufacturing Deployment Support Solution **Analysis Development & Analysis** Demonstration LRIP IOT&E Post-CDR Decision Development **Review and Audits** 12 **Technology Readiness Levels** TRL1 TRL 2 TRL 3 TRL 9 TRL 4 TRL 5 **Manufacturing Readiness Levels**

- ➤ Supply Chain developed in conjunction with technology and manufacturing
- ➤ Established reviews and audits trigger evaluation of supply chain
- ➤ Levels in technology and manufacturing readiness are considered from a SC perspective

SC developed along with Tech and Mfg

MRL

Supply Chain Readiness Levels

Source: Department of Defense, Manufacturing Readiness

Assessment (MRA) Deskbook, May, 2009

MRL

SCRL 1 SCRL 2 SCRL 3 SCRL 4 SCRL 5





SCRL: Supply Chain Characteristics

Inventory	Strategic raw material, WIP and FG placement in SC				
Strategic Sourcing	Sourcing decisions benefit enterprise, optimum number of SKUs & supp.				
Visibility	Ability to see varying levels of the SC				
Suppler /Cust Relationships	Working relationships at varying levels of the SC, Improvement focus				
Price Adaptability	Impact of variation in the price of commodities				
Collaboration	Flow of information up and down the supply chain				
Lifecycle Awareness	SC visibility and awareness of the current lifecycle phase				
Modeling & Simulation	Apply modeling and simulation to improve SC				
Performance Measurement	Metrics used to measure and improve supply chain				
Risk Management	Including obsolescence, sole-sourcing, counterfeit parts				
Criticality Focus	Focus level on critical parts, path and suppliers				
Sustainability	Long term viability of the industrial base				
Manufacturing Readiness	Monitoring manufacturing readiness of the SC				
Technology Readiness	Monitoring technology readiness of the SC	Total of 15 Threads			
Sub-Tier Management	All levels of SC adhere to SCRL standards				





SCRL: Supply Chain Characteristics

Inventory	SCRL	Requirement
	SCRL 1	Inventory levels not known throughout the SC. Inventory is not optimized even at the local level.
	SCRL 2	Inventory levels are being monitored at the local level. Stock- outs and low inventory turns are common.
Lifecynle Awaren Modeling & Simu Performance Me	SCRL 3	Inventory levels are defined and managed locally in order to satisfy next-level customer demand. Efforts are being made to identify major stockpiles of inventory throughout the supply chain.
Risk Managemen Criticality Focus Sustain ability	SCRL 4	Inventory is distributed throughout the supply chain with managed buffers at supply chain node interfaces. VMI may be in place at some locations.
Manufacturing R Tachnology Read Sub-Tier Manage	SCRL 5	Inventory is strategically placed throughout the supply chain to minimize total supply chain inventory costs while still satisfying the readiness demands of the system





SCRL: Supply Chain Characteristics

	SCRL	Requirement
	SCRL 1	Supply chain performance is not measured
Suppler /Cust Re Price Adaptabilit Collaboration	SCRL 2	Metrics are used to evaluate and improve supply chain performance at levels 1
Lifecycle Awarer Performance Measurement	SCRL 3	Metrics are used to evaluate and improve supply chain performance at levels 1 & 2
Riski Wanagema (27110211171 2016) Sisisinya 20171	SCRL 4	Metrics are used to evaluate and improve supply chain performance at levels 1 -3
Manufacturing R Technology Rea Sub-Tier Manage	SCRL 5	SCOR metrics and best practices utilized at all levels of the supply chain to provide standard measure of performance and these metrics are routinely used to improve supply chain performance





SCRL: Level & Assessment

Inventory	SCRL Assessment
Strategic Sourcing	
Visibility	An Assessment will be used to evaluate the SC
Suppler /Cust Relationships	readiness
Price Adaptability	
Collaboration	 Assessment questions and performance criteria established for each characteristic to define SCRL
Lifecycle Awareness	established for each characteristic to define SCIVE
Modeling & Simulation	 Overall SCRL for the supply chain being evaluated
Performance Measurement	will be determined by the minimum SCRL.
Risk Management	□ The economical regults could then be used to
Criticality Focus	☐ The assessment results could then be used to identify the specific supply chain characteristics and
Sustainability	practices that should be addressed to increase the
Manufacturing Readiness	SCRL and reduce the risk and cost before moving to
Technology Readiness	the next development phase.
Sub-Tier Management	





