



Re-engineering Ammunition Residue Management in IMCOM-SE

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Unclassified

Report Documentation Page				Form Approved OMB No. 0704-0188	
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1. REPORT DATE 01 JUN 2008		2. REPORT TYPE N/A		3. DATES COVERED -	
4. TITLE AND SUBTITLE Re-engineering Ammunition Residue Management in IMCOM-SE				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) United States Military Academy West Point, NY 10996				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release, distribution unlimited					
13. SUPPLEMENTARY NOTES See also ADM202527. Military Operations Research Society Symposium (76th) Held in New London, Connecticut on June 10-12, 2008, The original document contains color images.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT SAR	18. NUMBER OF PAGES 44	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

76th MORSS



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Title of Presentation:

Re-engineering Ammunition Residue Management in IMCOM-SE

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Agenda

- Current System
- Value Hierarchy
- Alternative Generation
- Feasible Alternatives
- Collecting Data
- Decision Matrix
- Life Cycle Cost
- Recommended Alternative



Initial Problem Statement

- Looking at the Entire Lifecycle of ammunition residue, determine the most efficient process for Ammunition Supply Point operations in the IMCOM-SE region.



Stakeholders

- IMCOM-SE
 - Mr. Hal Kelley, Director of Logistics, IMCOM-SE
 - Primary Stakeholder and decision maker
- Defense Ammunition Center (DAC)
- Contracting companies running ASP
- Installation Commanders
- MWR*
- DRMO*
- Environmental Agencies*

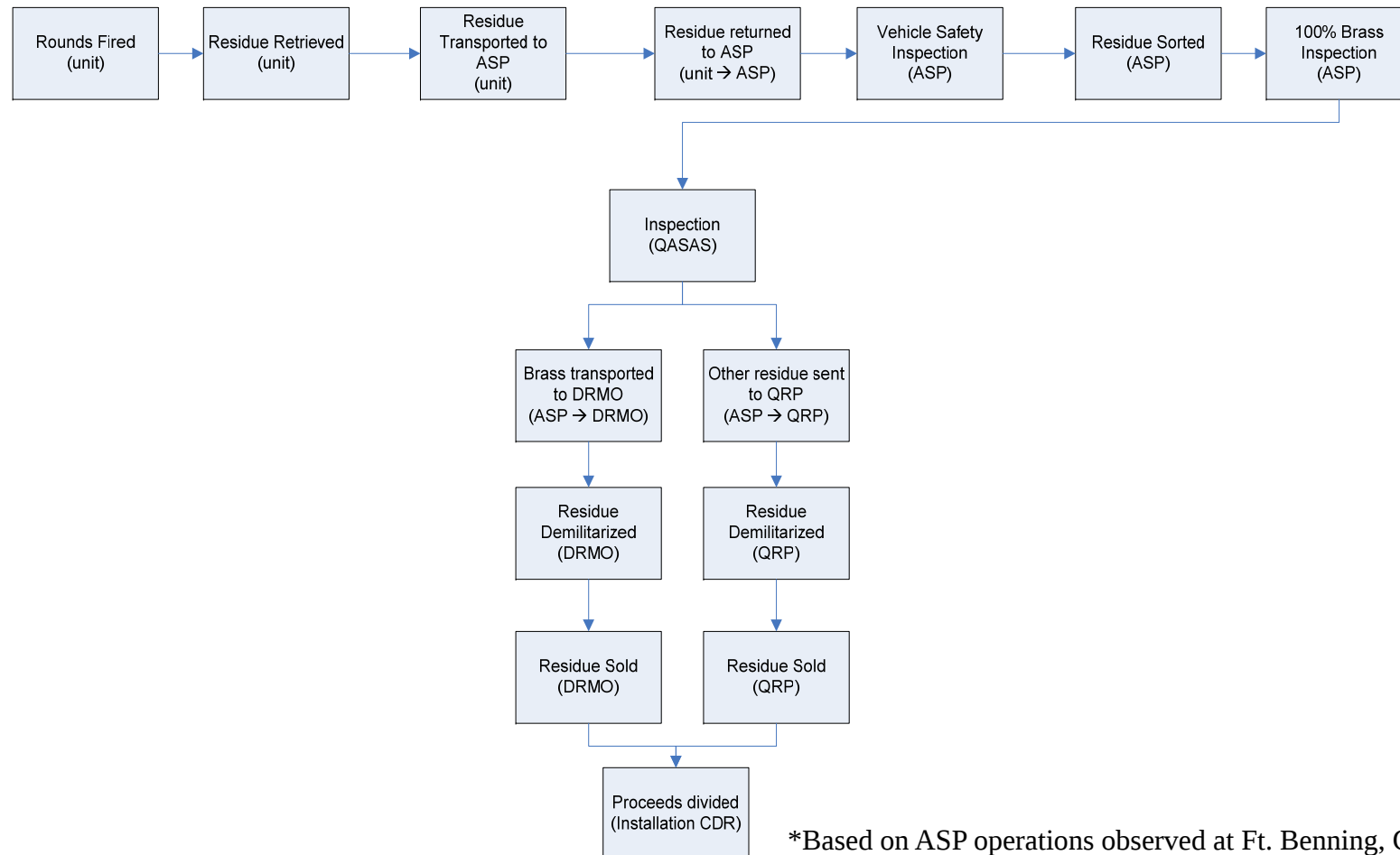


Current System

- IMCOM-SE controls 20 posts, 10 of which produce residue.
- Some ASPs managed and run by contractors, others run by DA Civilians
- No regional Standard
- Ammunition residue options
 - Qualified Recycling Program (QRP)
 - Defense Reutilization & Marketing Office (DRMO)



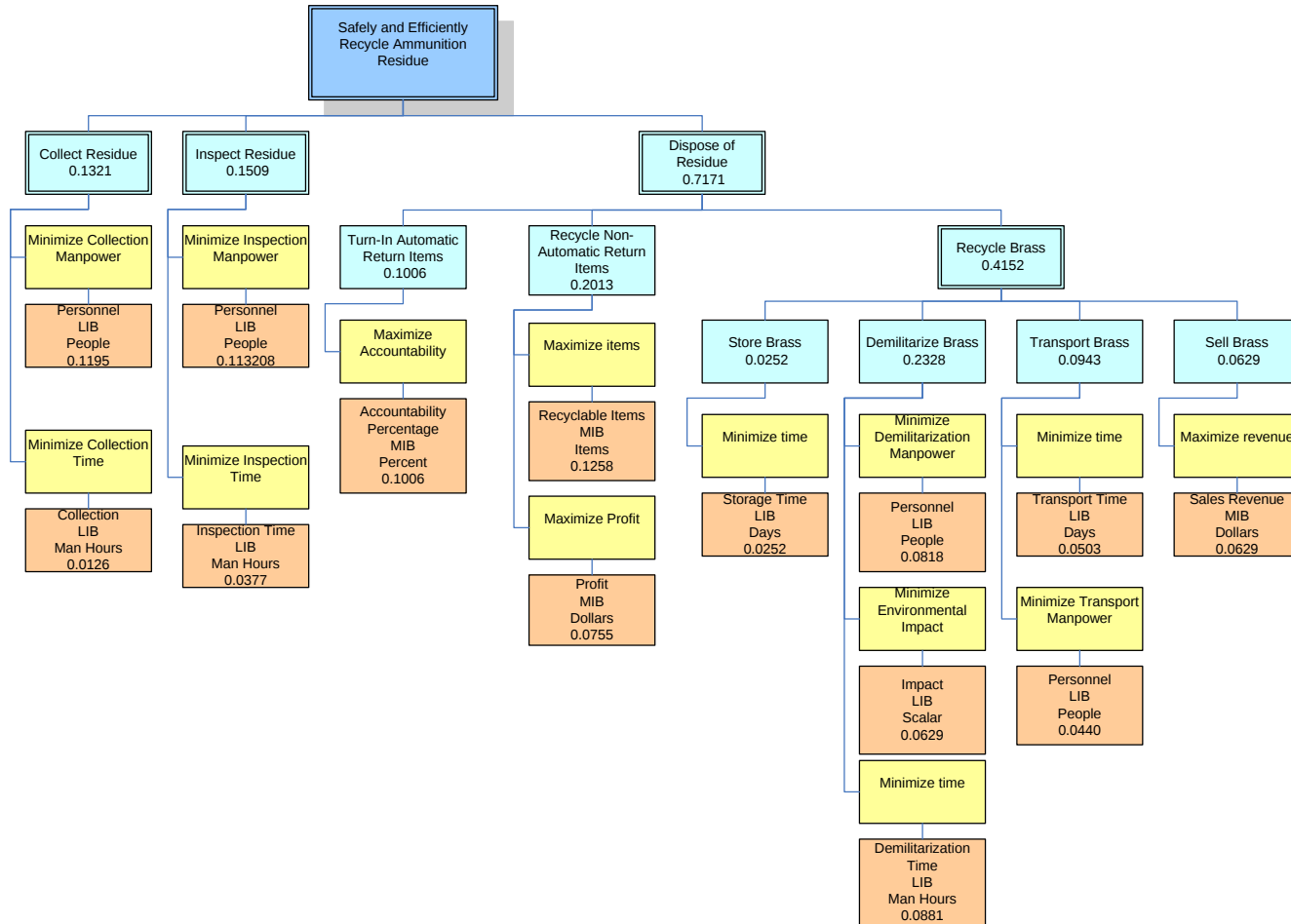
Process Flow Chart



*Based on ASP operations observed at Ft. Benning, GA.



Value Hierarchy





Revised Problem Statement

- Given the ammunition residue lifecycle, determine the most efficient process for Ammunition Supply Point residue management operations in the IMCOM-SE region.



Idea Generation

- Brainstorming
- Benchmarking
- Surveys
- Zwicky's Morphological Box



Literature Review

- **US Army Materiel Command (AMC)**
- **Memo for combined services qualified recycling program**
- **Public Works Technical Bulletin 420-49-18**
- **Qualified Recycling Program (QRP) Development Guide**
- **Disposal of Recyclable Materials-Proceeds Allocation-2577**
- **SOP for Inventory Procedures**
- **SOP 01-Duties and Functions of the Turn In Point at ASP**
- **SOP 08-Residue Yard and Handling of Class 5 Packing Material Turn-in**
- **SOP 14 (Hazcom Procedure)**
- **SOP 15-2nd Count Processes at ASP**
- **SOP 16-Operation and Maintenance of the APE 1408 Safety Certification System**
- **SOP 17-Small Arms Brass Deformer**
- **DoD 4160.21-M-1 Demilitarization Requirements for Munitions List Items**
- **DODI 4715.4 Pollution Prevention**
- **DODI 5010.36 Productivity Enhancing Capital Investment (PECI)**
- **Standard Concept of Operations for Ammunition Supply Points within CONUS**
- **Army Regulation 420-49**



Alternative Generation Table

Solution Design Parameters										
Collect Residue (OBJ: Min Manpower, Min Time)	Residue Path	Inspect Residue (OBJ: min time)	Secondary Inspection	Automatic Return Item Turn-In (OBJ: Max Accountability)	Non-Automatic Return Item Recycling (OBJ: Max Items, Max Profit)	Regionalize	Store Brass (OBJ: Min Time)	Demilitarize Brass (OBJ: Min Cost, Min Env Impact, Min Time)	Transport Brass (OBJ: Min Time, Min Cost)	Sell Brass (OBJ: Max Revenue)
Counting Machine	Demilitarize	Individual inspection	QASAS 10%	Manual Serial Number inspection	DRMO	Central Hub	At the ASP	Melt Brass	ASP Transport	Lot Sell
Returning Unit Counts	Remanufacture	100% QASAS		Barcoded serial number inspection	QRP	Mini-Hubs	DRMO Storage Facility	DRMO	DRMO Transport	Date Sell
No initial sort		0%				No	Civilian Contracted Storage Facility	Shredder	Contract Transport	DRMO Sell
Weigh Brass		Separate/APE 1408						Deformer/Crusher		Constant Price
		Separate/Chemical						Civilian Contractor		Monitor Market Sell
		By Hand								Civilian Contractor Sell



