Enterprise Resource Planning Systems: Sizing Metrics and CER Development (SW-07)

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Technomics
The Science of Informed Decision Making

Agenda

- What is ERP?
- Why is ERP different?
- Cost estimating approaches to date
- Proposed parametric approach
- Data Sources
- Scatter plot analysis
- Multivariate analysis
- Results & Conclusions

What is ERP?

- A software application that integrates internal and external data across the enterprise
- Includes a common database that supports all business functions
- Typically implemented with Commercial Off the Shelf Software (COTS)
- Typical DoD business areas automated with ERP include financial/accounting, asset management, procurement, and human resources
  - DEAMS, ECSS, GCSS, GFEBS, LMP, Navy ERP, SPS, BSM

Why is ERP Different?

- Heavy use of COTS versus developed software
- Greater cost and effort associated with integration & implementation
- Larger in size, both in terms of dollars, and amount of software
- Greater breadth across the organization
  - ERP touches multiple business functions, involves many processes, and many interfaces to other systems
  - Traditional software is often viewed as standalone.
- Great potential for cost savings

CER Cost Estimating Approaches To Date

- SLOC based
  - Not appropriate for ERP due to limited developed software.
- Bottoms-up based on vendor quotes
  - Subject to optimism / competitive pricing
  - Can't be done early in program life cycle
  - No way to ensure all costs are included
- Cost per RICE object (Reports, Interfaces, Conversions, and Extensions)
  - Doesn't allow for different weighting of each RICE component, i.e. multivariate analysis
  - Doesn't allow for fixed costs (an intercept term)
  - No statistical tests for significance or goodness of fit
  - Every RICE component is not necessarily known early in the program. Reports and extensions can be especially difficult to predict.

Proposed Parametric Approach

- Data collected from 9 DoD plus 1 NASA system
- Include financial, asset management, and procurement functions (human resources excluded)
- Normalization for inflation
- Single variable scatter plots to identify potential cost drivers
- Multivariate analysis with significance and goodness of fit tests
- Proposed Cost Estimating Relationships (CERs)

The goal: a parametric estimate based on available, CER-specific, sizing metrics

Data Sources

- IT budget data, as of March 2010.
  - DoD IT projects are available on snap-it website: https://snap.pae.osd.mil/snapit/home.aspx
  - Other federal agency IT projects are available on the IT dashboard: http://it.usaspending.gov/
- Open source search
  - Program office websites, briefings
  - GAO reports
  - Government IT industry articles

Data Sources - Program Attributes

Program	Core Users	Total Users	Interfaces	Legacy Systems Replaced	Locations	Investment Period (years)	Financial Business Mission	Asset Mgmt Business Mission	Procurement Business Mission	HR Business Mission	Count	FOC	Agency	SW Vendor
DEAMS	6,200	28,000	70	15	70	10.9	x				1	2017	AF	Oracle
ECSS		250,000		240	600	8.3		x	x		2	2013	AF	Oracle
GCSS-A		135,000	22	14		13.0		x			1	2016	Army	SAP
GCSS-MC		56,965	42	4		9.3		x	x		2	2013	MC	Oracle
GFEBS		79,000	87	84	200	8.3	x				1	2012	Army	SAP
LMP		17,000	70		1000	7.8		x			1	2011	Army	SAP
Navy ERP	18,000	87,000	119	239	120	8.7	x	x	x		3	2013	Navy	SAP
SPS		38,000	30	76	800	13.7			x		1	2007	DoD	Custom
IEMP CF		10,000		10	10		x				1	2004	NASA	SAP
BSM		7,500	110			7.0		x			1	2007	DoD	SAP

- Definitions
  - Users. Number of licensed users anticipated at FOC.
  - Interfaces. Number of external systems transferring data to or from the ERP.
  - Legacy Systems Replaced. Number of system migrations to the ERP.
  - Locations. Number of physical locations where the ERP is deployed.

Data Sources - Program Attribute Data

- Attribute data limitations:
  - Relies on program-reported metrics, not independently measured data.
  - No guarantee that identical definitions of each metric are used. For example, definition of an "interface" and "deployment location" are based on the program office interpretation.
  - Reports and extensions, two of the components of RICE objects are not generally reported

Data Sources - Program Cost Data

- Example milestone data for GCSS-MC:

	Total Cost		Baseline				Percentages Complete	
Description of Milestone	Planned Cost ($M)	Actual Cost ($M)	Planned Start Date	Actual Start Date	Planned Completion Date	Actual Completion Date	Planned Percent Complete	Actual Percent Complete
MS A -- Permission to begin planning and development of the system	2	2	2003-10-01	2003-10-01	2004-07-23	2004-07-23	100	100
MS B -- This milestone takes the outcome of analysis and preliminary design to gain permission to complete the design and build of the system. Deliverables are the Preliminary Design.	35	38	2004-07-23	2004-07-24	2007-02-01	2007-04-02	100	100
System Design -- This is an intermediate step between MS B and MS C. The Deliverable is the detailed system design.	19	20	2007-02-01	2007-04-03	2008-01-31	2008-02-20	100	100
System Build -- This is an intermediate step between MS B and MS C. The Deliverable is the completed system ready for production at the PRR.	54	73	2008-01-31	2008-02-01	2010-02-05		90	90
MS C -- This milestone provides approval to conduct operational test of the system. Deliverable is the production ready system.	8	0	2009-11-01	2009-11-02	2010-03-03		90	90
R1.2 System Design -- This task completes the design for the Release 1.2 component.	20	0	2009-11-13	2009-11-13	2010-05-31		0	0
R1.1 Initial Operational Capability -- This milestone provides permission to field the system throughout the Marine Corps. Deliverable: Operationally Test and Approved System	23.85	0	2010-03-08		2010-09-01		50	50
R1.2 System Development -- This task completes the development and build of the R1.2 component.	30	0	2010-06-01		2011-04-11		0	0
R1.2 IOC -- This task completes the initial fielding of the R1.2 capability.	30.7	0	2011-04-12		2011-12-31		0	0
Full Operational Capability -- This milestone addresses when the system is completely fielded in the Marine Corps.	174	0	2012-01-01		2013-02-01		0	0
Sustainment -- This period addresses the end of the current planned lifecycle of the system as denoted by the LCCE. It includes sustainment and other costs not normally tracked via EVMS.	417	0	2013-02-02		2023-01-31		0	0

Data Sources - Program Cost Data

- Cost data limitations:
  - Costs are an estimate at complete, and represent a mix of actuals and budget data. However, because only 3 programs are post-FOC, the budget data may represent a majority of the total cost.
  - Costs represent centralized program office funding, and generally do not include all implementation and operating costs, particularly user time.
  - Budget data generally include only contract costs, and may exclude government costs such as government program management, and use of existing infrastructure such as data centers, and communication.
  - Investment versus Sustainment is not always separated and identified. If program-provided milestone / cost data do not distinguish between investment and sustainment, then costs after FOC are considered sustainment.
  - Budget data must always be normalized to constant year dollars. This requires making an assumption that costs within a milestone are distributed uniformly.

