Calculating the Return on Investment (ROI) for DMSMS Management

Peter Sandborn
CALCE, Department of Mechanical Engineering
(301) 405-3167
sandborn@calce.umd.edu
www.enme.umd.edu/ESCML/obsolescence.htm

December 17, 2010

The Problem with Cost Avoidance

- The value of DMSMS management activities is usually quantified as a "cost avoidance"

Cost avoidance is a cost reduction that results from a spend that is lower than the spend that would have otherwise been required if the cost avoidance exercise had not been undertaken.

B. Ashenbaum, Defining Cost Reduction and Cost Avoidance, CAPS Research, March 2006

- While management can (with a bit of effort) understand cost avoidance, it is not necessarily "sellable"
- Requesting resources to create a cost avoidance is not as persuasive as making a return on investment argument

Evaluating the ROI Associated with DMSMS Management

What is ROI?

$$ROI = \frac{\text{Return - Investment}}{\text{Investment}}$$

(Arithmetic Formulation)

Why evaluate the ROI?

- ★ To build a business case for management activities
- – To perform cost/benefit analysis on different management approaches
- – Evaluate when management may not be warranted

Interpreting ROI:

0 = breakeven (no cost impact)

> 0 there is a direct cost benefit

< 0 there is no direct cost benefit

ROI for DMSMS Management

So, how do we formulate an ROI for DMSMS Management?

Problem #1 – The "return" in this case is the "cost avoidance," i.e., a reduction in costs that have to be paid in the future to sustain the system:

$$ROI = \frac{V_f - V_i}{V_i} = \frac{\text{Cost Avoidance} - \text{Investment}}{\text{Investment}}$$

where,

V_f = final value of the investment

V_i = initial value of the investment

ROI for DMSMS Management (continued)

Problem #2 - ROI compared to what? ROI has to be relative to something. Presumable one wants to compare to the no DMSMS management case, but what is this case?

- Are you comparing to a case where the system becomes non-sustainable (if so, what is the life cycle cost of a non-sustainable system)?
- Are you comparing to a case where the system remains operational but at a higher cost (cost of what?)
- Whatever case you choose to measure ROI from it will be ambiguous (no two folks will define it the same way)

One possible solution:

- A clearly definable stake in the ground is the "perfect world" case, which represents the sustainment of the system if nothing ever went obsolete
- This is not a real case, but, it is a clearly definable point to measure everything from (is it definable without ambiguity?)
- However, the downside is that it will require some manipulation of the final ROI to create a useful/meaningful number

ROI for DMSMS Management (continued)

Problem #3 – Separating the life cycle costs when DMSMS is managed from life cycle costs when DMSMS is unmanaged may be impossible to do.

ROI for DMSMS Management (continued)

- ROI relative to the "perfect world" (0) case gives

$$ROI_0 = \frac{(C_0 - C_m)}{(I_m - I_0)}$$

where,

C_0 = total life cycle cost of the system if nothing ever went obsolete
C_m = total life cycle cost of the real system with DMSMS management
I_0 = investment cost in DMSMS management if nothing ever went obsolete
I_m = investment cost in DMSMS management in the real system

- By definition, $I_0 = 0$ (contains no investment in DMSMS management because there is no DMSMS to manage)
- ROI becomes,

$$ROI_0 = \frac{C_0 - C_m}{I_m}$$

- (C_m-C_0) excludes all the costs that are a "wash" (i.e., the same whether parts go obsolete or not) – solves the problem of splitting up costs
- $C_0 = C_m$ gives ROI = 0 (which is right, note C_m includes I_m within it)

ROI for DMSMS Management (continued)

- Investment cost

$$I_m = C_{NRE} + C_{INF}$$

where,

C_{NRE} = DMSMS management non-recurring costs
C_{INF} = DMSMS management infrastructure costs

- DMSMS management NRE costs = non-recurring cost of identifying and putting in place specific resolutions for specific parts
- DMSMS infrastructure cost = cost of acquiring and keeping DMSMS management resources in place (people, training, software, databases, plan development, etc.)

ROI for DMSMS Management (continued)

- Not so fast! Is I_m complete? Are there other investment costs too?