Feasible Alternatives

Alternative	Collect Residue (OBJ: Min Manpower, Min Time)	Residue Path	Inspect Residue (OBJ: min time)	Automatic Return Item Turn-In (OBJ: Max Accountability)	Non-Automatic Return Item Recycling (OBJ: Max Items, Max Profit)	Regionalize	Store Brass (OBJ: Min Time)	Demilitarize Brass (OBJ: Min Cost, Min Env Impact, Min Time)	Transport Brass (OBJ: Min Time, Min Cost)	Sell Brass (OBJ: Max Revenue)
DRMO Regionalized	Weigh Brass	Demilitarize	Separate/APE 1408	Barcoded serial number inspection	DRMO	Mini-Hubs	DRMO Storage Facility	DRMO	DRMO Transport	DRMO Sell
Current QRP Process	Weigh Brass	Demilitarize	Individual inspection	Manual Serial Number inspection	QRP	No	At the ASP	Deformer/Crusher	ASP Transport	Monitor Market Sell
Mini-hub civilian transport	Weigh Brass	Demilitarize	Separate/APE 1408	Barcoded serial number inspection	QRP	Mini-Hubs	At the ASP	Deformer/Crusher	Contract Transport	Monitor Market Sell
ASP Remanufacture	Weigh Brass	Remanufacture	Individual inspection	Barcoded serial number inspection	QRP	Mini-Hubs	At the ASP	N/A	ASP Transport	Monitor Market Sell
Unit Counts	Returning Unit counts	Demilitarize	Separate/APE 1408	Barcoded serial number inspection	QRP	No	At the ASP	Deformer/Crusher	ASP Transport	Monitor Market Sell
DRMO Non-Regionalized	Weigh Brass	Demilitarize	Individual inspection	Barcoded serial number inspection	DRMO	No	DRMO Storage Facility	DRMO	DRMO Transport	DRMO Sell
Civilian Remanufacture	Weigh Brass	Remanufacture	Individual inspection	Barcoded serial number inspection	QRP	Central Hub	Civilian Contracted Facility	N/A	Contract Transport	Civilian Contractor Sell
Mini-hub w/ no new technology	Returning Unit Counts	Demilitarize	Separate/APE 1408	Manual Serial Number inspection	QRP	Mini-Hubs	At the ASP	Deformer/Crusher	ASP Transport	Lot Sell
DRMO w/ minimum ASP equipment	Returning Unit counts	Demilitarize	Individual inspection	Barcoded serial number inspection	DRMO	Central Hub	DRMO Storage Facility	DRMO	DRMO Transport	DRMO Sell
Current Process Centrally Regionalized	Weigh Brass	Demilitarize	Individual inspection	Manual Serial Number inspection	QRP	Central Hub	At the ASP	Deformer/Crusher	ASP Transport	Monitor Market Sell



Raw Data Matrix

Simulation
Independent Research
Stakeholder Input

	Collection Manpower	Collection Time	Inspection Manpower	Inspection Time	Automatic Return Item Time	Recyclable Items	Profit	Storage Time	Demilitarization Manpower	Environmental Impact	Demilitarization Time	Transportation Time	Transportation Manpower	Sales Revenue
Alternative	People	Man hours	People	Man hours	Items / hr	Items	Dollars	Days	Personnel	Rating	Man hours	Man hours	Personnel	Dollars/kg
DRMO Regionalized	8	3902.8	6	275.6	8	6	0.7	0	6	1	0	0	0	4.0292
Current QRP Process	8	3902.8	10	674	3	6	1	141.6	18	4	556	0	0	5.756
Mini-hub civilian transport	8	3902.8	6	276	8	6	1	74.6	6	2	276	529.56	0	5.756
ASP Remanufacture	8	3902.8	15	535	8	6	1	74.6	0	3	0	529.56	10	11.61575
Unit Counts	8	1000	18	556	8	6	1	141.6	18	2	556	0	0	5.756
DRMO Non-Regionalized	8	3902.8	10	674	8	6	0.7	0	0	5	0	0	0	4.0292
Civilian Remanufacture	8	3902.8	12	521	8	6	1	51.6	0	2	0	2661	0	11.61575
Mini-hub w/ no new technology	8	1000	6	276	3	6	1	74.6	6	1	276	529.56	10	5.756
DRMO w/ minimum ASP equipment	8	1000	12	521	8	6	0.7	0	0	2	0	0	0	4.0292
Current Process Centrally Regionalized	8	3902.8	12	521	3	6	1	51.6	4	2	530	2661	14	5.756



Multi-Hub Load Distance

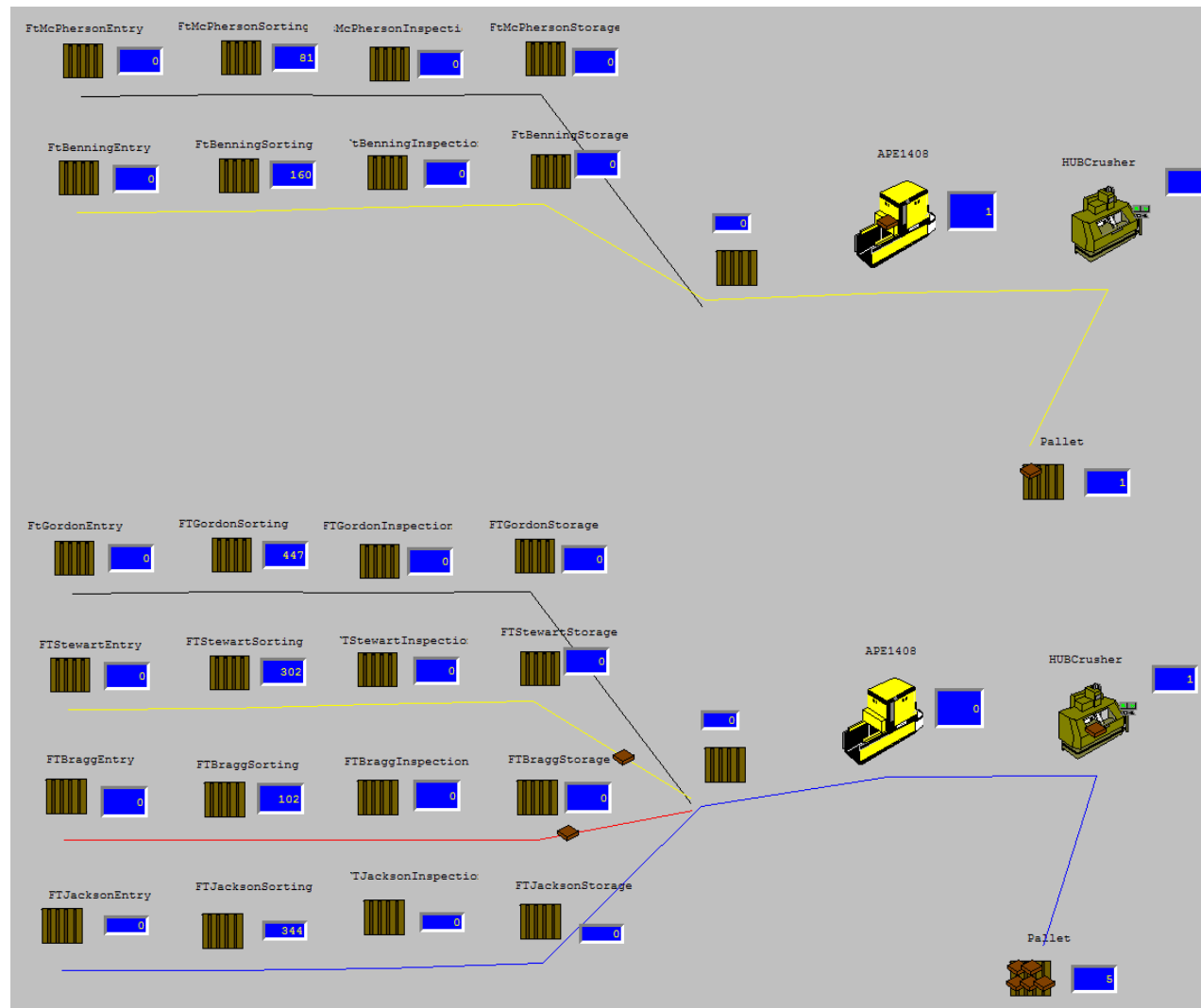
Transportation Model, Three Hubs

Hub 1	-87.62	36.59	1.00
Hub 2	-80.83	34.04	4.00
Hub 3	-84.83	32.40	9.00

<u>Post</u>	<u>Lat</u>	<u>Lon</u>	<u>Load</u>	<u>ldx1</u>	<u>ldy1</u>	<u>distance</u>	<u>km</u>	<u>ldx2</u>	<u>ldy2</u>	<u>km</u>	<u>ldx3</u>	<u>ldy3</u>	<u>km</u>	<u>Min dist</u>	
Fort Campbell	1	-87.62	36.59	26.30	0.00	0.00	0.00	0.00	178.52	67.05	190.70	73.48	110.38	132.60	0.00
Fort Knox	2	-85.90	37.90	18.77	32.25	24.59	40.56	211.00	95.12	72.43	119.55	20.17	103.34	105.29	40.56
Fort Gordon	3	-82.24	33.35	2.73	14.67	8.83	17.12		3.83	1.89	4.27	151.00	7.05	2.60	7.52
Fort Jackson	4	-80.83	34.04	25.20	171.03	64.23	182.70		0.00	0.00	0.00	0.00	100.63	41.51	108.86
Fort McPherson	5	-84.44	33.71	0.41	1.31	1.18	1.76		1.48	0.14	1.48		0.16	0.54	0.56
Fort Stewart	6	-81.60	31.98	13.94	83.99	64.28	105.77		10.64	28.74	30.65	240.00	45.04	5.77	45.41
Fort Rucker	7	-85.74	31.40	0.00	0.00	0.00	0.00		0.00	0.00	0.00		0.00	0.00	0.00
Fort Bragg	8	-79.14	35.11	12.37	104.96	18.29	106.55		20.99	13.25	24.82	196.00	70.40	33.63	78.02
Fort Benning	9	-84.83	32.40	41.16	114.99	172.73	207.51		164.37	67.81	177.81		0.00	0.00	0.00
			140.88												
				523.21	354.15				474.93	251.29			316.94	297.77	2218.30



ProModel Simulation





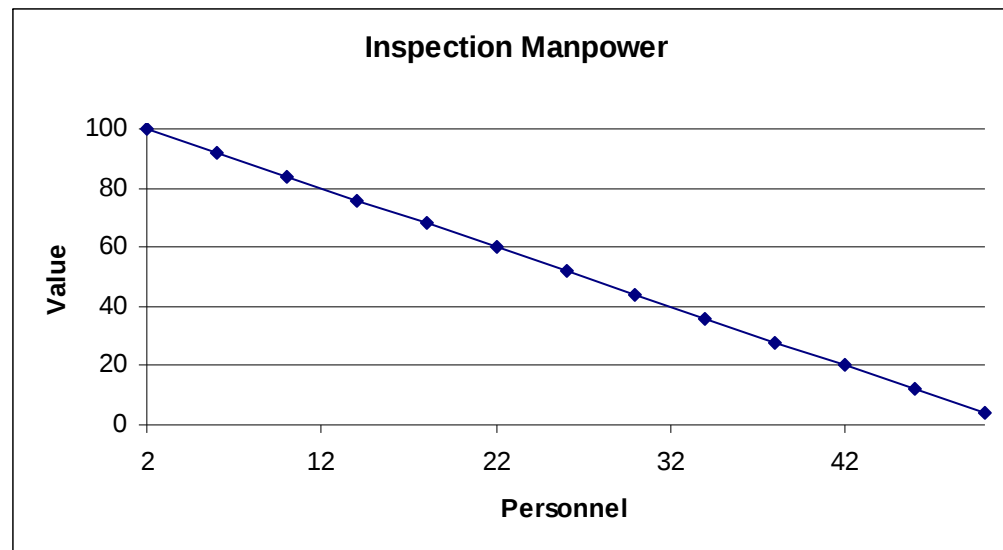
Raw Data Matrix

Simulation
Independent Research
Stakeholder Input

	Collection Manpower	Collection Time	Inspection Manpower	Inspection Time	Automatic Return Item Time	Recyclable Items	Profit	Storage Time	Demilitarization Manpower	Environmental Impact	Demilitarization Time	Transportation Time	Transportation Manpower	Sales Revenue
Alternative	People	Man hours	People	Man hours	Items / hr	Items	Dollars	Days	Personnel	Rating	Man hours	Man hours	Personnel	Dollars/kg
DRMO Regionalized	8	3902.8	6	275.6	8	6	0.7	0	6	1	0	0	0	4.0292
Current QRP Process	8	3902.8	10	674	3	6	1	141.6	18	4	556	0	0	5.756
Mini-hub civilian transport	8	3902.8	6	276	8	6	1	74.6	6	2	276	529.56	0	5.756
ASP Remanufacture	8	3902.8	15	535	8	6	1	74.6	0	3	0	529.56	10	11.61575
Unit Counts	8	1000	18	556	8	6	1	141.6	18	2	556	0	0	5.756
DRMO Non-Regionalized	8	3902.8	10	674	8	6	0.7	0	0	5	0	0	0	4.0292
Civilian Remanufacture	8	3902.8	12	521	8	6	1	51.6	0	2	0	2661	0	11.61575
Mini-hub w/ no new technology	8	1000	6	276	3	6	1	74.6	6	1	276	529.56	10	5.756
DRMO w/ minimum ASP equipment	8	1000	12	521	8	6	0.7	0	0	2	0	0	0	4.0292
Current Process Centrally Regionalized	8	3902.8	12	521	3	6	1	51.6	4	2	530	2661	14	5.756



Value Curve Example



- Example: If the number of personnel is 10, the curve is used to translate that number to a unitless value. In this case, 10 personnel translates to a value of 84.