Data Collection Summary

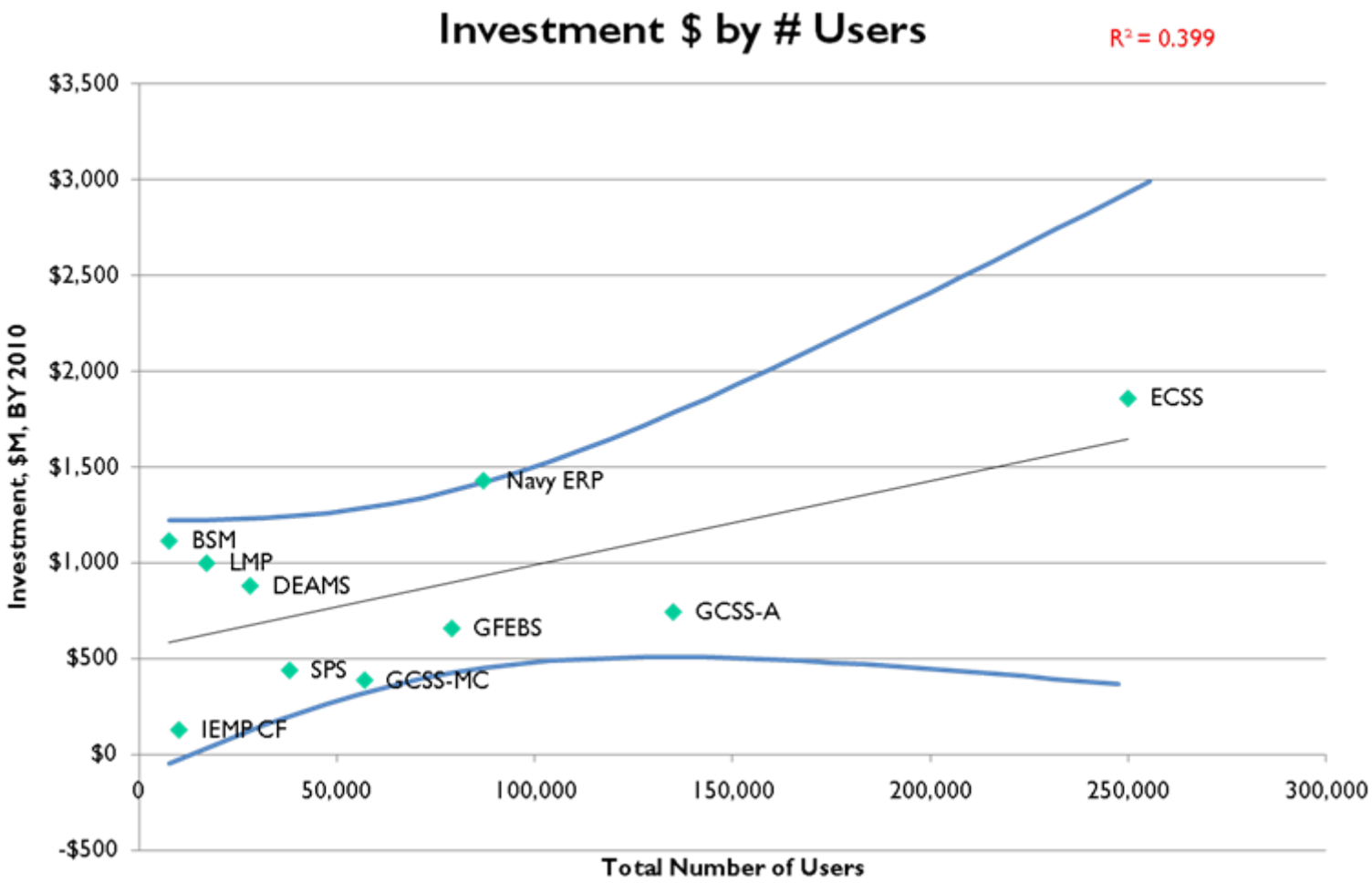
Program	Total Users	Interfaces	Legacy Systems Replaced	Locations	Investment Period (years)	Financial Business Mission	Asset Mgmt Business Mission	Procurement Business Mission	FOC	Agency	SW Vendor	$M,BY10 Investment	$M, BY10 Sustainment	years	$M, BY10 Sustainment per year
DEAMS	28,000	70	15	70	10.9	x			2017	AF	Oracle	$ 880.4	$ 556.9	10	$ 55.69
ECSS	250,000		240	600	8.3		x	x	2013	AF	Oracle	$ 1,860.2			
GCSS-A	135,000	22	14		13.0		x		2016	Army	SAP	$ 743.3	$ 197.5	3	$ 65.83
GCSS-MC	56,965	42	4		9.3		x	x	2013	MC	Oracle	$ 386.9	$ 363.9	10	$ 36.39
GFEBS	79,000	87	84	200	8.3	x			2012	Army	SAP	$ 657.5	$ 826.5	12.3	$ 67.43
LMP	17,000	70		1000	7.8		x		2011	Army	SAP	$ 998.7	$ 532.5	5	$ 106.50
Navy ERP	87,000	119	239	120	8.7	x	x	x	2013	Navy	SAP	$ 1,430.8	$ 777.9	11	$ 70.72
SPS	38,000	30	76	800	13.7			x	2007	DoD	Custom	$ 438.8	$ 143.6	4	$ 35.90
IEMP CF	10,000		10	10		x			2004	NASA	SAP	$ 126.7			
BSM	7,500	110			7.0		x		2007	DoD	SAP	$ 1,115.1	$ 207.2	3	$ 69.07

- All costs are expressed in $M, BY 2010.
- Sustainment reported as a total and as a per-year amount

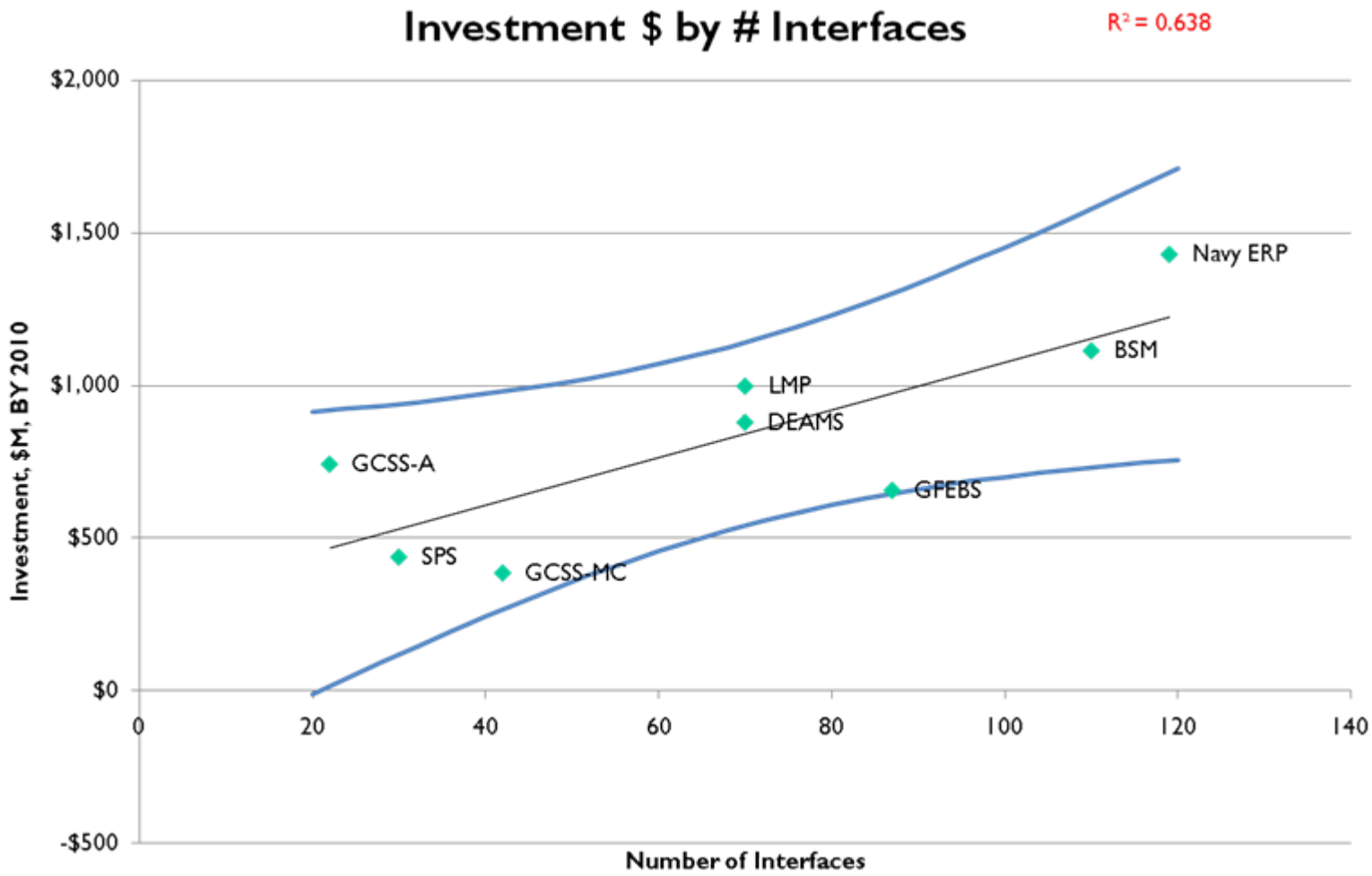
Data Analysis

- Single variable scatter plot graphs
  - Used as a first cut to determine significant variables and outliers.
  - R-squared measures correlation but not statistical significance.
  - 90% confidence bands show goodness of fit
- Multivariate regressions
  - Each coefficient and overall model evaluated for significance (T-score and F-score)
  - Separate models for investment and sustainment