- This is a difficult question
- Examples:
  - What if my DMSMS resolution approach is to buy an emulated part that costs 20x the original part cost from the original manufacturer. Is the increase in the recurring cost per part an investment cost (i.e., part of I_m)?
  - What if my managed DMSMS program ends up buying more parts than an unmanaged program. Is the cost of the extra parts accounted for as part of the investment (I_m)?
  - What if (for simplicity) my DMSMS management approach resulted in buying the exact same number of parts for exactly the same price per part as my unmanaged approach, but I buy them at different times. Due to the non-zero cost of money, this does not end up costing the same. Is the cost of money part of I_m?
- These costs would not be included in the investment cost because they are the result of the investment and are reflected in the life cycle cost C_m

Life Cycle Obsolescence Management Cost

Life Cycle Obsolescence Management Cost ($C_{DMSMS} = C_m - C_0$):
$C_m - C_0$ = Actual total life cycle cost – Life cycle cost if no parts had gone obsolete

Includes:
- All recurring costs (build and part procurement)
- All non-recurring design refresh and re-qualification costs
- All lifetime buy and bridge buy costs
- All inventory costs

Includes:
- All recurring costs (build and part procurement)
- No obsolescence events
- No design refreshes (for obsolescence management)
- No lifetime buy or bridge buy costs
- No inventory costs (for extra parts)

ROI for DMSMS Management (continued)

$$ROI_0 = \frac{C_0 - C_m}{I_m} = \frac{-C_{DMSMS}}{I_m}$$

- ROI_0 is always a negative number. In this form, the closer to zero the ROI is, the higher the value of your DMSMS management, i.e., you are closer to the life cycle cost of the no obsolescence case (the best possible case would be an ROI_0 of zero).

Re-writing the ROI relative to a no management (N) case assuming $I_N = 0$ (rather than a perfect world case) we get,

$$ROI_N = \frac{C_N - C_m}{I_m} = \frac{C_0 + C_S - C_m}{I_m} = ROI_0 + \frac{C_S}{I_m}$$

- Where the life cycle cost of a real unmanaged system be $C_N = C_0 + C_S$, where C_S is the sustainment cost of the unmanaged system
- Why write the ROI this way?
  - ROI_N is the sellable quantity (it has a real meaning and a clear interpretation to management)
  - ROI_0 is a calculatable quantity (people could keep track of it or predict it)
  - C_S is the "mapping" between ROI_N and ROI_0

Cost Avoidance Estimate Example

Consider all the resolutions from a particular DMSMS management organization (we ignored the redesigns). The conventional cost avoidance calculation would be:

Resolution	Number of Occurrences	Cost Avoidance	Total Cost Avoidance
Existing Stock (No Action)	79	$2000	$158,000
Reclamation	0	$5000	0
Alternate	15	$13,000	$195,000
Substitute	40	$32,000	$1,280,000
Aftermarket	30	$23,000	$690,000
Emulation	0	$47,000	0
Redesign-Minor	-	$328,000	-
Redesign-Major	-	0	-
Total	164		$2,323,000

2004 DMEA Numbers

The organization would report this cost avoidance to their management to value their DMSMS management efforts

For whatever mitigation solution is chosen, one can consider an associated cost avoidance equal to the difference between the cost of your solution and the next most expensive one.

Cost Avoidance Estimate Example (continued)

- But what does the $2,323,000 mean?
- Is this real money? Would the life cycle cost of the system actually have been $2,323,000 higher if the DMSMS management organization had not existed?
- Is $2M in Program A valued the same as $2M in the Program B?

These are all really good questions for which there aren't generally any answers

Cost Avoidance Estimate Example (continued)

Let's take one more step with the conventional approach:

Assume the following costs:

C_{NRE} = $471,648 (ignoring redesigns)

C_{INF} = $200,000 (DMSMS infrastructure costs) for the period of time covered by the data – software licenses, training, etc.

With these values the organization using the conventional cost avoidance calculation could compute an ROI for their program:

$$ROI = \frac{\text{Cost Avoidance - Investment}}{\text{Investment}} = \frac{\$2{,}323{,}000 - (\$471{,}648 + \$200{,}000)}{\$471{,}648 + \$200{,}000} = 2.46$$

This gets us past the value of money problem (it divides out), but, this ROI is relative to what?

It's relative to the "next most expensive resolution," which isn't a fixed point. So the meaning of this ROI is unknown.

Cost Avoidance Estimate Example (An Actual ROI Calculation)

We need to determine the recurring cost (C_{REC}) for the organization's DMSMS management of their program:

Resolution	Recurring part price multipliers	Number of instances	Additional Recurring Cost (due to DMSMS management)
Alternate-Common	2.5	15	$225,000 (15)(1000)($10)(2.5-1)
Substitute-Desktop	1.6	23	$138,000
Substitute-Normal	5.8	8	$384,000
Substitute-Complex	10	9	$810,000
Aftermarket-Common	7.5	30	$1,950,000
Lifetime Buy	1	120	$300,000 (120)(1000)($10)(0.25)
Total (C_{REC})			$3,807,000

1999 DMEA Numbers

Other assumptions:

Average demand per part at obsolescence = 1000 (number of parts needed)
Average price per part at obsolescence = $10/part
Lifetime buy buffer size = 25%

Cost Avoidance Estimate Example (An Actual ROI Calculation - continued)