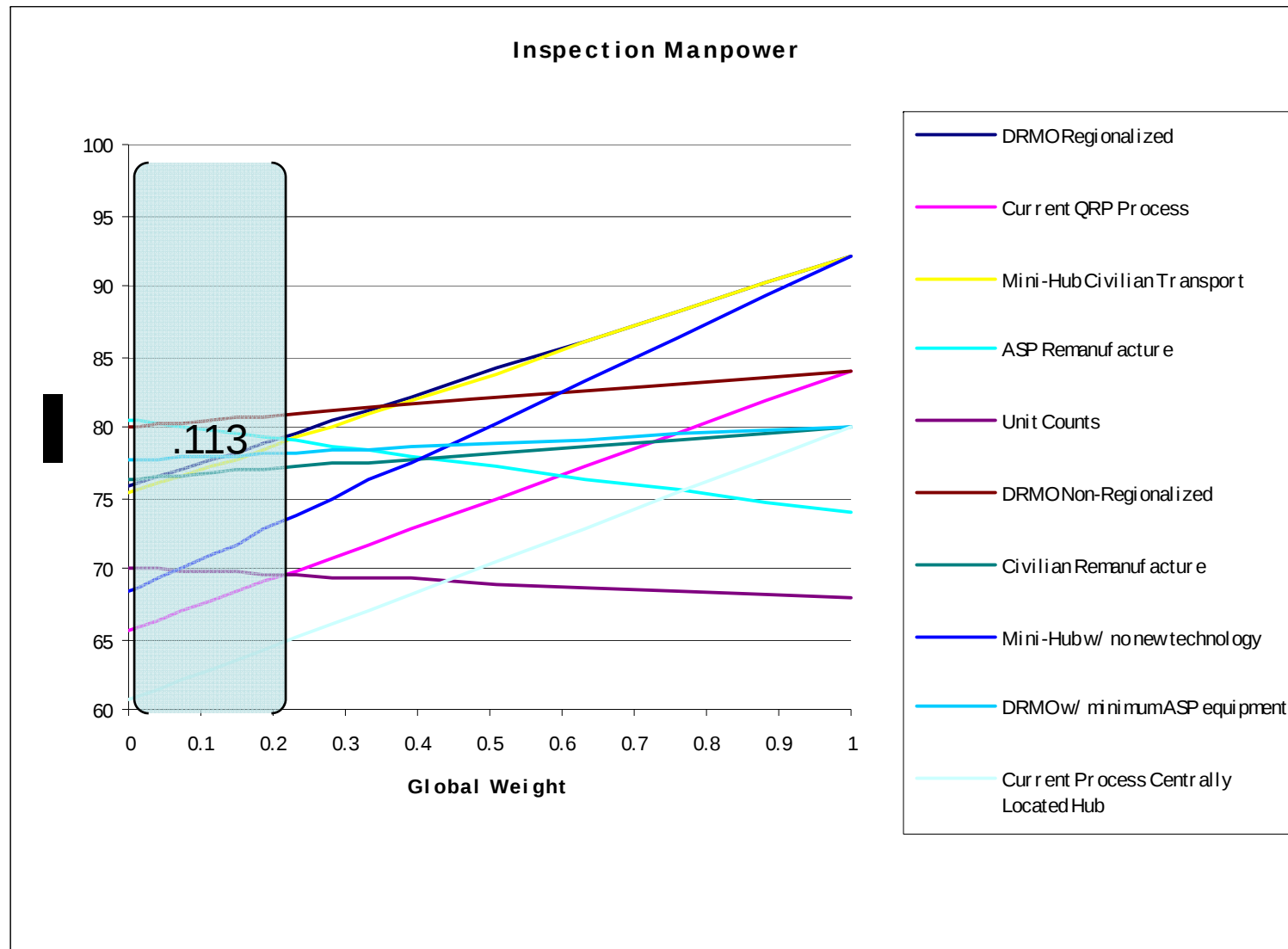
Decision Matrix

Simulation
Independent Research
Stakeholder Input

	Collection Manpower	Collection Time	Inspection Manpower	Inspection Time	Automatic Return Item Time	Recyclable Items	Profit	Storage Time	Demilitarization Manpower	Environmental Impact	Demilitarization Time	Transportation Time	Transportation Manpower	Sales Revenue	Total Value Scores
Alternative	People	Man hours	People	Man hours	Items / hr	Items	%	Days	Personnel	Rating	Man hours	Man hours	Personnel	Dollars/kg	
Global Weights	0.1195	0.0126	0.113208	0.0377	0.1006	0.1258	0.0755	0.0252	0.0818	0.0629	0.0881	0.0503	0.044	0.0629	
DRMO Regionalized	98.00	27.43	92.00	84.31	80.00	60.00	70.00	100.00	90.40	20.00	100.00	100.00	100.00	26.86	77.63
Current QRP Process	98.00	27.43	84.00	26.94	30.00	60.00	100.00	11.36	71.20	80.00	44.40	100.00	100.00	38.37	67.60
Mini-hub civilian transport	98.00	27.43	92.00	84.26	80.00	60.00	100.00	50.27	90.40	40.00	72.40	80.74	100.00	38.37	77.23
ASP Remanufacture	98.00	27.43	74.00	46.96	80.00	60.00	100.00	50.27	100.00	60.00	100.00	80.74	80.00	77.44	79.83
Unit Counts	98.00	100.00	68.00	43.94	80.00	60.00	100.00	11.36	71.20	40.00	44.40	100.00	100.00	38.37	69.85
DRMO Non-Regionalized	98.00	27.43	84.00	26.94	80.00	60.00	70.00	100.00	100.00	100.00	100.00	100.00	100.00	26.86	80.38
Civilian Remanufacture	98.00	27.43	80.00	48.98	80.00	60.00	100.00	65.60	100.00	40.00	100.00	3.24	100.00	77.44	76.70
Mini-hub w/ no new technology	98.00	100.00	92.00	84.26	30.00	60.00	100.00	50.27	90.40	20.00	72.40	80.74	80.00	38.37	70.97
DRMO w/ minimum ASP equipment	98.00	100.00	80.00	48.98	80.00	60.00	70.00	100.00	100.00	40.00	100.00	100.00	100.00	26.86	77.90
Current Process Centrally Regionalized	98.00	27.43	80.00	48.98	30.00	60.00	100.00	65.60	93.60	40.00	47.00	3.24	72.00	38.37	62.79



Sensitivity Analysis Chart



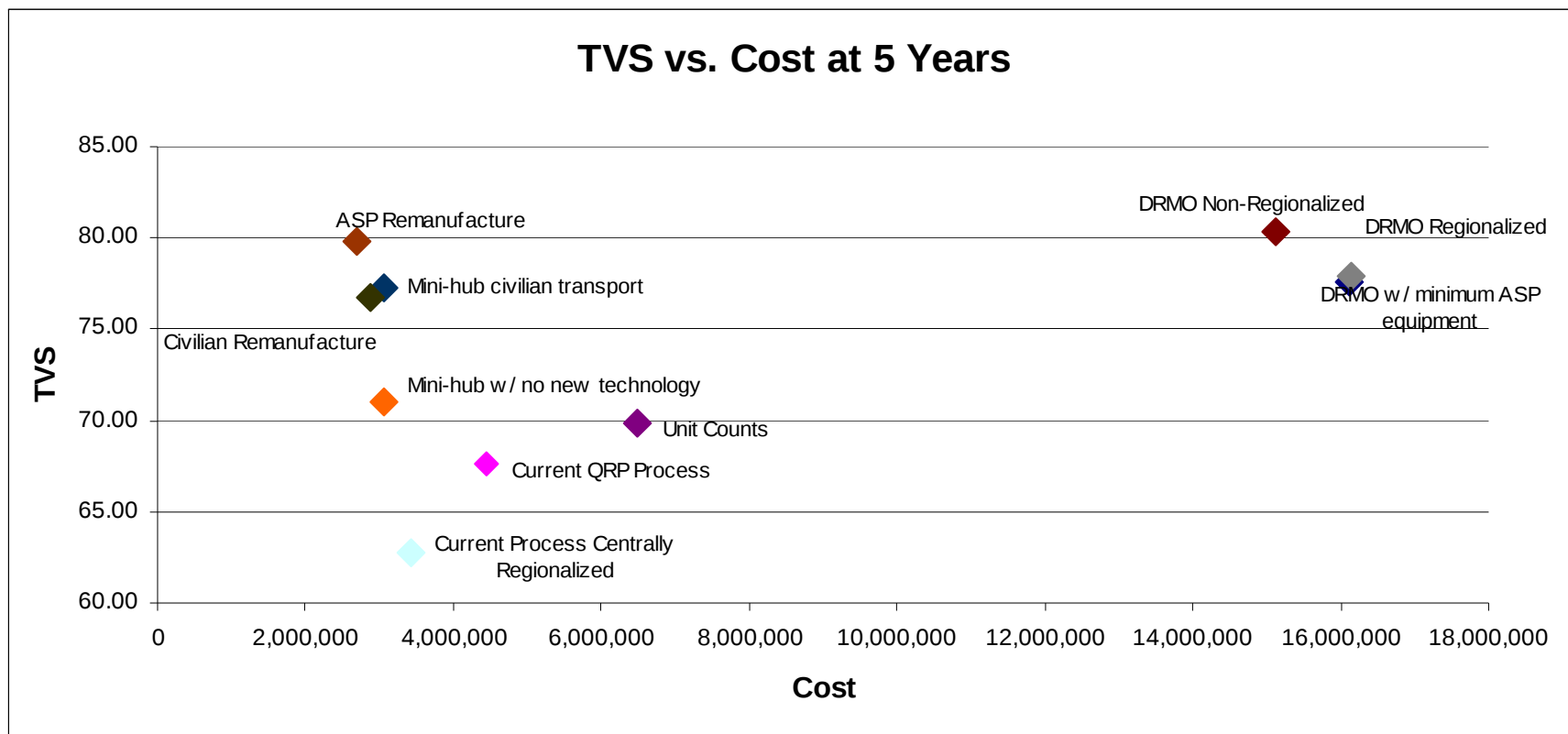


Cost-Benefit Analysis

	Recurring Costs										Fixed Costs	
Alternative	Workers	Wages	Miles	Hazmat	Transport	DRMO loss	Operation	Total	Equipment	Total Cost at 5 Years		
DRMO Regionalized	20	66,325	1346	1,600	4,292	220,881	1,737	293,235	396,000	17,990,083		
Current QRP Process	36	119,385	0	0	0	0	0	119,385	577,447	7,740,547		
Mini-hub civilian transport	20	66,325	1346	1,600	4,292	0	1,737	72,354	612,543	4,953,790		
ASP Remanufacture	23	76,274	1346	1,600	4,292	0	0	80,566	0	4,833,945		
Unit Counts	42	139,283	0	0	0	0	1,737	141,020	1,633,447	10,094,624		
DRMO Non-Regionalized	18	59,693	0	0	0	220,880	0	280,573	0	16,834,368		
Civilian Remanufacture	20	66,325	5153	2,800	13,106	0	0	79,431	0	4,765,860		
Mini-hub w/ no new technology	20	66,325	1346	1,600	4,292	0	1,737	72,354	612,543	4,953,790		
DRMO w/ minimum ASP equipment	20	66,325	5153	2,800	13,106	220,880	0	300,311	0	18,018,678		
Current Process Centrally Regionalized	22	72,958	5153	2,800	13,106	0	0	86,064	336,181	5,499,991		



Total Value Score vs. Cost Chart





Recommended Alternative

Based on the potential for increase profits, it is recommended that the mini-hub with civilian transport be utilized. This will minimize costs, generate increased profits, and have a high value to the stakeholder.

Mini-hub civilian transport	
Demilitarize	Brass will be demilitarized as opposed to remanufactured
QRP	A QRP will be used in order to recycle non-automatic return items as well as brass from the mini-hubs.
Weigh Brass	Standard Procedure currently used.
Separate/APE 1408	Brass will be sent to mini-hubs to undergo inspection via APE1408. APE1408's will need to be redistributed or purchased for mini-hub ASPs.
QASAS 10%	Standard procedure required by regs.
At the ASP	Brass will be stored at the ASP prior to being shipped to the mini-hubs for the inspection and demilitarization process. Once at the mini-hub, brass is stored until it is sold through the QRP.
Mini-Hubs	This alternative entails a regionalized transportation system that utilizes three current ASPs as mini-hubs. It reduces the number of personnel required throughout the region and still benefits from the QRP.
Contract Transport	Civilian contractors will be used in order transport the brass from the individual ASPs to the mini-hubs.
Deformer/Crusher	Brass will be demilitarized at the mini-hubs by deformers.
Monitor Market Sell	Demilitarized brass will be held at the mini-hubs until the market is best suited for brass sale. This ensures that maximum profit is received and can be best utilized throughout the region.
Barcoded serial number inspection	Each ASP will receive a barcoding system that increases efficiency in automatic return item turn-in.