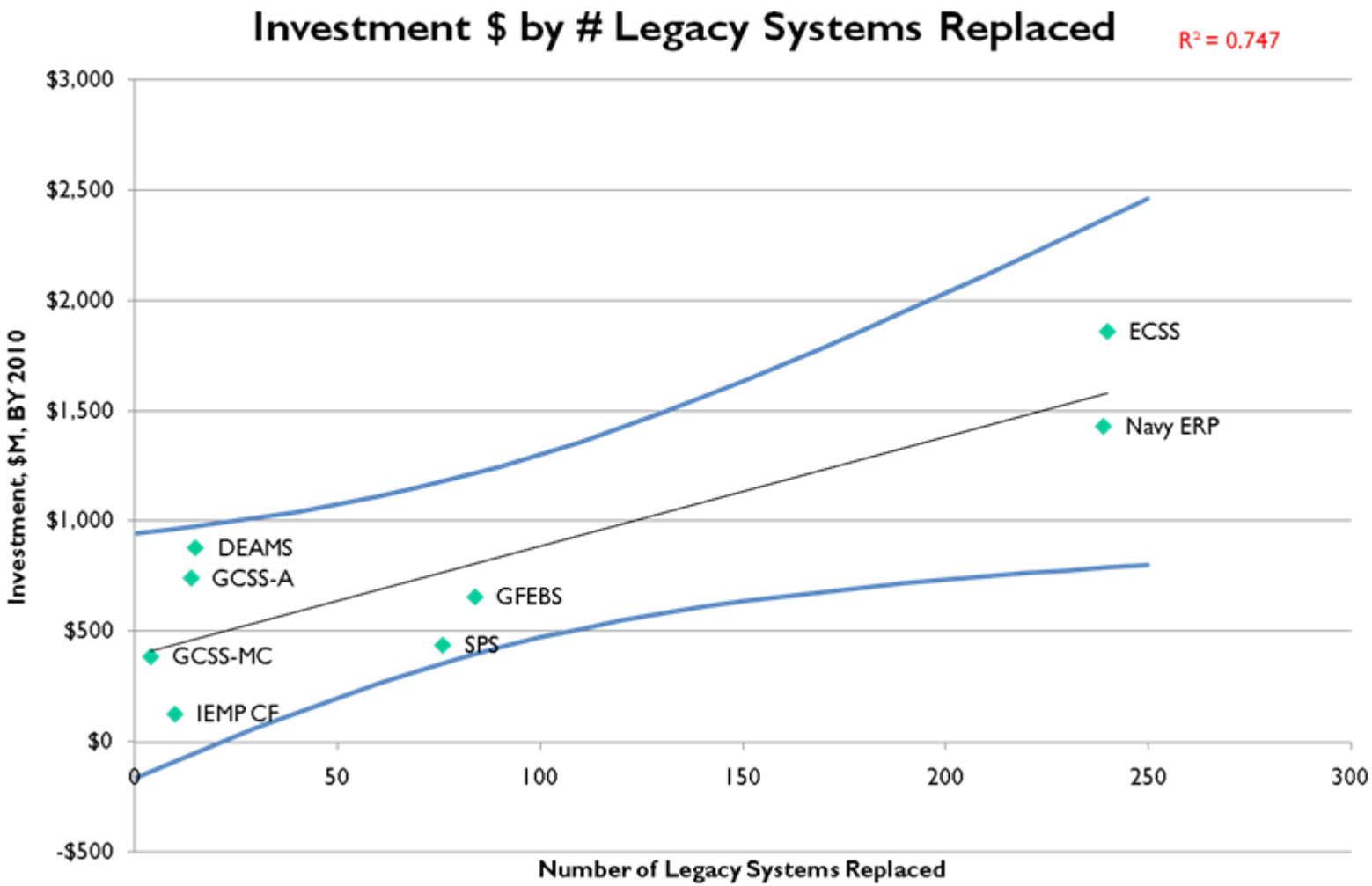
Scatter Plot Analysis - Investment



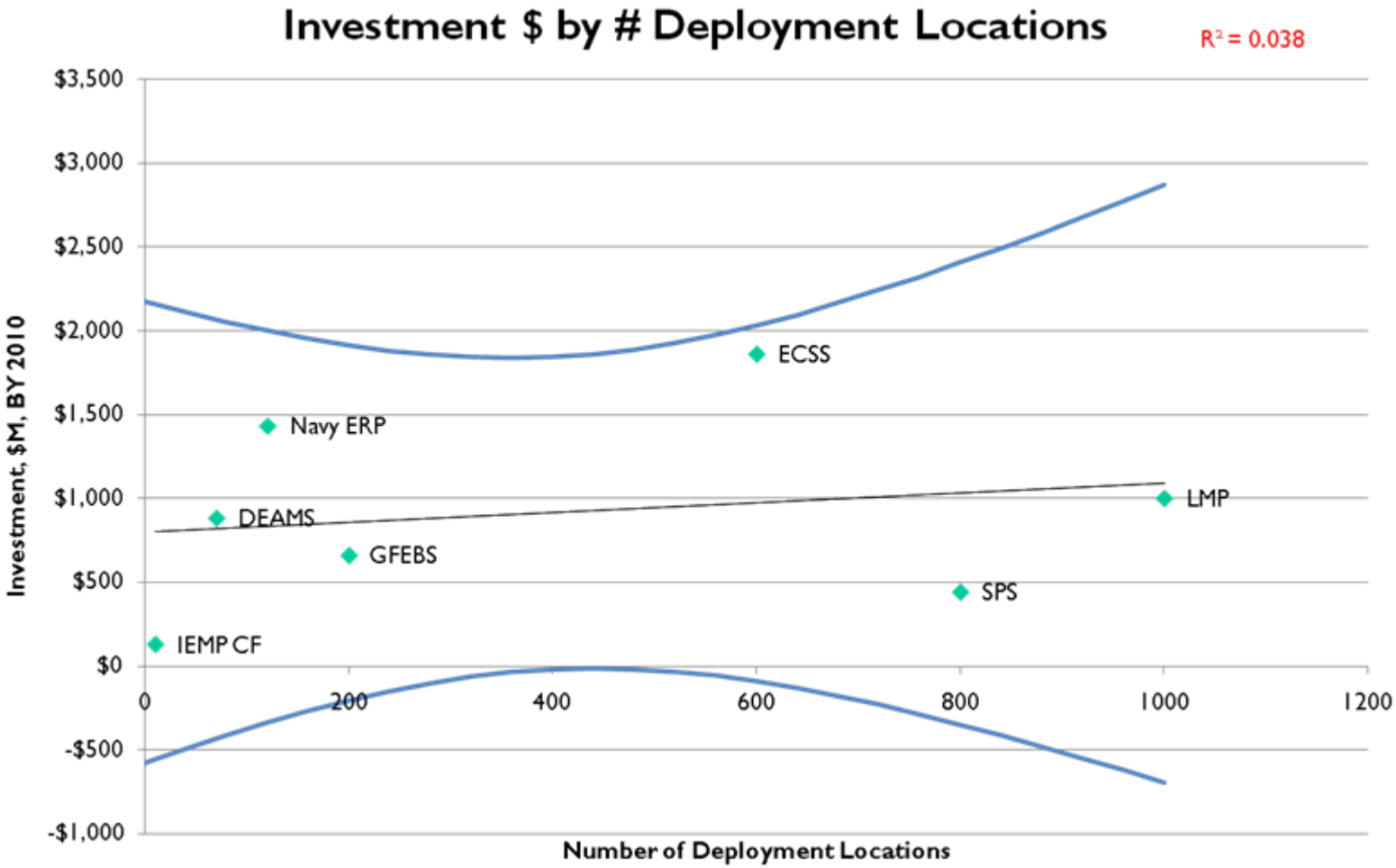
Scatter Plot Analysis - Investment



Scatter Plot Analysis - Investment



Scatter Plot Analysis - Investment

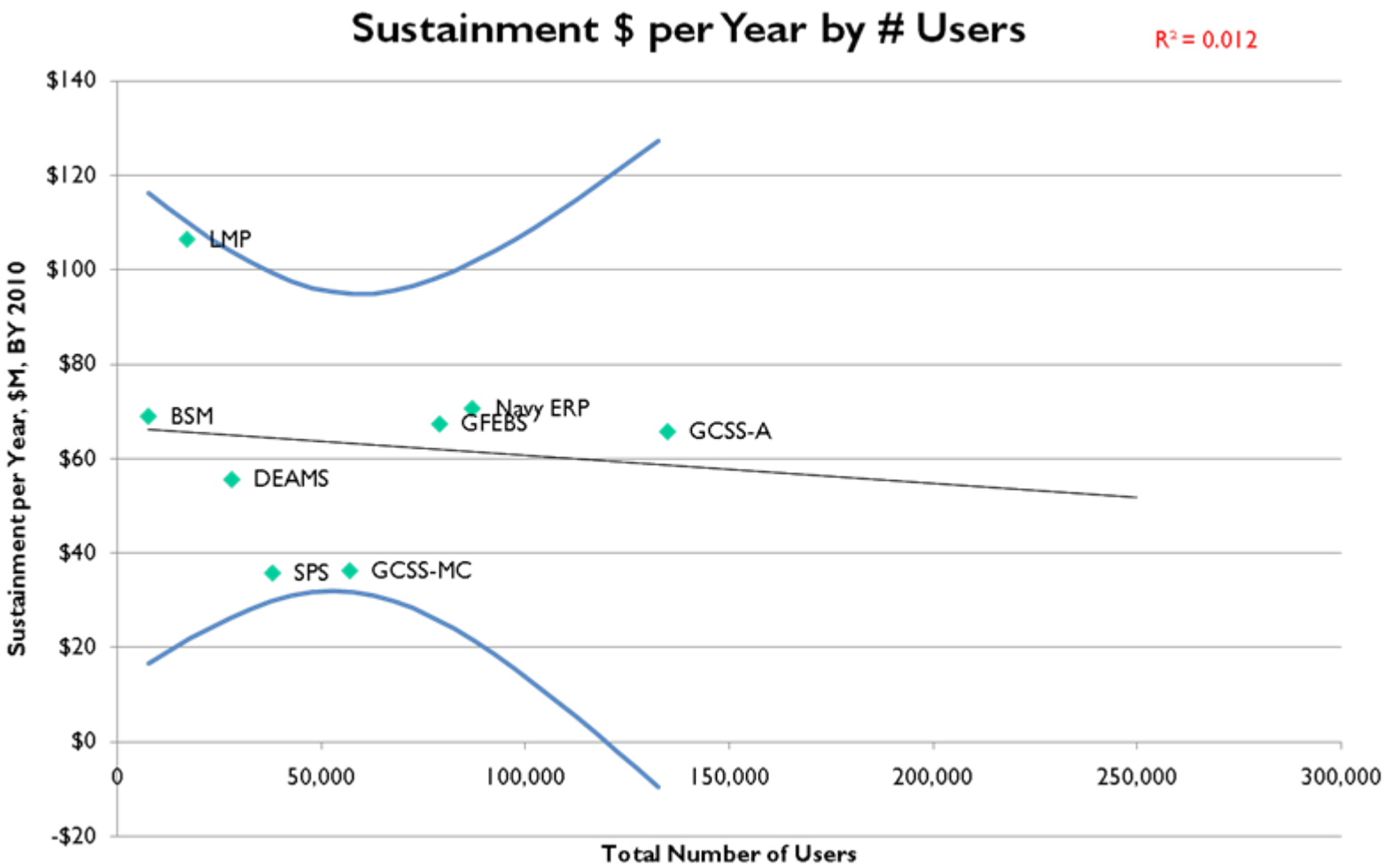


Scatter Plot Analysis - Investment

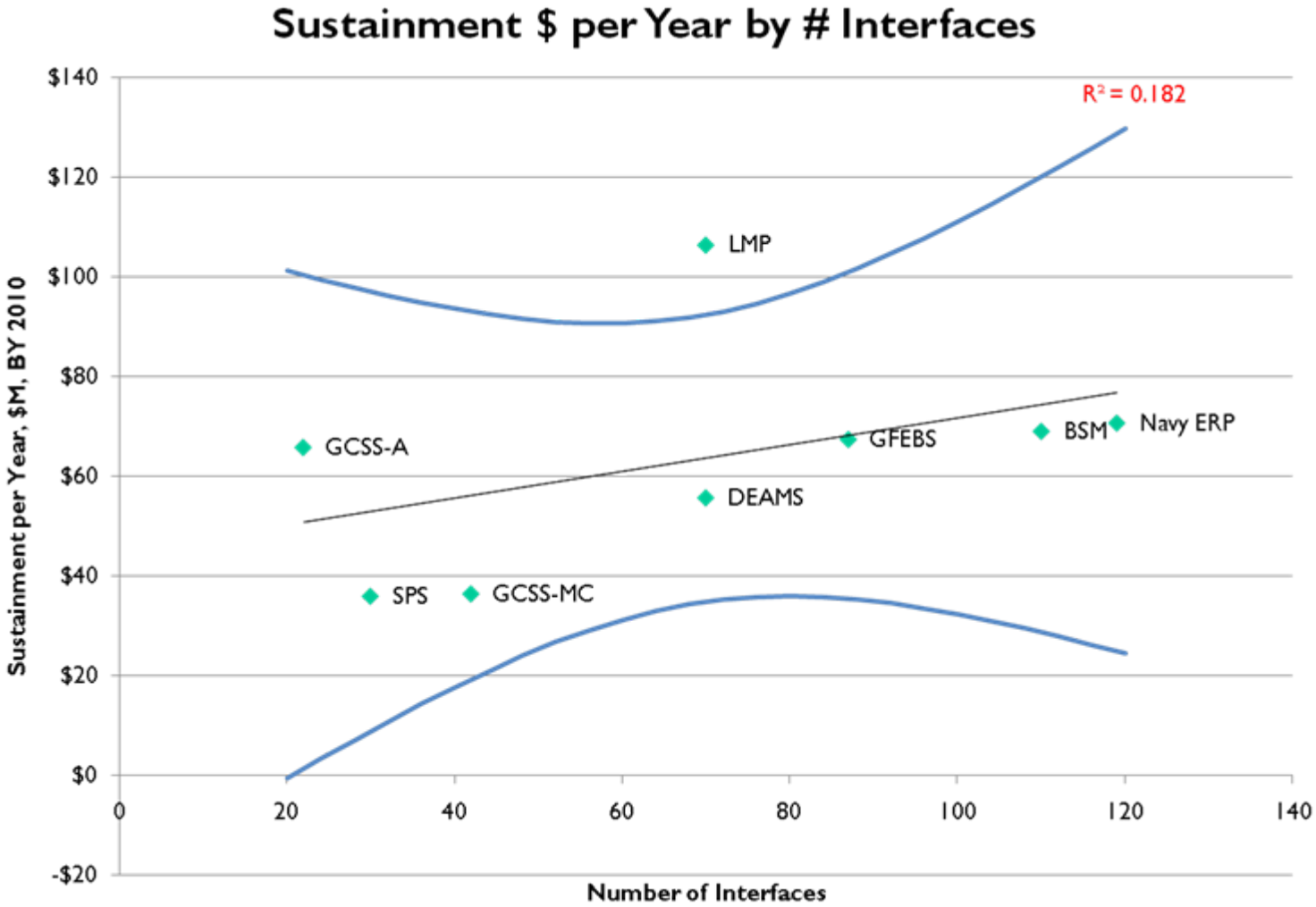
- Conclusions:

Candidate Cost Driver	Preliminary Conclusion	Comments
# users	Positively correlated	Positive slope and intercept are logical
# interfaces	Positively correlated	Positive slope and intercept are logical
# legacy systems	Positively correlated	Positive slope and intercept are logical
# deployment locations	Not correlated	