$I_m = C_{NRE} + C_{INF}$ = $200,000 + $471,648 = $671,648 (same as for the conventional calculation)

Total cost of DMSMS management:

$C_{DMSMS} = C_{REC} + I_m$ = $4,478,648

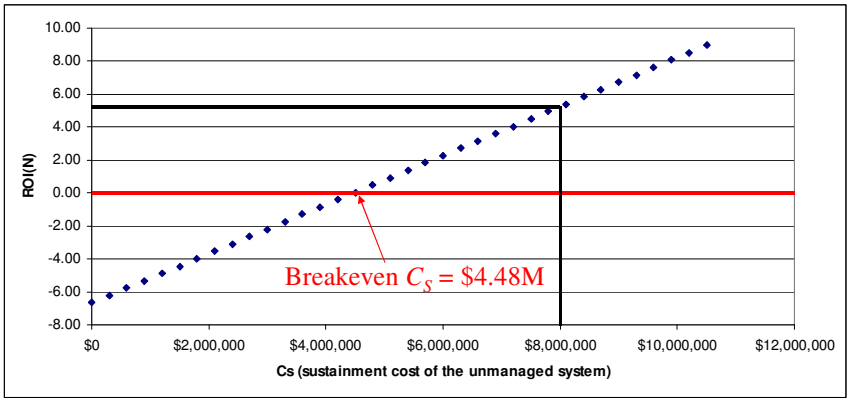
ROI_0 (relative to the no obsolescence case) for the program:

$$ROI_0 = \frac{-C_{DMSMS}}{I_m} = \frac{-\$4{,}478{,}648}{\$671{,}648} = -6.67$$

In order to calculate the ROI relative to the unmanaged case, the remaining unknown is C_S (the sustainment cost of the unmanaged system)

Cost Avoidance Estimate Example (An Actual ROI Calculation - continued)

$$ROI_N = ROI_0 + \frac{C_S}{I_m} = -6.67 + \frac{C_S}{\$671{,}648}$$

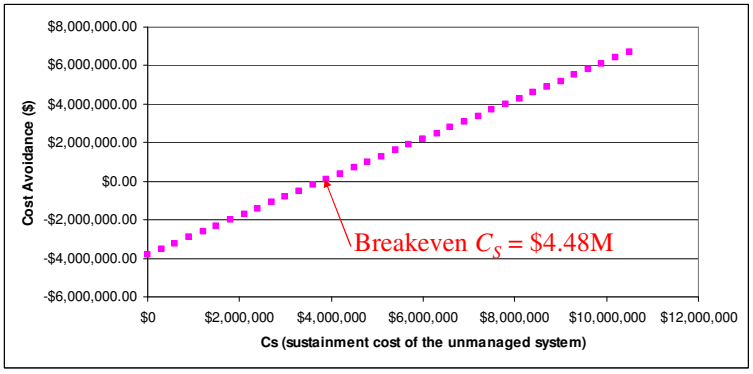


Example, if C_S = $8M, the ROI of this DMSMS management program relative to an unmanaged program will be 5.24

Cost Avoidance Estimate Example (An Actual ROI Calculation - continued)

Alternatively, you can cast this as a cost avoidance:

$$ROI_N = \frac{\text{Cost Avoidance} - \text{Investment}}{\text{Investment}} \qquad \text{Cost Avoidance} = (ROI_N + 1) I_m$$



ROI for DMSMS Management (continued)

Time dependency of costs:

- Note, SD-22 also refers to a "Breakeven Point (BEP)" that is the point in time where the ROI reaches 0. The graph on the previous slide is the C_S (unmanaged system sustainment cost) at which ROI reaches 0.
- Costs are not generally constant over time due to:
  - Inflation/deflation
  - Discount rate (cost of money)
- Only a simple ROI calculation example was presented here – one really needs to do a discounted cash flow ROI, i.e., performing a cumulative time dependent calculation that includes the discount rate on money
- A discounted cash flow ROI could be used to generate a ROI as a function of time and thus determine the type of BEP that is described in SD-22

Cost Avoidance Estimate Example (An Actual ROI Calculation - continued)

Conclusion (for this example):

- If sustaining this program without DMSMS management costs less than $4.48M, then there is no economic advantage to having a DMSMS management program.
- If the sustainment cost of the unmanaged program can be estimated, an actual ROI can be found
- The meaning of the $2,323,000 cost avoidance found using the conventional approach is unknown
- ROI calculations incorporating the conventional cost avoidance are measures that are relative to a complex moving scale associated with the "next most expensive resolution approach"
- You can still cast the final answer in terms of a cost avoidance if you want

ROI for DMSMS Management (continued)

More problems:

Problem #4 – How is a design refresh that concurrently resolves multiple current and future DMSMS problems valued?