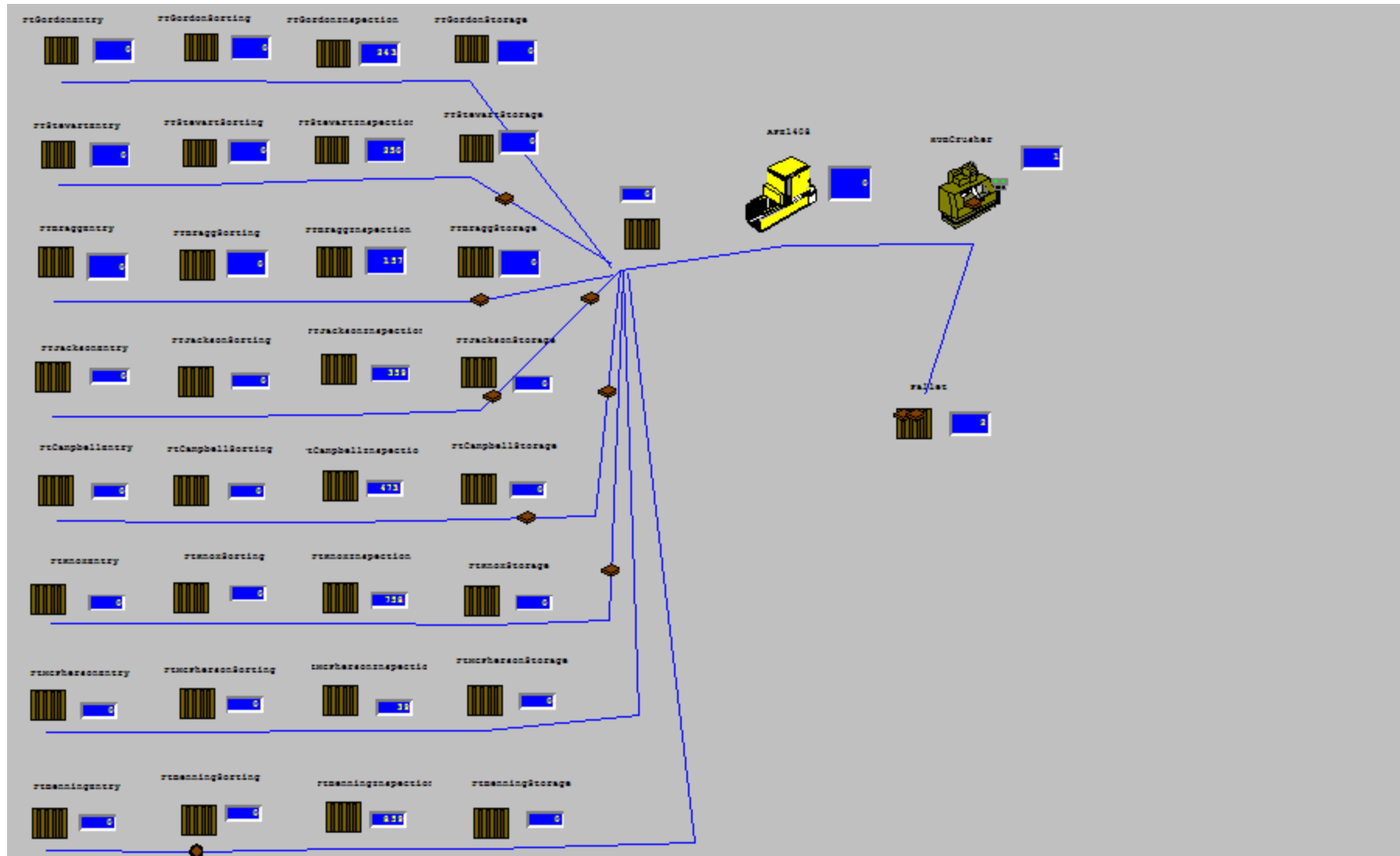
Questions?



Backup Slides



ProModel Simulation





Load Distance Model

Transportation Model, Single Hub

Post	Lat	Lon	Load	km	time	Load Distances								
						Fort Campbell	Fort Knox	Fort Gordon	Fort Jackson	Fort McPherson	Fort Stewart	Fort Rucker	Fort Bragg	Fort Benning
Fort Campbell	-87.621	36.5925	26.30333	354.8	4.008409979	0	3.02912	8.62476	9.33595	6.07106	10.63415	7.07451	9.96149	6.99003413
Fort Knox	-85.9023	37.90292	18.76667	167.7	1.894617682	3.02912	0	8.21648	8.92767	5.66278	10.22587	6.66623	9.55321	6.58175413
Fort Gordon	-82.2384	33.35034	2.725	244.3	2.760018483	8.62476	8.21648	0	2.09761	2.5537	2.00939	5.45455	4.86407	3.54309229
Fort Jackson	-80.834	34.04355	25.2	400.5	4.524713068	9.33595	8.92767	2.09761	0	3.93771	2.8242	7.55216	2.76646	5.64070229
Fort McPherson	-84.4353	33.70714	0.41	0	0	6.07106	5.66278	2.5537	3.93771	0	4.56309	3.61445	6.70417	1.70299229
Fort Stewart	-81.597	31.98235	13.94333	316.4	3.574579812	10.63415	10.22587	2.00939	2.8242	4.56309	0	4.72796	5.59066	3.64411587
Fort Rucker	-85.7408	31.39819	0	0	0	7.07451	6.66623	5.45455	7.55216	3.61445	4.72796	0	10.31862	1.91145771
Fort Bragg	-79.138	35.11401	12.37333	589.4	6.658841154	9.96149	9.55321	4.86407	2.76646	6.70417	5.59066	10.31862	0	8.40716229
Fort Benning	-84.82731	32.39616	41.16167	45.67	0.515964159	6.99003413	6.58175413	3.54309229	5.64070229	1.70299229	3.64411587	1.91145771	8.40716229	0
			140.8833											
						Fort Campbell	Fort Knox	Fort Gordon	Fort Jackson	Fort McPherson	Fort Stewart	Fort Rucker	Fort Bragg	Fort Benning
						0	79.67595307	226.8599372	245.5666048	159.6891149	279.7135922	186.0831947	262.020392	183.8611977
						56.84648533	0	154.1959413	167.542607	106.2715047	191.9054937	125.1029163	179.2819077	123.5175858
						23.502471	22.389908	0	5.71598725	6.9588325	5.47558775	14.86364875	13.25459075	9.65492649
						235.26594	224.977284	52.859772	0	99.230292	71.16984	190.314432	69.714792	142.1456977
						2.4891346	2.3217398	1.047017	1.6144611	0	1.8708669	1.4819245	2.7487097	0.698226839
						148.2754982	142.582714	28.01759457	39.378762	63.6246849	0	65.92352227	77.95243593	50.81112228
						0	0	0	0	0	0	0	0	0
						123.2568363	118.2050517	60.18475947	34.23033173	82.95293013	69.17509973	127.6757248	0	104.0246214
						287.7214548	270.9159696	145.8395838	232.1807074	70.09800098	149.9978827	78.67878511	346.0528118	0
						877.3578202	861.0686202	669.0046054	726.2294613	588.82536	769.308363	790.1241485	951.0256398	614.7133783

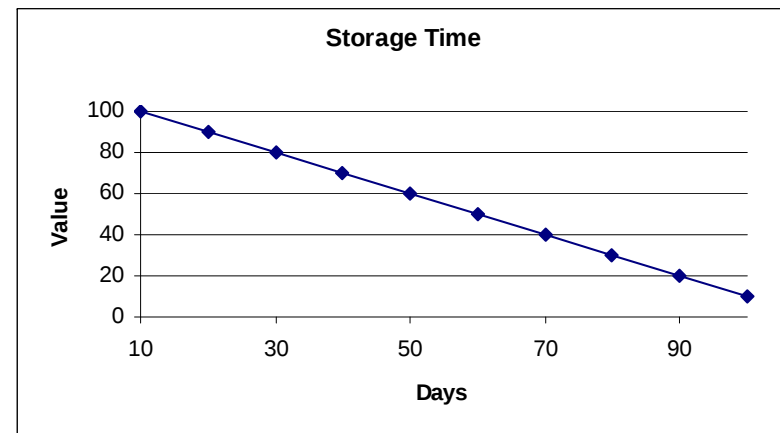
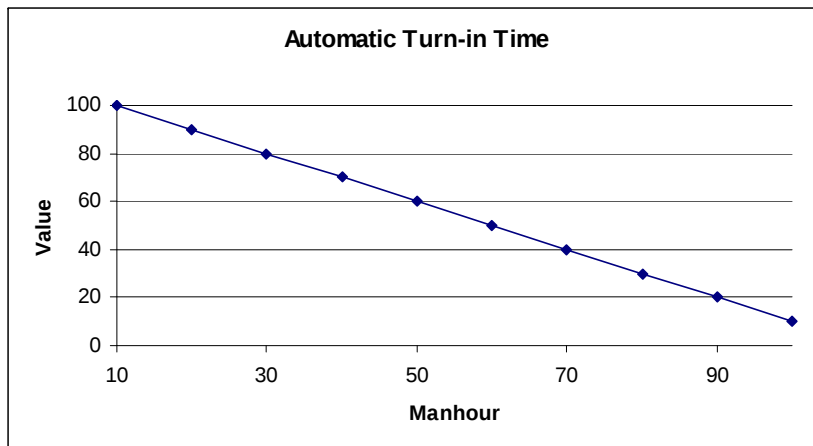
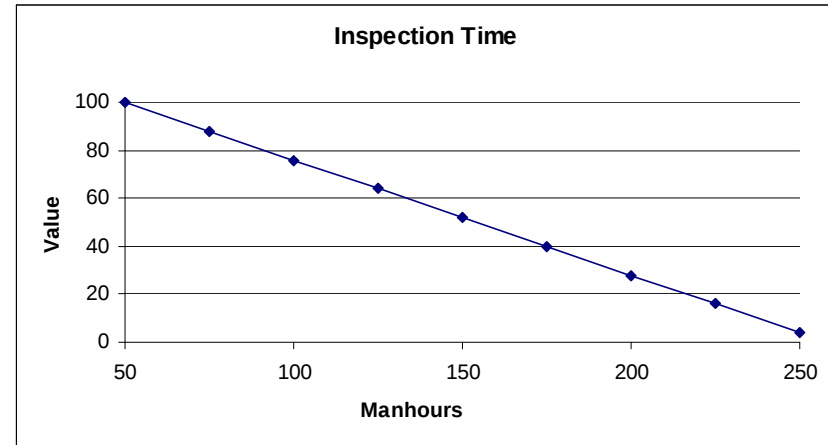
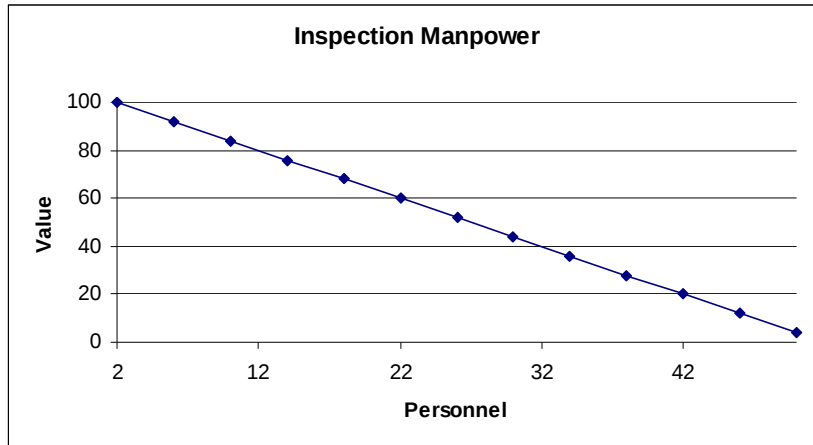


Swing Weight Matrix

		Importance		
		High	Medium	Low
Variability	High	Recyclable Non-Accountable Items 100 Personnel - Collection 95 Personnel - Inspect 90	Demil Time 70 Demil Personnel 65	Transportation Time 40 Transportation personnel 35
	Medium	Processing time - Accountable Items 80	Profit - Non-Accountable 60 Sales Revenue 50	Storage Time 20
	Low	Environmental Impact 50	Inspection Time - Inspect Res 30	Collection Time 10