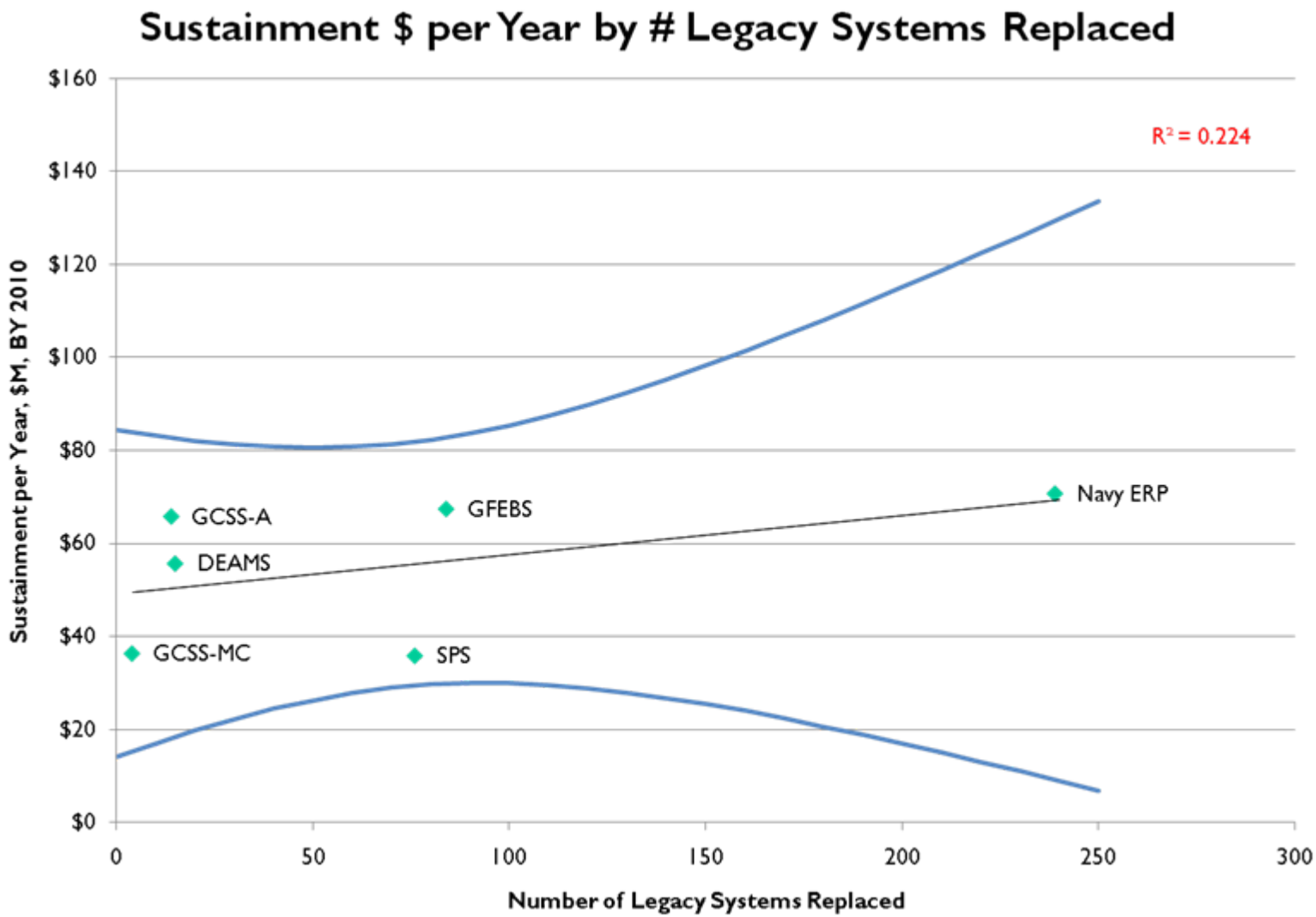
Scatter Plot Analysis - Sustainment



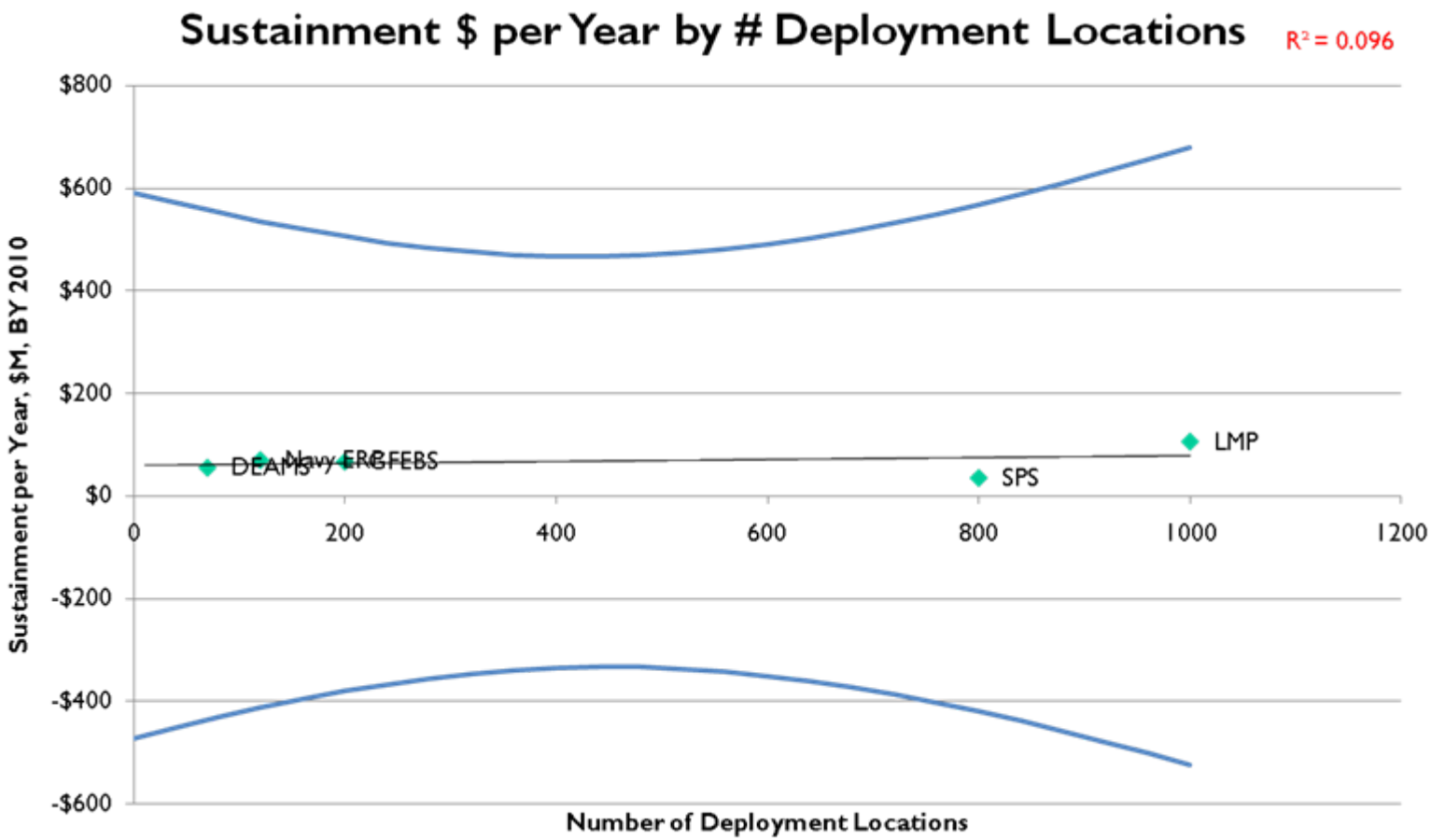
Scatter Plot Analysis - Sustainment



Scatter Plot Analysis - Sustainment



Scatter Plot Analysis - Sustainment



Scatter Plot Analysis - Sustainment

- Conclusions:
  - Cost drivers for sustainment are less apparent than for investment. This may be because limited historical cost data is available for sustainment, because sustainment is not as well correlated to the program attributes available in this study, or because with a small data set, a single extreme outlier (LMP) can significantly alter the results.

Candidate Cost Driver	Preliminary Conclusion	Comments
# users	Not correlated	
# interfaces	Slight positive correlation	Positive slope and intercept are logical
# legacy systems	Slight positive correlation	Positive slope and intercept are logical
# deployment locations	Not correlated	

Multivariate Regressions - Investment

Investment$ = a + b * users + c * interfaces + d * legacy systems

	a (intercept)	b (users)	c (interfaces)	d (legacy)
coefficients	129.850	0.0026	5.802	1.224
p-value(t)	0.786	0.564	0.445	0.685

Adj R^2	0.336
CV	40.8%
p-value(f)	0.370

- Interpretation of coefficients: Investment$ = $130M fixed costs plus $2.6K per user plus $5.8M per interface plus $1.2M per legacy system
- P-value (t) is a significance test of the T score, which measures the significance of each coefficient. Numbers close to zero indicate a significant correlation.
- Adjusted R-squared, CV, and p-value (f) measure the model as a whole and can be used to compare different models.

Multivariate Regressions – Investment

Investment$ = a + b * users + c * interfaces

	a (intercept)	b (users)	c (interfaces)
coefficients	175.964	0.0015	8.336
p-value(t)	0.532	0.537	0.025

Adj R^2	0.534
CV	28.8%
p-value(f)	0.064

- Removing # of legacy systems helps in 2 ways:
  - It adds a degree of freedom to the model by removing an independent variable.
  - It adds two more degress of freedom by increasing the number of available data points from 6 to 8.

Multivariate Regressions – Investment

Investment$ = a + b * users + c * legacy systems

	a (intercept)	b (users)	c (legacy)
coefficients	256.885	0.0031	3.412
p-value(t)	0.135	0.119	0.045

Adj R^2	0.793
CV	32.0%
p-value(f)	0.008

- Produces the best adjusted R-squared among investment models. Indicates that the model explains 79% of the variation.
- P-value(t) scores indicate all coefficients are significant at the 15% level
- The overall model is highly significant (better than 1%). This indicates that the observed correlations are less than 1% likely to be due to random variance.
- Relatively high CV indicates high level of native variance in the data.

Multivariate Regressions - Sustainment

Sustainment$ = a + b * legacy systems + c * locations

	a (intercept)	b (legacy)	c (locations)
coefficients	61.714	0.0647	-0.037
p-value(t)	0.095	0.455	0.257

Adj R^2	0.662
CV	15.9%
p-value(f)	0.336

- Sustainment is estimated on a per year, $M BY 2010 basis.
- Sustainment models are not as significant as investment
- Negative coefficient on locations does not seem logical

Multivariate Regressions - Sustainment

Sustainment$ = a + b * users + c * legacy systems

	a (intercept)	b (users)	c (legacy)
coefficients	33.963	0.00023	0.070
p(t)	0.078	0.241	0.387

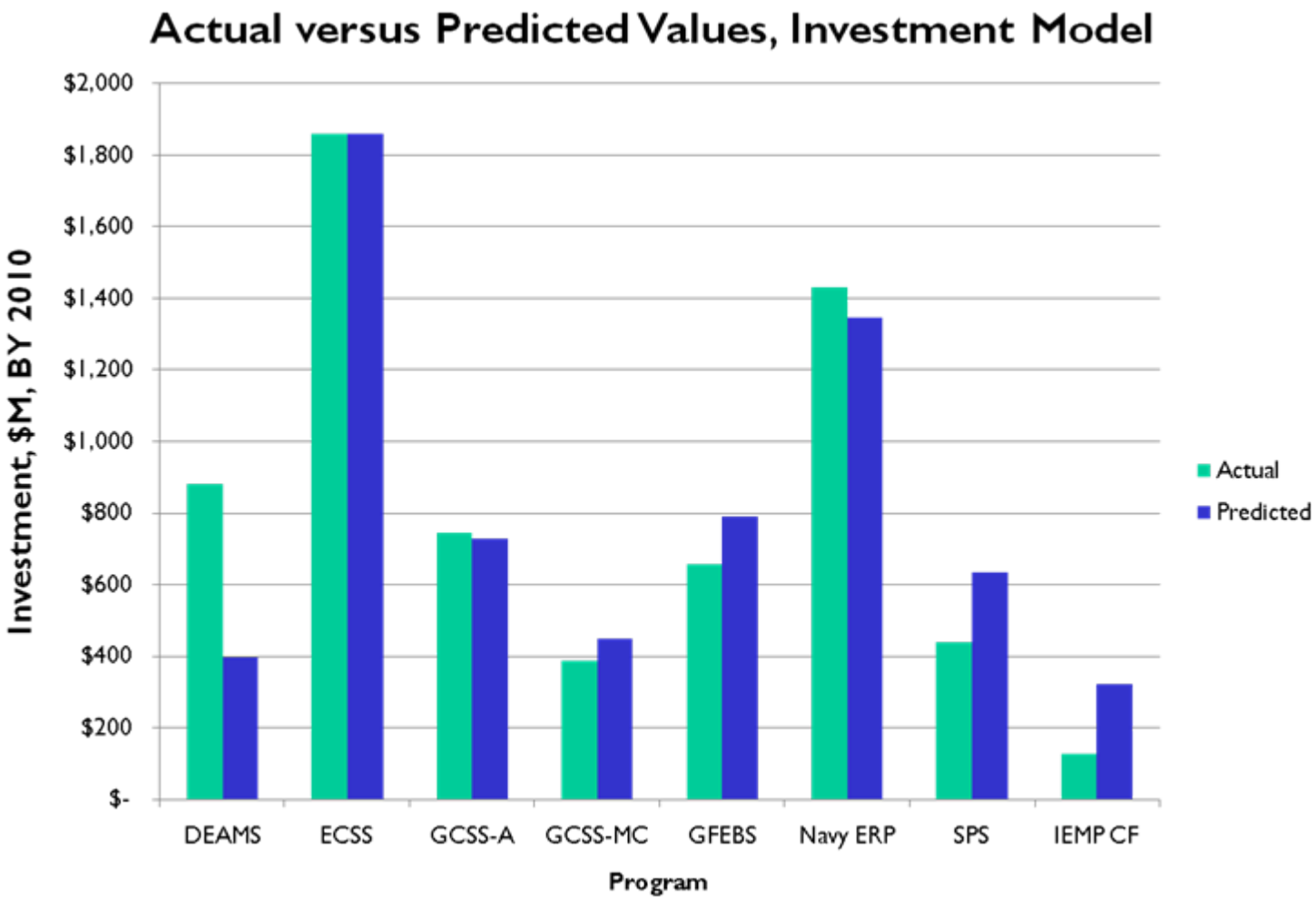
Adj R^2	0.243
CV	24.7%
p(f)	0.306

- Even with a lower adjusted R-squared, this appears to be a better model. All coefficients are logical. $34M fixed costs plus $230 per user plus $70K per legacy system.