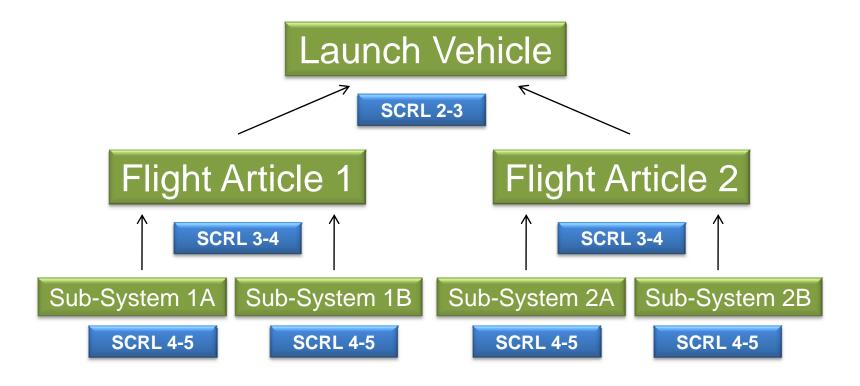
SCRL: Levels by Characteristic

Inventory	SCRL 1	SCRL 2	SCRL 3	SCRL 4	SCRL 5
Strategic Sourcing	SCRL1	SCRL 2	SCRL 3	SCRL 4	SCRL 5
Visibility	SCRL 1	SCRL 2	SCRL 3	SCRL 4	SCRL 5
Suppler /Cust Relationships	SCRL 1	SCRL 2	SCRL 3	SCRL 4	SCRL 5
Price Adaptability	SCRL 1	SCRL 2	SCRL 3	SCRL 4	SCRL 5
Collaboration	SCRL 1	SCRL 2	SCRL 3	SCRL 4	SCRL 5
Lifecycle Awareness	SCRL 1	SCRL 2	SCRL 3	SCRL 4	SCRL 5
Modeling & Simulation	SCRL 1	SCRL 2	SCRL 3	SCRL4	SCRL 5
Performance Measurement	SCRL 1	SCRL 2	SCRL 3	SCRL 4	SCRL 5
Risk Management	SCRL 1	SCRL 2	SCRL 3	SCRL 4	SCRL 5
Criticality Focus	SCRL 1	SCRL 2	SCRL 3	SCRL 4	SCRL 5
Sustainability	SCRL 1	SCRL 2	SCRL 3	SCRL 4	SCRL 5
Manufacturing Readiness	SCRL 1	SCRL 2	SCRL 3	SCRL 4	SCRL 5
Technology Readiness	SCRI 1	SCRI 2	SCRL 3	SCRL 4	SCRL 5
Sub-Tier Management	Exa	mple	SCRL 3	SCRL 4	SCRL 5





SCRL & the Extended Supply Chain



It is anticipated that the Supply Chain Readiness Level required will increase with the depth of the supply chain level assessed.





Benefits of using SCRL

- Standard Assessment and Construction Model
 - Concurrently addressing SCM issues in the same manner
 - Risk mitigation can begin in the earliest phases and accurate lifecycle costs can be assessed and controlled.
- Proactive Collaboration
 - SC entities develop collaborative structures and relationships
 - Improved visibility throughout SC
- Continuous Improvement
 - Identify opportunities for improvement
 - Monitor as SC entities and conditions change
- Framework for Contracts and Data Requirements





Path Forward

- Complete development of matrix
 - Refine levels and threads
 - SCRLs are in early stage of development
 - Develop body of knowledge/references to support development
- Peer review of SCRL SC characteristic matrix
 - Acceptance by government agency
 - Acceptance by industry
- Develop SCRL Assessment
- Perform pilot projects to validate
 - Good, Bad, OK