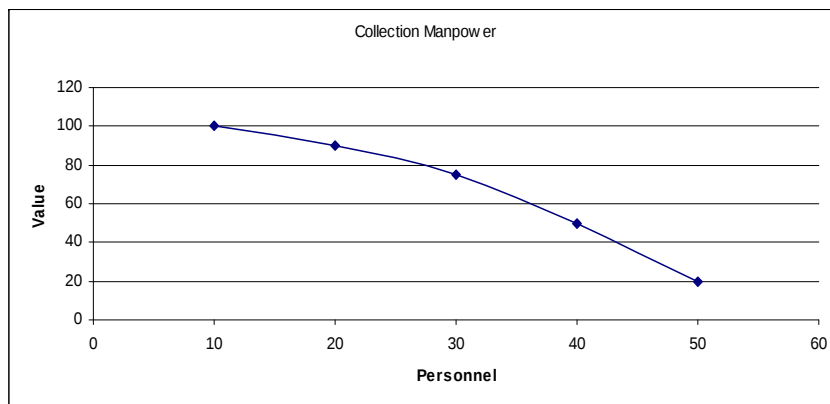
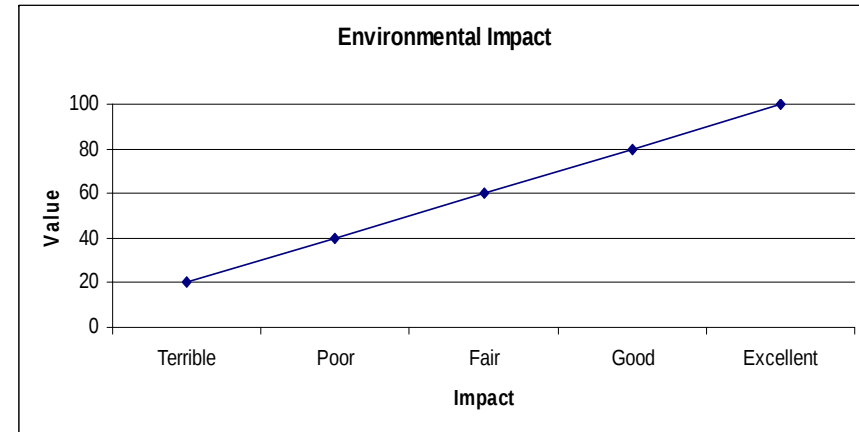
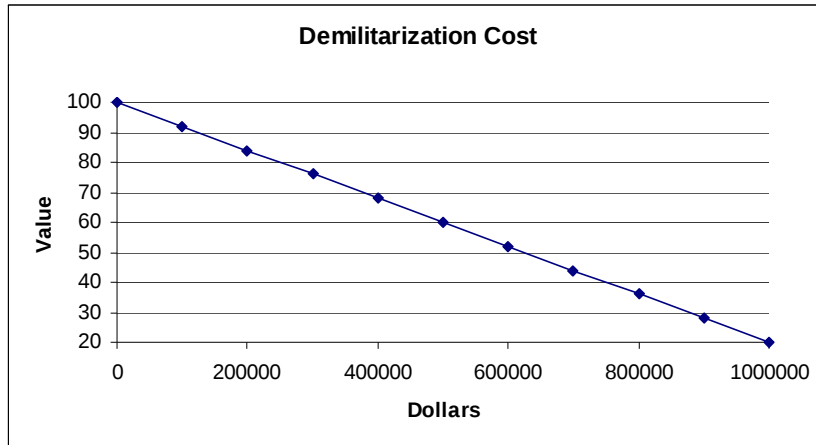


Value Curves



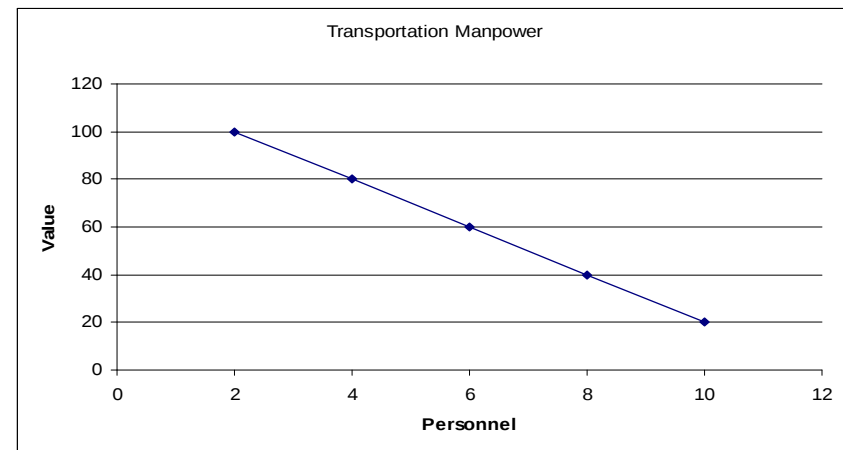
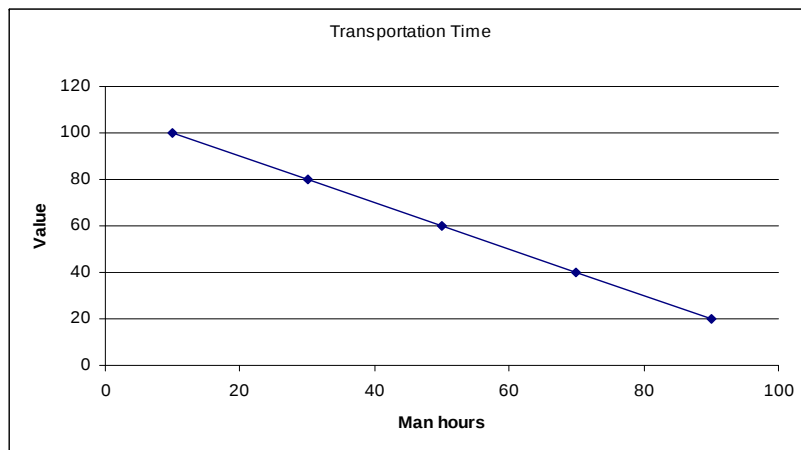
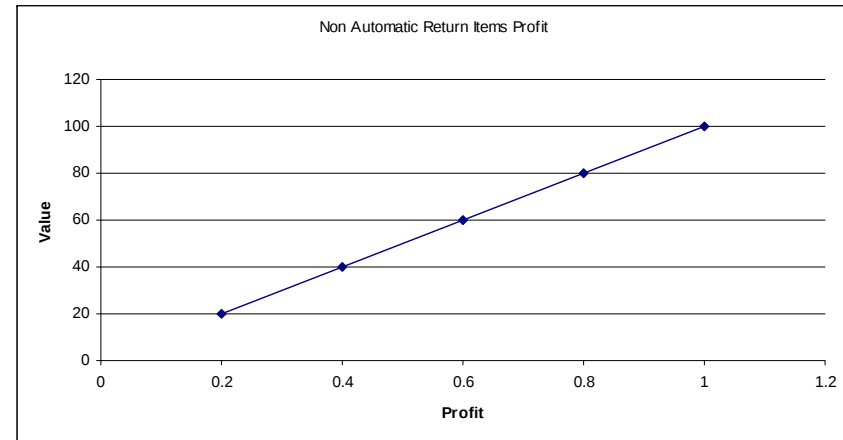
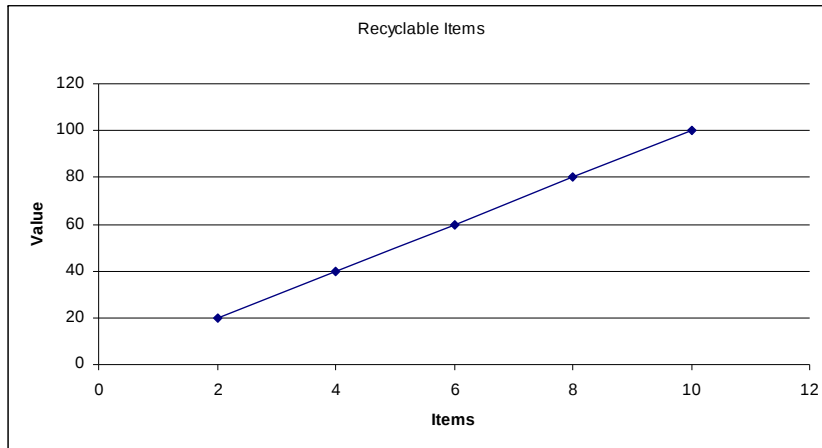


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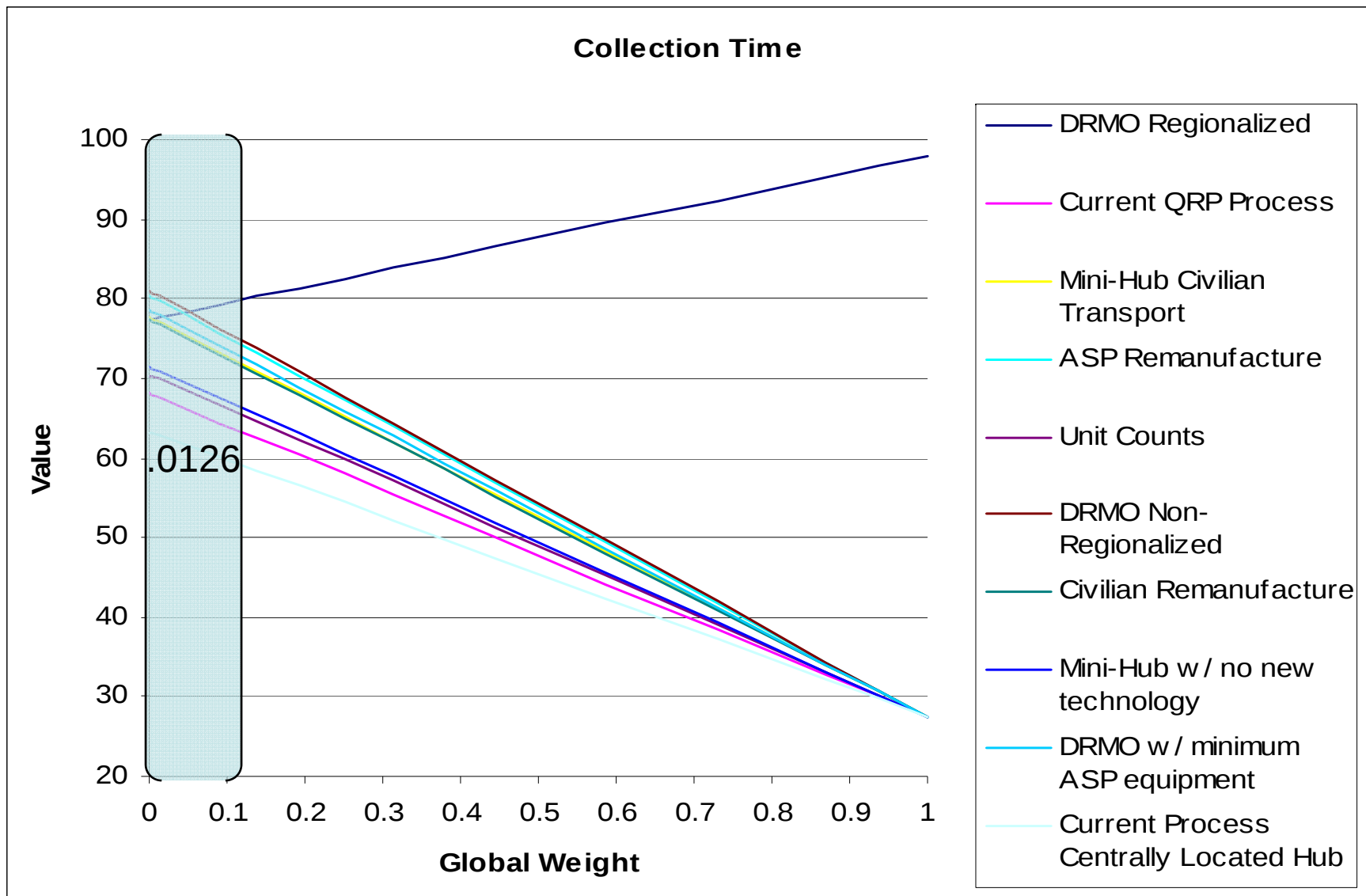