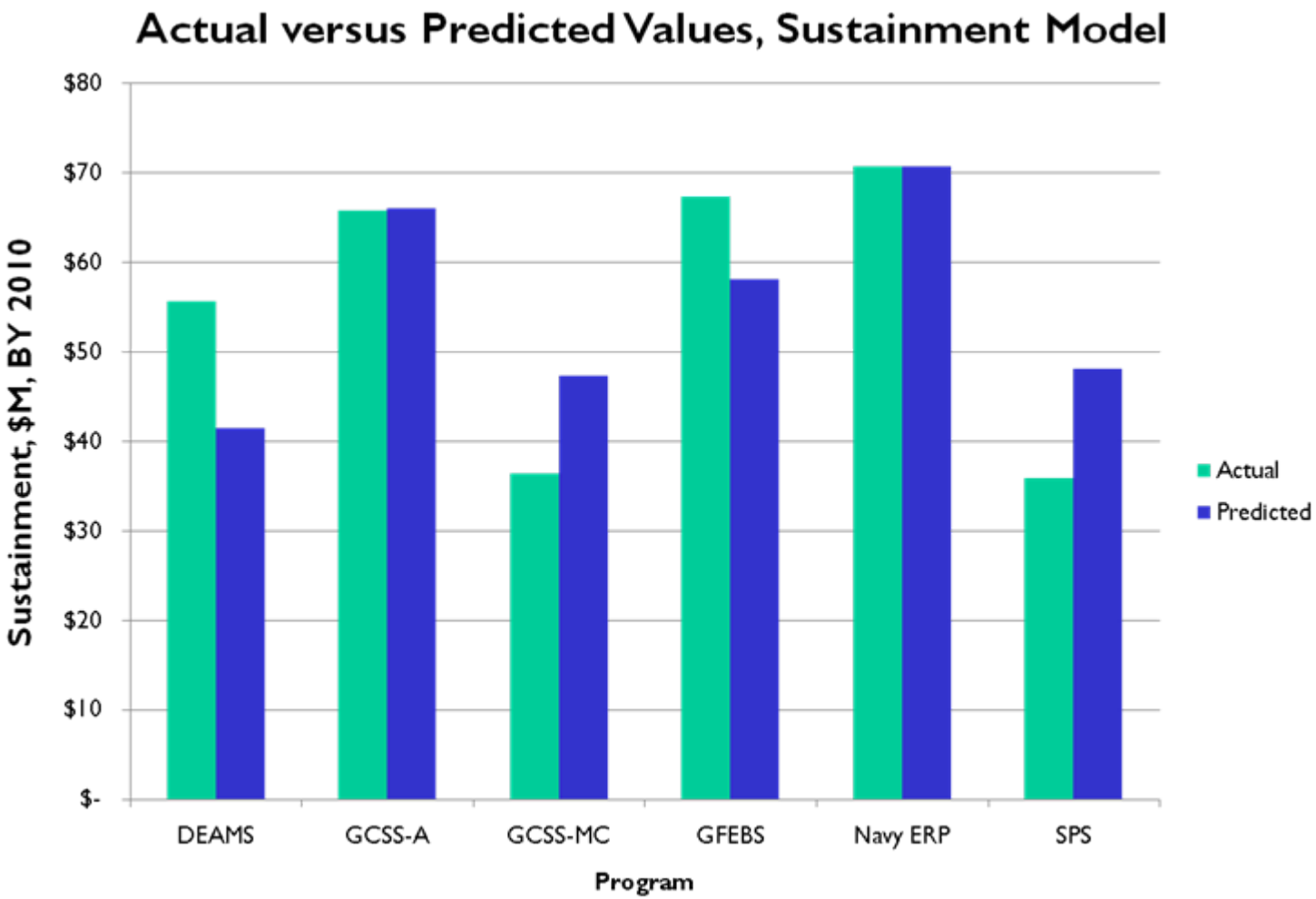
Results

- The best investment model is:
  - Investment = $256.9M + $3.1K * users + $3.4M * legacy systems
  - Highly significant model, better than 1% significance of the F test.
  - CV of 32%
- The best sustainment model is:
  - Sustainment = $34.0M + $230 * users + $70K * legacy systems
  - F test significance of 30.6% is not strong, but is the best among viable sustainment models.
  - CV of 25%