- I_m includes the NRE costs associated with the design refresh (true for both the conventional cost avoidance analysis and ROI methods)
- In the ROI approach, the life cycle cost value (or possibly lack of value) of the design refresh is part of C_m (the actual life cycle cost of the system) – so all future impacts on the system of doing a refresh are accounted for correctly
- In the conventional cost avoidance calculation, the value of the design refresh is calculated for the resolution of a current DMSMS event (possibly multiple current events) – no accounting for future DMSMS resolutions avoided is possible

Comment – Only a simple ROI calculation example was presented here – one really needs to do a discounted cash flow ROI, i.e., performing a cumulative time dependent calculation that includes the discount rate on money

ROI for DMSMS Management (continued)

Problem #5 – The formulation we have measures the ROI of a DMSMS management approach relative to a world in which there was no obsolescence. How do we measure the ROI of one DMSMS approach relative to another?

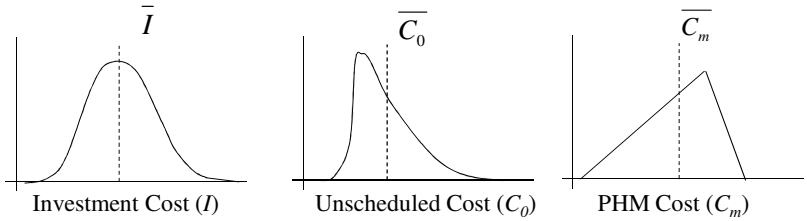
It is not valid to calculate the ROIs of each of the DMSMS management approaches relative to the no obsolescence case and subtract them. Instead, the ROI of *m2* relative to *m1*:

$$ROI = \frac{C_{m1} - C_{m2}}{I_{m2} - I_{m1}}$$

Problem #6 – How can uncertainties be taken into account?

Non-Stochastic ROI

Non-Stochastic ROI Calculation:



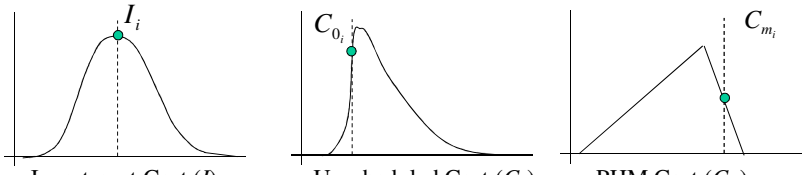
Investment Cost (I) Unscheduled Cost (C_0) PHM Cost (C_m)

$$ROI_0 = \frac{\overline{C_0} - \overline{C_m}}{\overline{I}}$$

This calculation is static, not stochastic. It uses values that are averaged over the whole population of part resolutions.

Stochastic ROI (with Uncertainties)

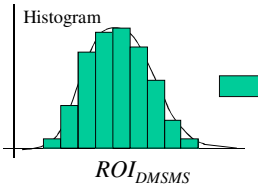
Problem – a particular part resolution (resolution i) may be represented by this set of values:



Investment Cost (I) Unscheduled Cost (C_0) PHM Cost (C_m)

$$ROI_{0_i} = \frac{C_{0_i} - C_{m_i}}{I_i}$$

ROI for each resolution instance



Value:
- Mean ROI
- ROI uncertainty
- ROI confidence

Business Case

Summary

- We have no idea what the costs or ROIs generated by the conventional cost avoidance calculation approach really mean
- ROI_0 (the ROI relative to a case where nothing goes obsolete) can be determined from data collected by DMSMS management organizations today, and is a valid measure of DMSMS management value, but is it "sellable"?
- Problems of comparing differing values of money ($1 at Boeing ≠ $1 at Raytheon) are solved by ROI since it is a ratio
- If a C_S (sustainment cost of the unmanaged system) can be established (or estimated) for a system, then a real ROI for the DMSMS management effort can be found, alternatively, application-specific breakeven C_S can be calculated
- The conventional cost avoidance calculation has the potential to significantly undervalue design refreshes and other strategic activities because does not account for future DMSMS resolutions that have been avoided (ROI does account for them)
- The conventional approach may capture how hard the management organization is working, but does not measure how smart it is working

Comments

- This is NOT about DMEA numbers, this is about what you do with the numbers to estimate the value to your program or organization
- The DMEA numbers are only guidelines, you should be collecting and developing your own program-specific cost resolution numbers
- The conventional cost avoidance calculation method for evaluating DMSMS management organizations appears in both of the following:
  - Sept 2010 DMEA Report: http://www.bis.doc.gov/defenseindustrialbaseprograms/osies/defmarketresearchrpts/cost_metric_final.pdf
  - Sept 2010 SD-22: http://www.dmsms.org/files/SD-22_DMSMS_Guidebook_Update_09-2010.pdf