Value Curves



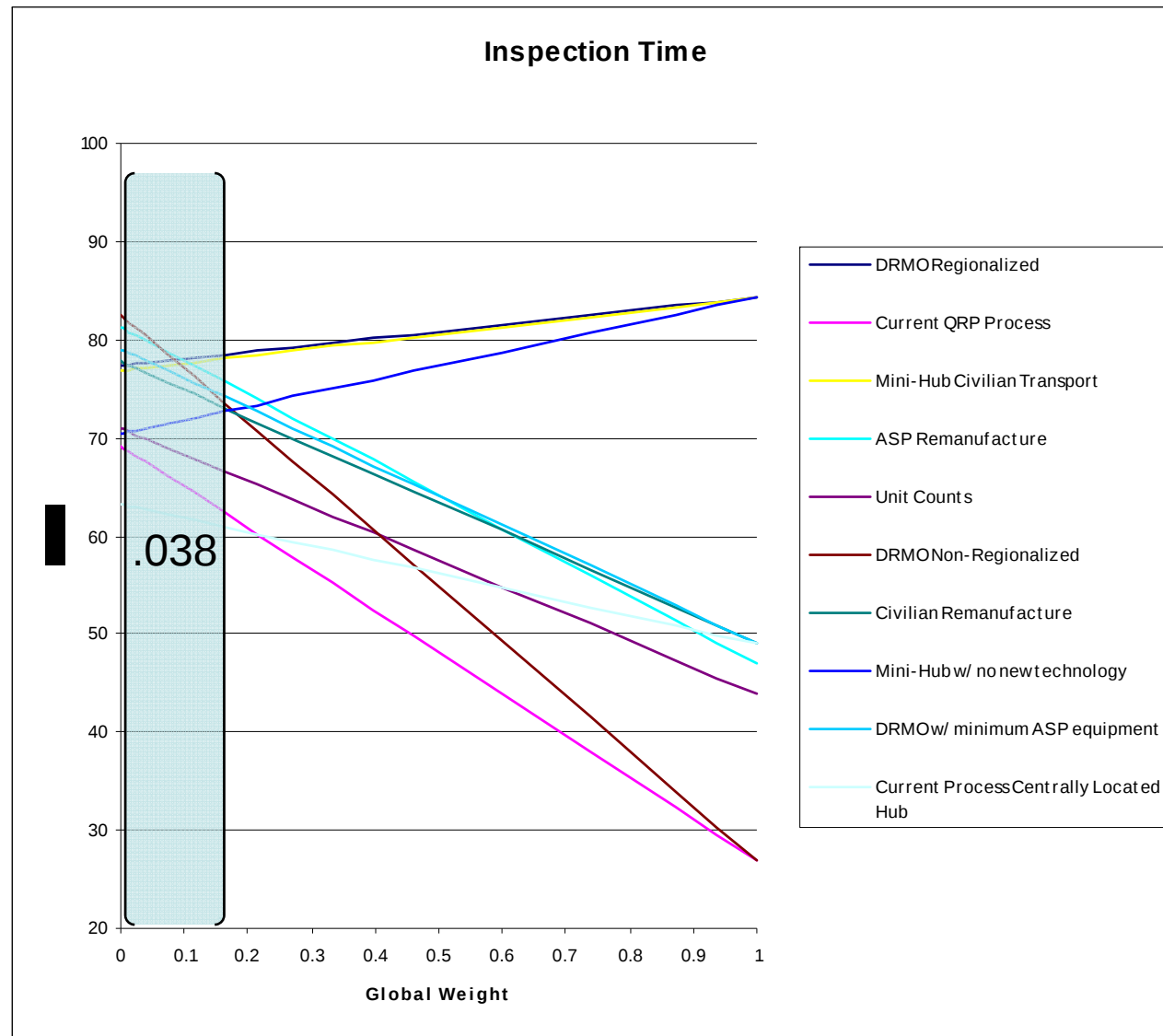


Sensitivity Analysis Chart



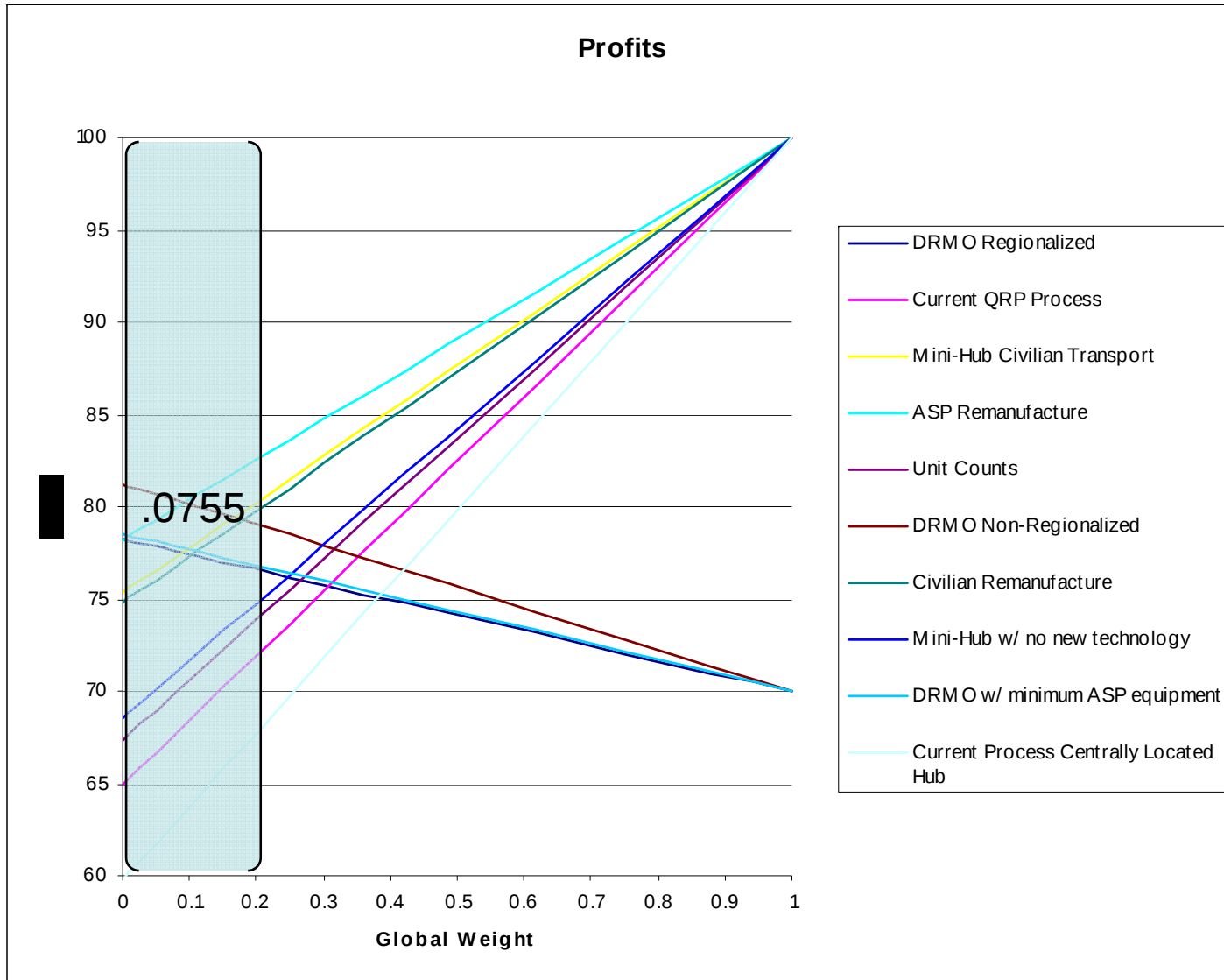


Sensitivity Analysis Charts



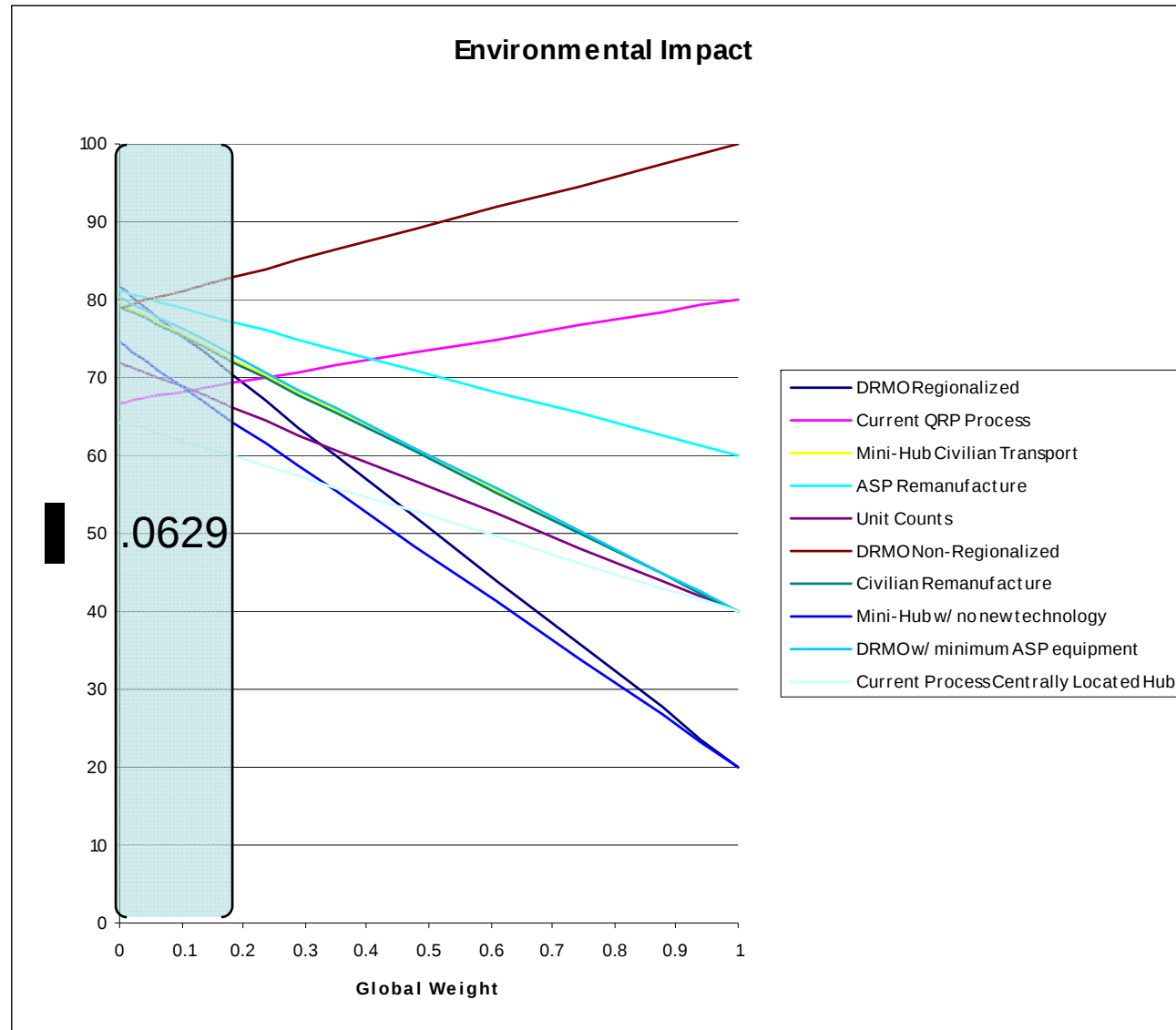


Sensitivity Analysis Charts



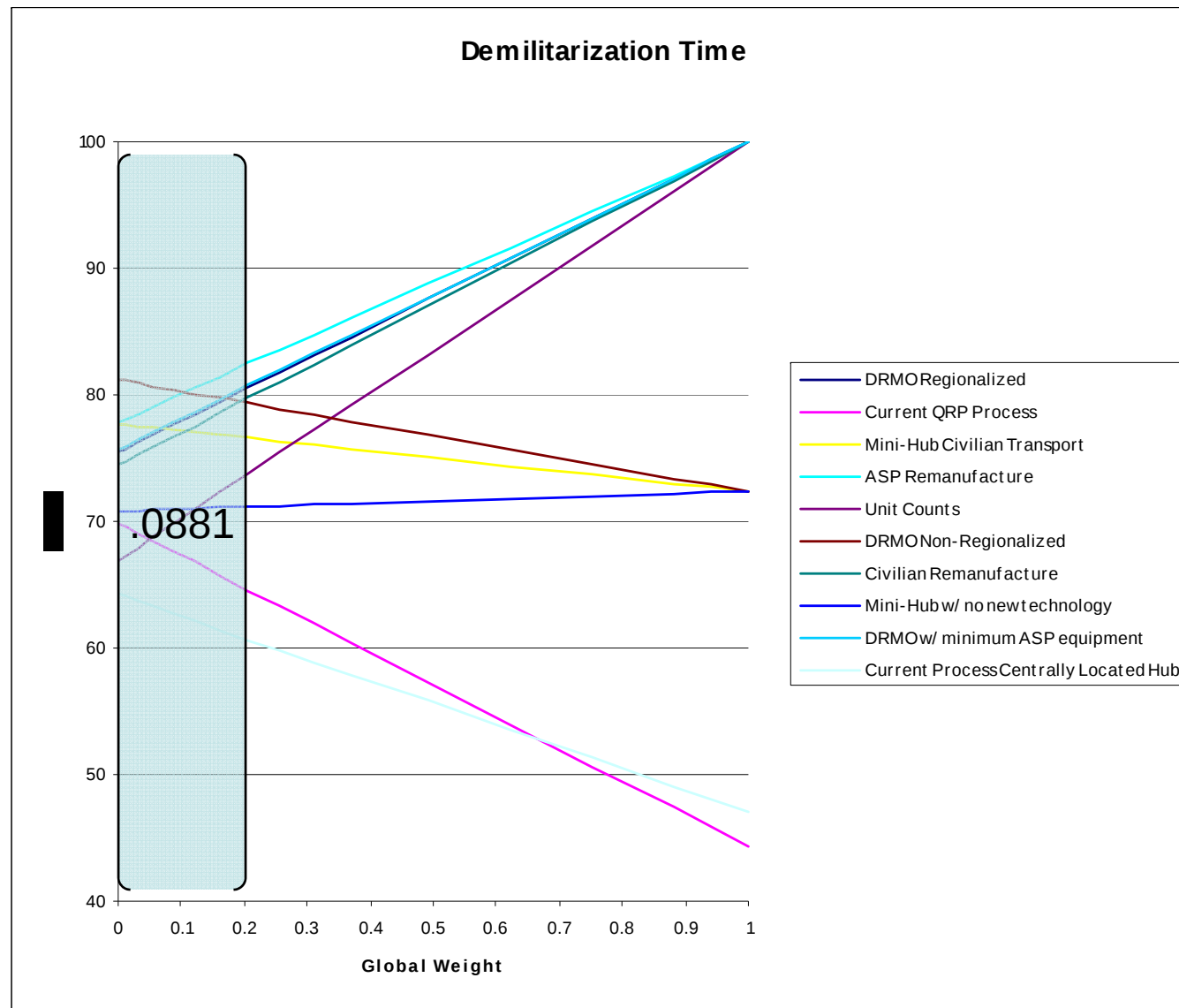


Sensitivity Analysis Charts



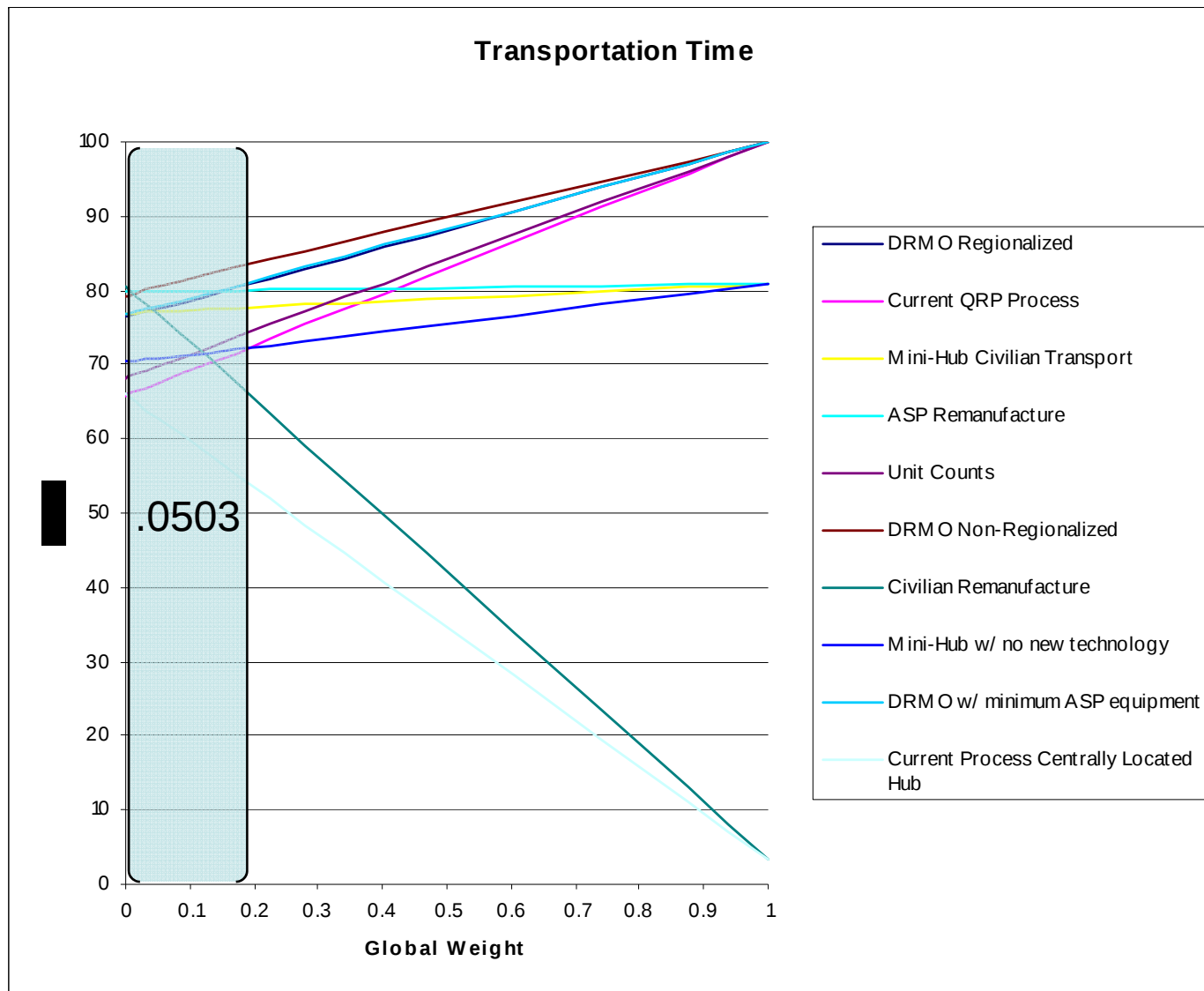


Sensitivity Analysis Charts



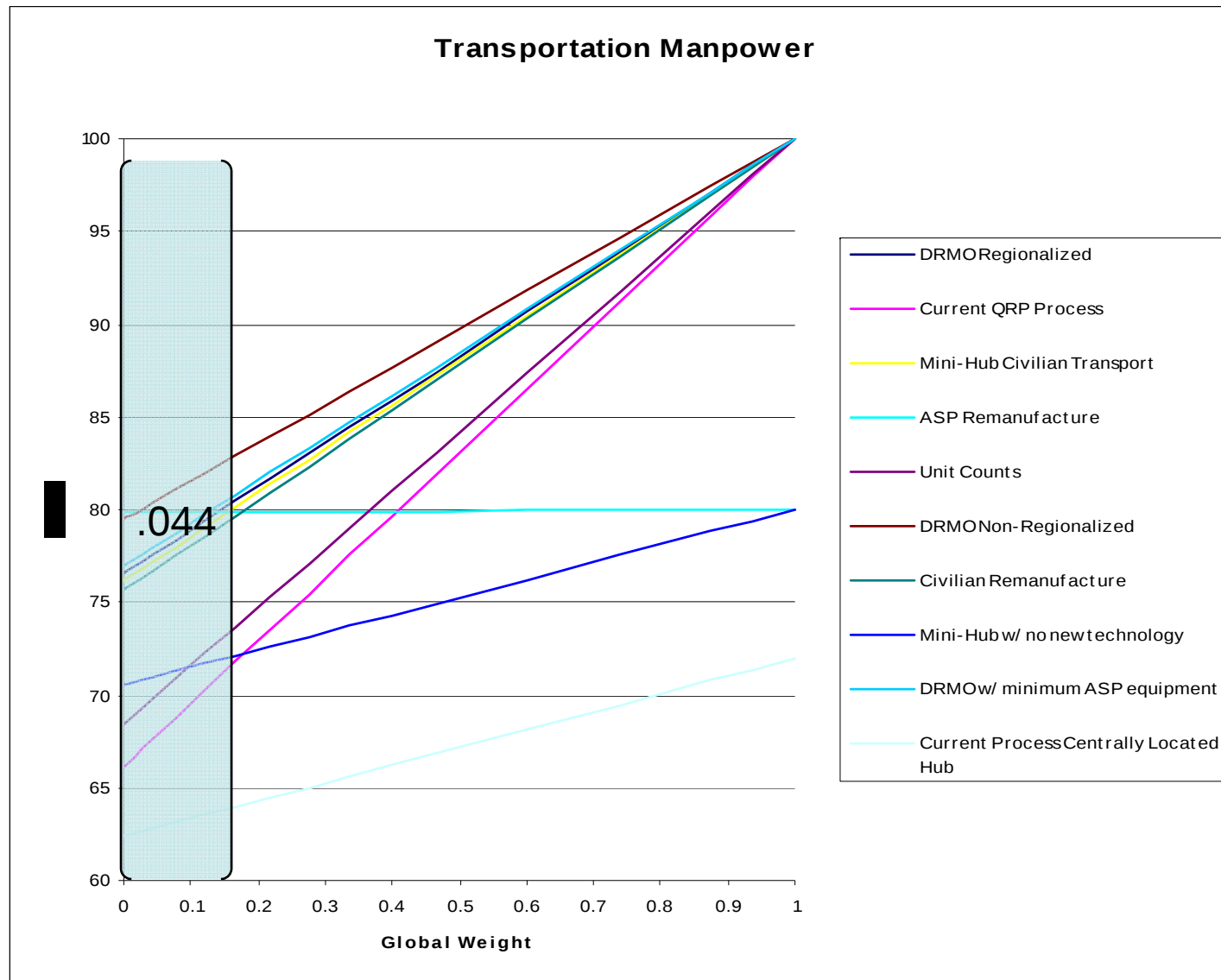


Sensitivity Analysis Charts



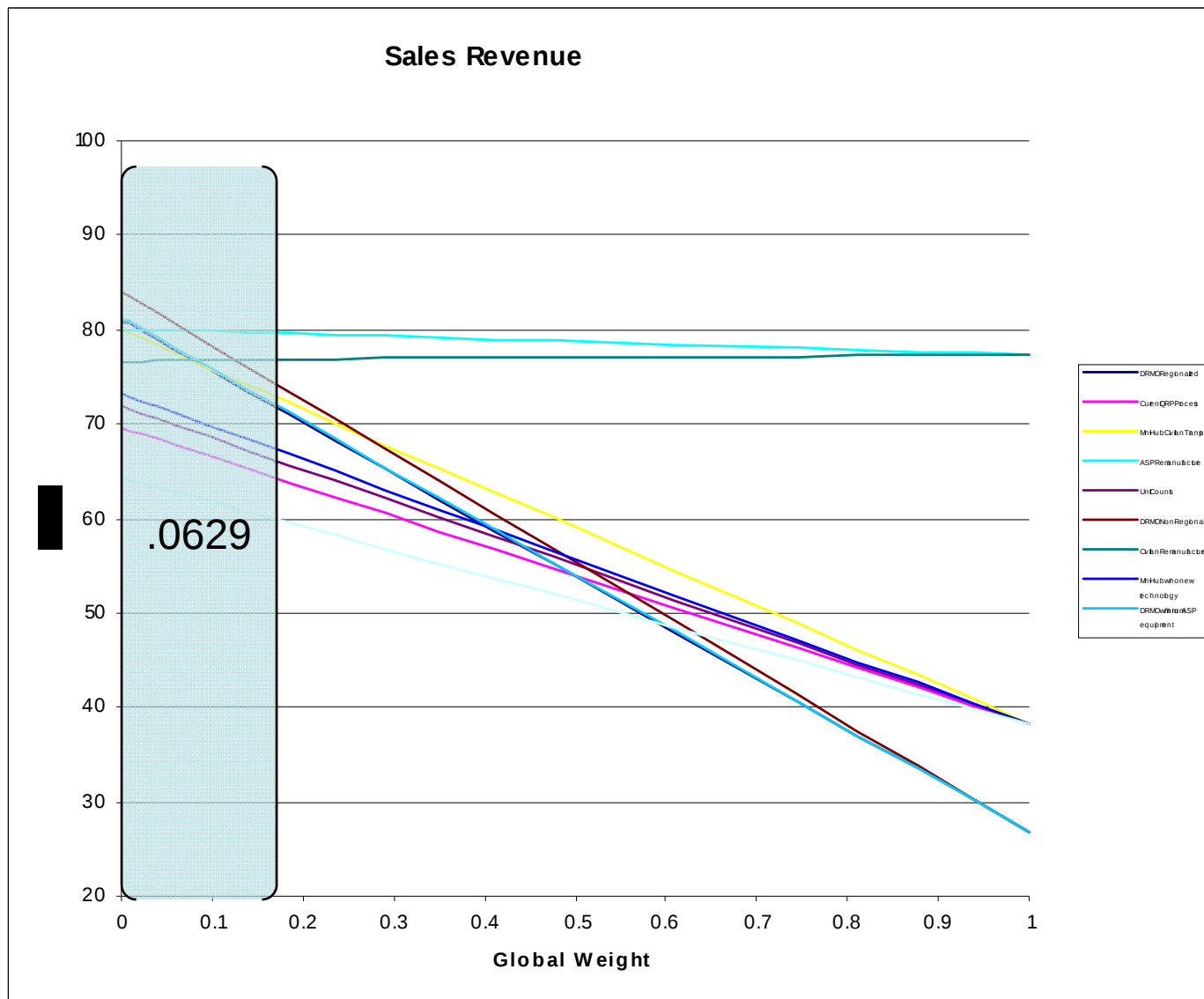


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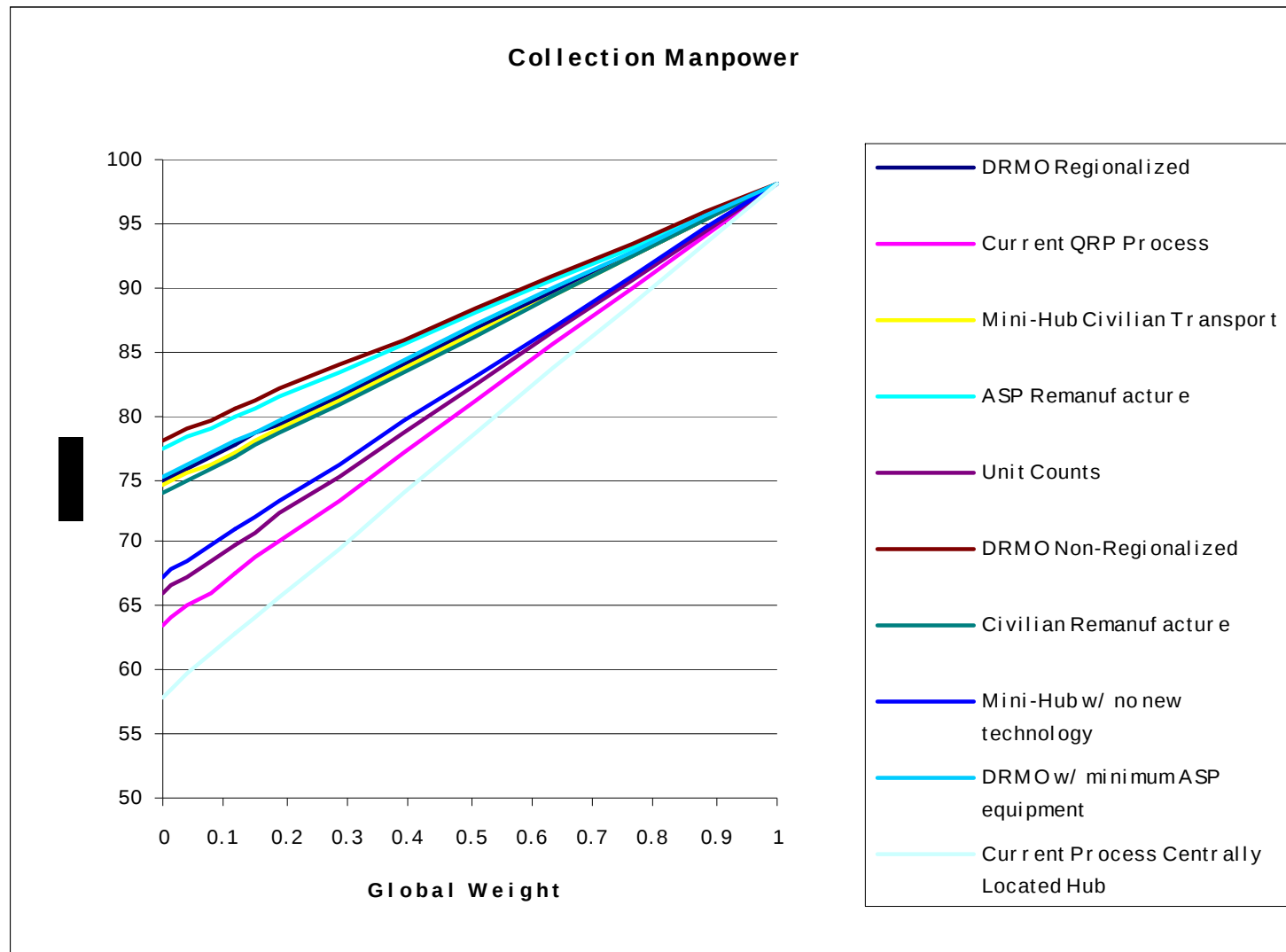


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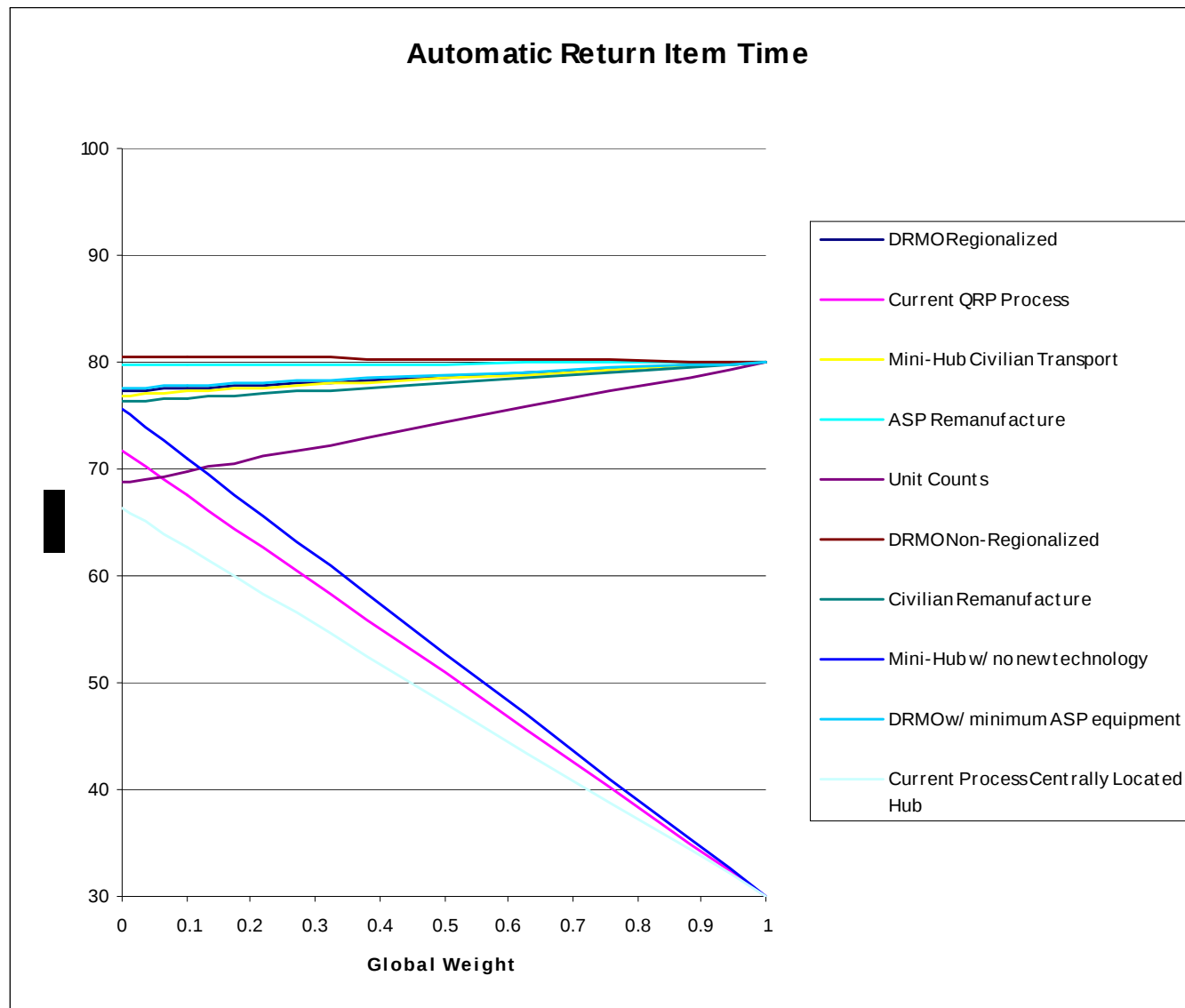


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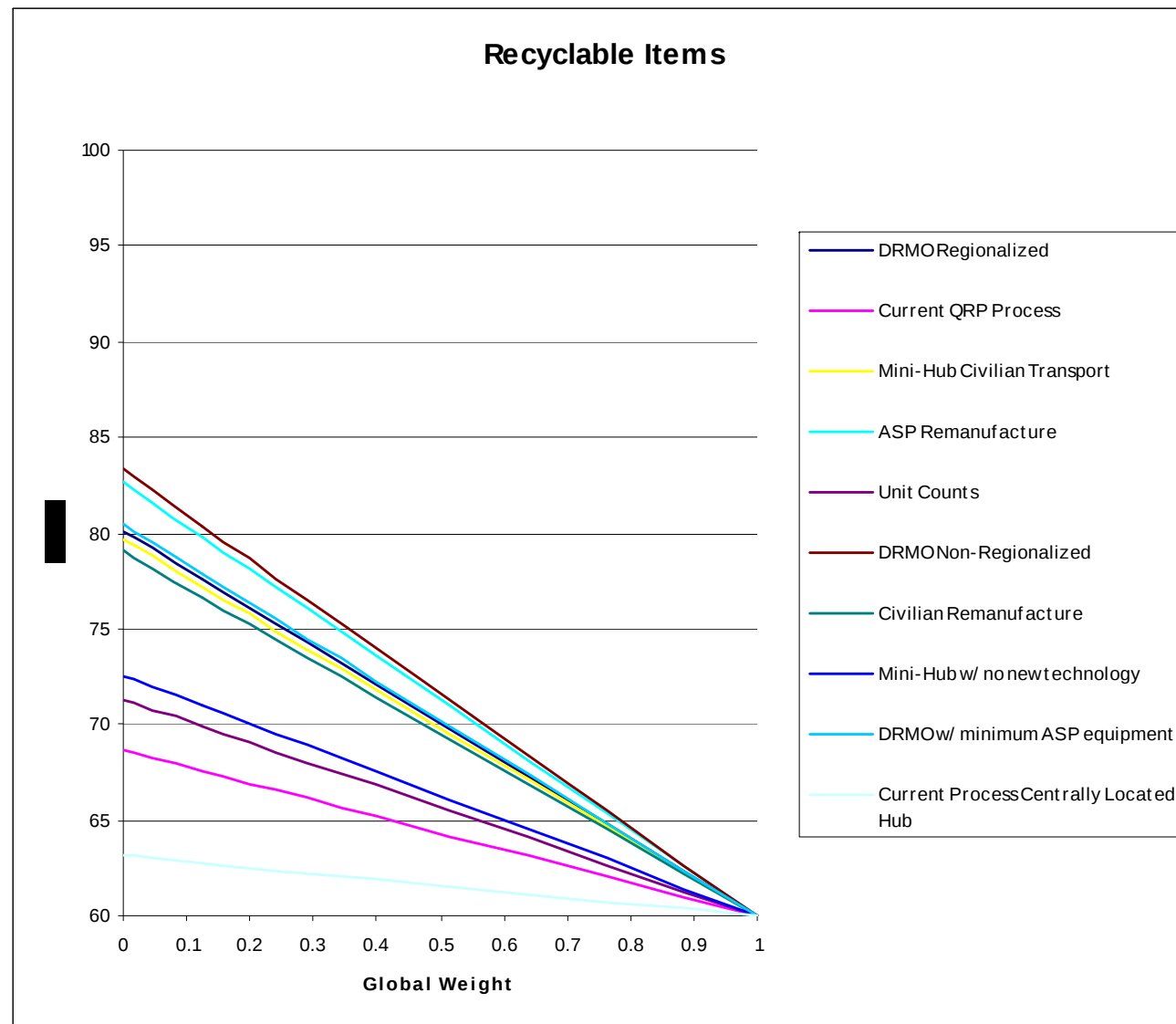


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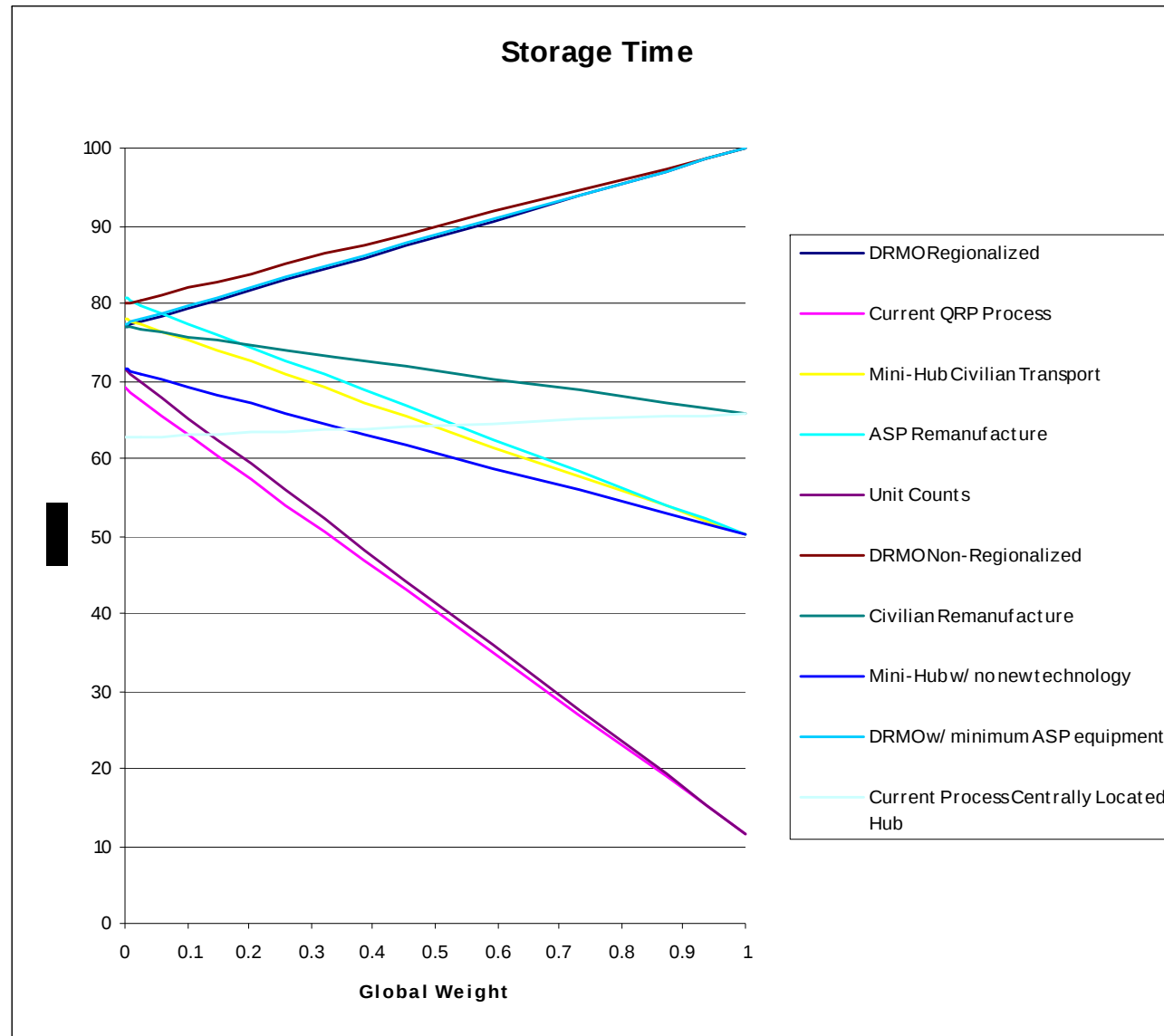


Sensitivity Analysis Charts





Sensitivity Analysis Charts





Sensitivity Analysis Charts