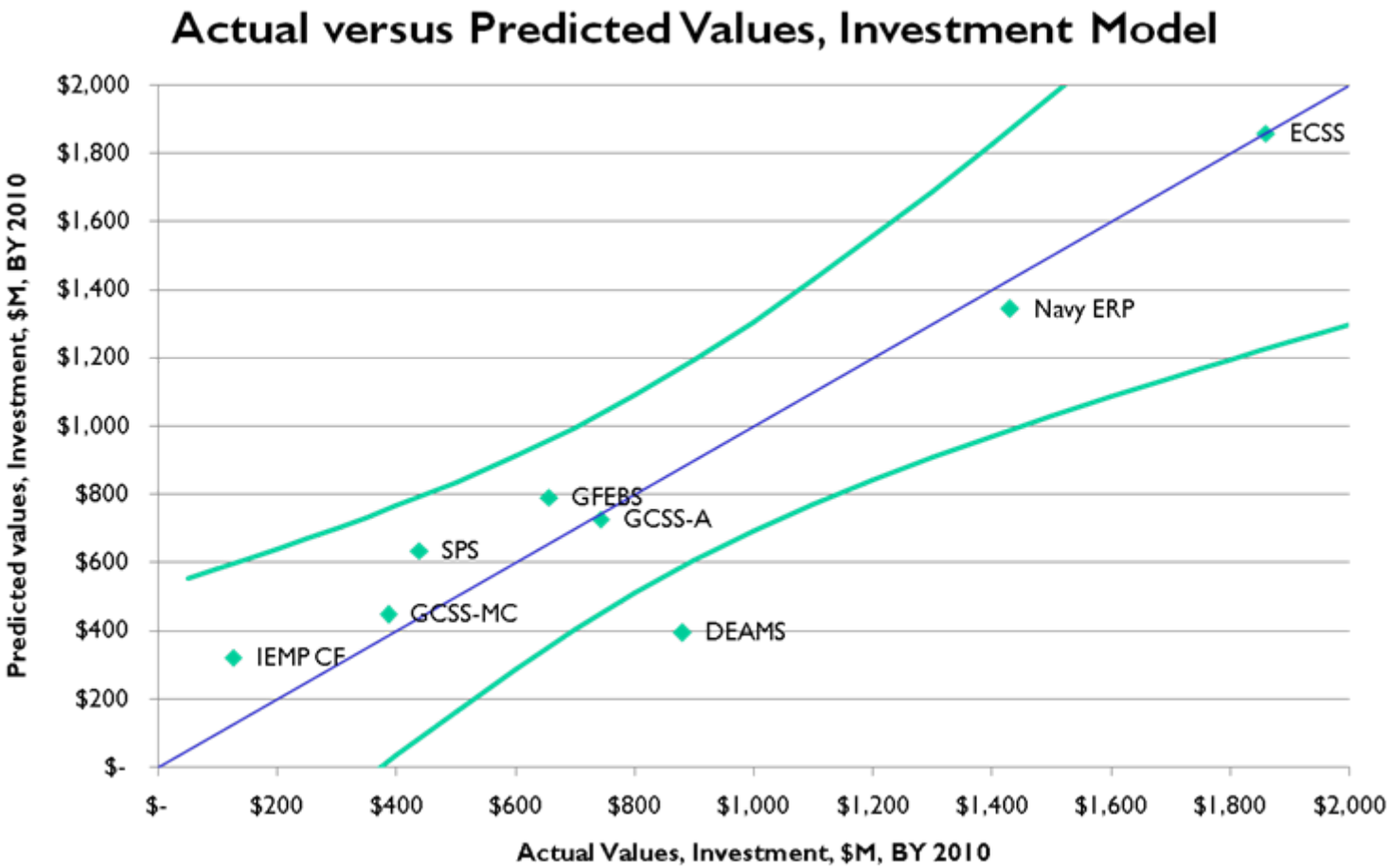
Results - Investment



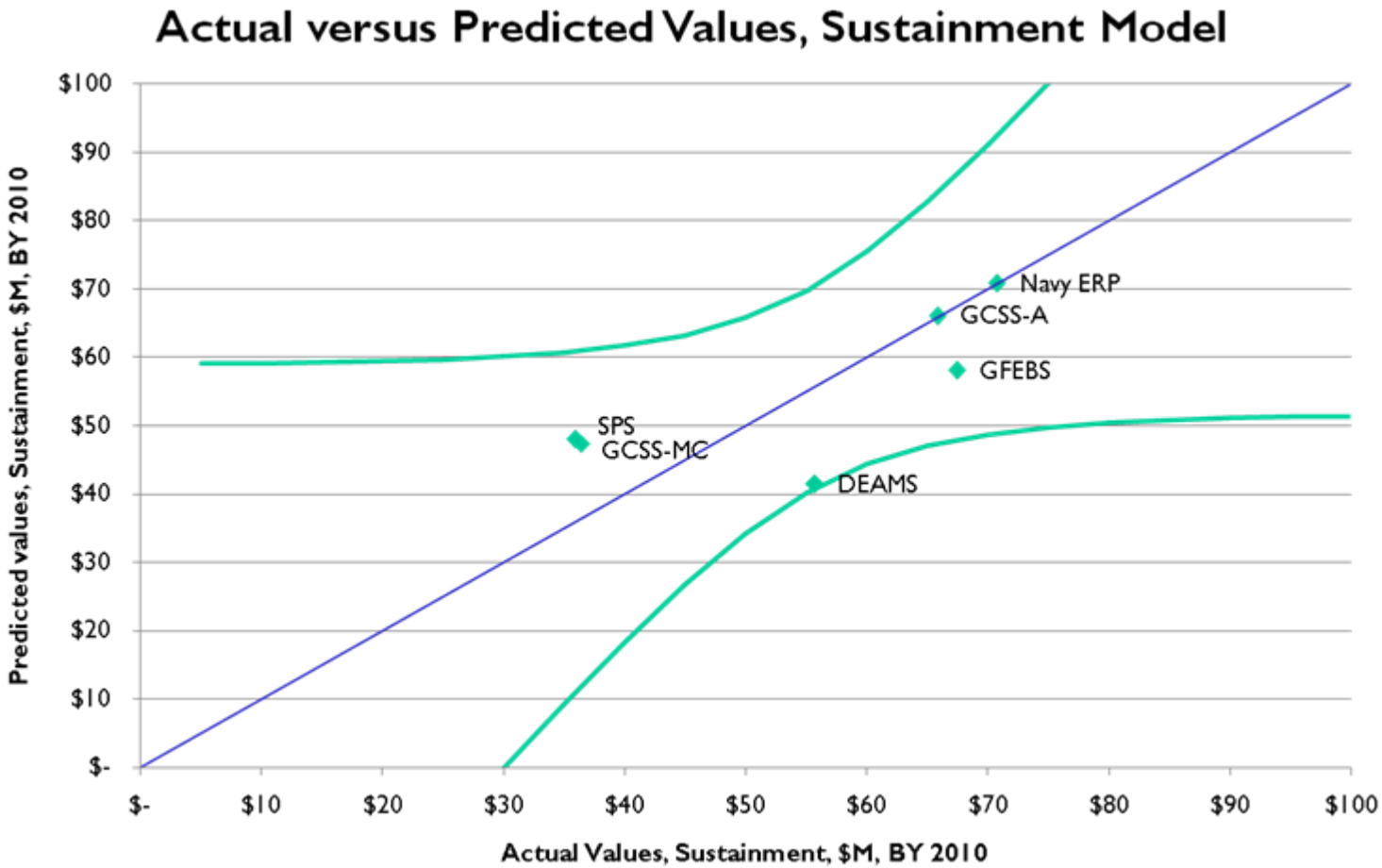
Results - Sustainment



Results - Investment



Results - Sustainment



Conclusions

- Advantages of ERP-specific CER's
  - Can be used early in the program life cycle because they don't require detailed technical specifications.
  - Require a minimal amount of effort to obtain a top level estimate.
  - Significance tests and CV statistics quantify a level of uncertainty of the estimate.

Next Steps

- Continue to update all models as programs progress and generate actual costs and updated estimates.
- Incorporate human resource ERP's and adjust CER's as necessary.
- Validate sizing metrics to ensure consistent application of definitions for users, interfaces, and legacy systems.
- Investigate non-linear forms.

Questions?

Backup Slides

Program Cost Data

- Example milestone data for Navy ERP:

	Total Cost		Baseline				Percentages Complete	
Description of Milestone	Planned Cost ($M)	Actual Cost ($M)	Planned Start Date	Actual Start Date	Planned Completion Date	Actual Completion Date	Planned Percent Complete	Actual Percent Complete
Release 1.0 provides development and deployment of Financial Management (Working Capital and General Fund), Work Force Management, Plant Supply and Acquisition functionality.	348.74	308.63	2004-07-26	2004-07-26	2013-03-31		89	89
Release 1.1 provides development and deployment of Wholesale and Retail Supply functionality.	168.06	135.87	2006-10-01	2006-10-01	2013-03-31		81	81
Core encompasses all of the Program Management support as the costs for Functional and Technical experts who are shared across all parts of the program.	501	279.68	2004-07-26	2004-07-26	2023-03-31		56	56
Sustainment provides help desk, operational and maintenance support, as well as software and hardware upgrades, currently to the initial sites, increasing in scope as Releases 1.1 is developed and deployed to more sites.	1,327.17	123.94	2004-10-01	2004-10-01	2023-03-31		9	9

Program Cost Data

- Example resource data for GCSS-MC:

Resources (Dollars in Thousands)	FY 2009	FY 2010	FY 2011	FY 2012
INITIATIVE TOTAL:	56,537	107,899	138,327	79,651
OPERATIONS				
O&M, MC				
0206312M 01-OPERATIONAL FORCES	0	1,800	0	0
0702808M 01-FIELD LOGISTICS	0	0	76,124	42,842
0702808M 01-OPERATIONAL FORCES	0	0	7,285	7,285
0708012M 01-FIELD LOGISTICS	16,341	46,283	0	0
O&M, MC RES				
0502514M 01-OPERATING FORCES	0	2	1	1
0509720M 01-OPERATING FORCES	133	0	0	0
OPERATIONS TOTAL:	16,474	48,085	83,410	50,128
PROCUREMENT				
PROCUREMENT, MC				
0206313M 04-COMBAT SUPPORT SYSTEM	0	4,570	27,158	11,267
0206313M 04-COMMON COMPUTER RESOURCES	0	0	0	0
PROCUREMENT TOTAL:	0	4,570	27,158	11,267
RDT&E				
RDT&E, NAVY				
0206313M 07-MAGTF CSSE & SE	40,063	55,244	27,759	18,256
RDT&E TOTAL:	40,063	55,244	27,759	18,256

Program Cost Data

- Accuracy of the uniform normalization assumption can be evaluated by comparing against front-loaded and back-loaded costs
- Navy ERP results are due to lengthy milestones
- To improve accuracy, Navy ERP was evaluated by combining resource data and milestone data.

Investment:						
Program	**Uniform**	**Front**	**Back**		**%Front**	**%Back**
DEAMS	$ 880.38	$ 910.49	$ 853.42		3.4%	-3.1%
ECSS	$ 1,860.25	$ 1,933.63	$ 1,812.88		3.9%	-2.5%
GCSS-A	$ 743.30	$ 768.10	$ 719.63		3.3%	-3.2%
GCSS-MC	$ 386.93	$ 390.45	$ 382.42		0.9%	-1.2%
GFEBS	$ 657.53	$ 697.33	$ 664.12		6.1%	1.0%
LMP	$ 998.70	$ 1,007.32	$ 990.10		0.9%	-0.9%
Navy ERP	$ 978.70	$ 1,112.41	$ 878.33		13.7%	-10.3%
SPS	$ 438.81	$ 448.62	$ 432.63		2.2%	-1.4%
BSM	$ 1,115.10	$ 1,148.22	$ 1,087.72		3.0%	-2.5%
Sustainment:						
Program	**Uniform**	**Front**	**Back**		**%Front**	**%Back**
DEAMS	$ 556.94	$ 605.43	$ 506.51		8.7%	-9.1%
ECSS	$ -					
GCSS-A	$ 197.48					
GCSS-MC	$ 363.91	$ 394.36	$ 333.18		8.4%	-8.4%
GFEBS	$ 826.55	$ 883.03	$ 721.41		6.8%	-12.7%
LMP	$ 532.49	$ 532.49	$ 532.49		0.0%	0.0%
Navy ERP	$ 1,242.39	$ 1,492.41	$ 1,026.15		20.1%	-17.4%
SPS	$ 143.61					
BSM	$ 207.20					

Program Cost Data

- Example resource data for Navy ERP:

Resources (Dollars in Thousands)	FY 2009	FY 2010	FY 2011	FY 2012
INITIATIVE TOTAL:	218,214	209,286	242,627	160,813
DWCF				
WCF, NAVY				
0605010DN 20-N/A	21,731	32,909	74,479	26,898
0708202DN 20-N/A	31,593	31,432	52,506	11,924
DWCF TOTAL:	53,324	64,341	126,985	38,822
OPERATIONS				
O&M, NAVY				
0702207N 01-AIRCRAFT DEPOT OPERATIONS SUPPORT	118,923	0	0	0
0708020N 01-ENTERPRISE INFORMATION	0	115,924	102,537	111,825
0708020N 04-SERVICEWIDE COMMUNICATIONS	0	7,880	8,096	8,135
OPERATIONS TOTAL:	118,923	123,804	110,633	119,960
PROCUREMENT				
OTHER PROC, NAVY				
0204161N 07-COMMAND SUPPORT EQUIPMENT	6,865	0	0	0
0708020N 07-COMMAND SUPPORT EQUIPMENT	0	4,058	5,009	2,031
PROCUREMENT TOTAL:	6,865	4,058	5,009	2,031
RDT&E				
RDT&E, NAVY				
0605013N 05-ERP CONVERGENCE	39,102	17,083	0	0
RDT&E TOTAL:	39,102	17,083	0	0

Program Cost Data

- Navy ERP data profile created using a combination of milestone and resource data:

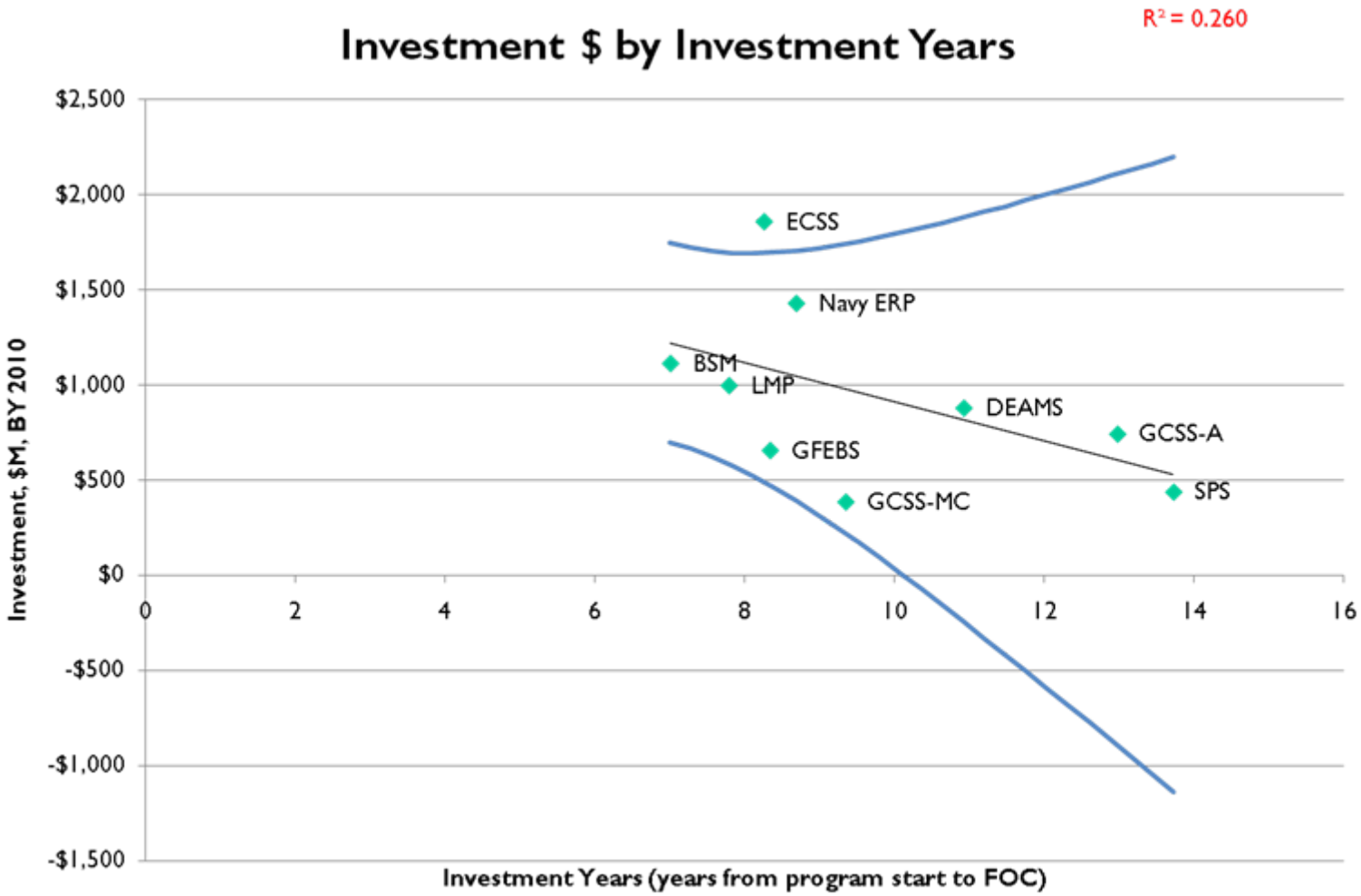
	TOTAL	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
BY08 Ex53	**494**			115	178	201							
BY06 Ex53	**239**	44	68	127									
BY05 Ex53	**100**	0	100										
IT1 2011	**831**						218	209	243	161			
IT1 2010	**587**					203	190	194					
IT1 2009	**793**				174	203	177	239					
IT1 2008	**671**			115	178	201	177						
IT1 2007	**553**		66	115	178	193							
it.usaspending.gov Ex53	**670**						218	209	243				
FY11 Milestone Budget (uniform normalization method)	**2,345**	12	139	139	164	165	164	164	164	165	131	99	99

- End result is a TY total equal to the milestone data ($M 2,345), but allocated by FY using resource data where possible.

Programs Excluded

- Programs analyzed, but excluded from the data set:
  - GCSS-AF. This is a system of systems, that provides a service oriented architecture. It was excluded due to being non-analogous in system architecture, number of users, and interfaces.
  - FAA LCS. A system integration contract was awarded May 2010. The program was excluded because reliable cost data are not yet available.
  - DIMHRS. This program was excluded because it was recently (Feb 2010) cancelled as a centrally managed program. It was excluded because reliable estimate at complete cost data are not available.
  - DCPDS. Life cycle cost estimates were not available for this program. Additionally, as a human resources system, the program is non-analogous.
  - DMHRSi. A human resources system for the DoD medical community. The program was excluded because it contains none of the 3 business mission areas of TASC. Additionally, focus on the medical community is a non analogous attribute. Also, the number of users, relative to the size and scope of the system is non-analogous.
- With additional data, dummy variables may be able to compensate for attributes such as SOA and HR business mission

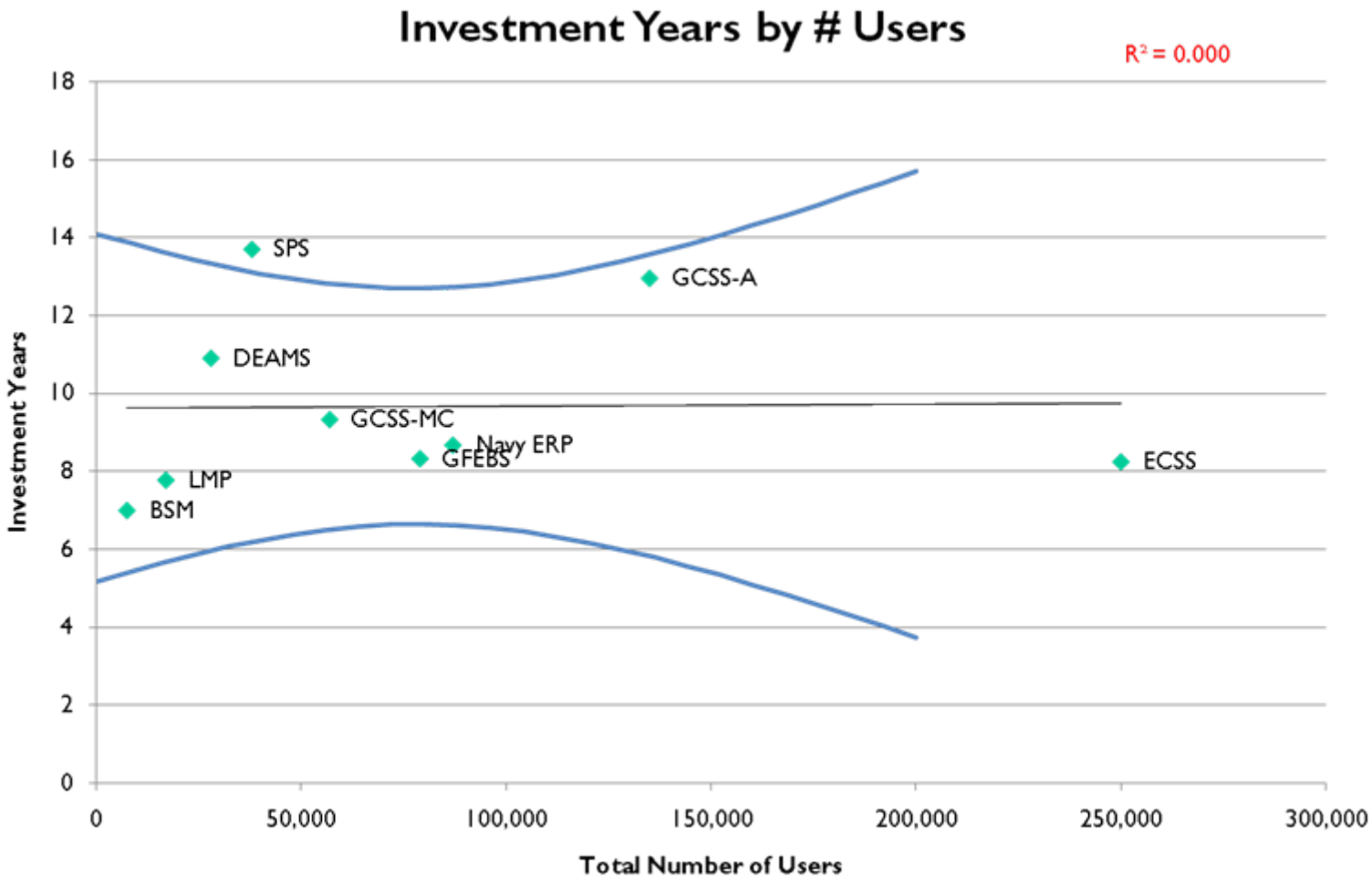
Scatter Plot Analysis



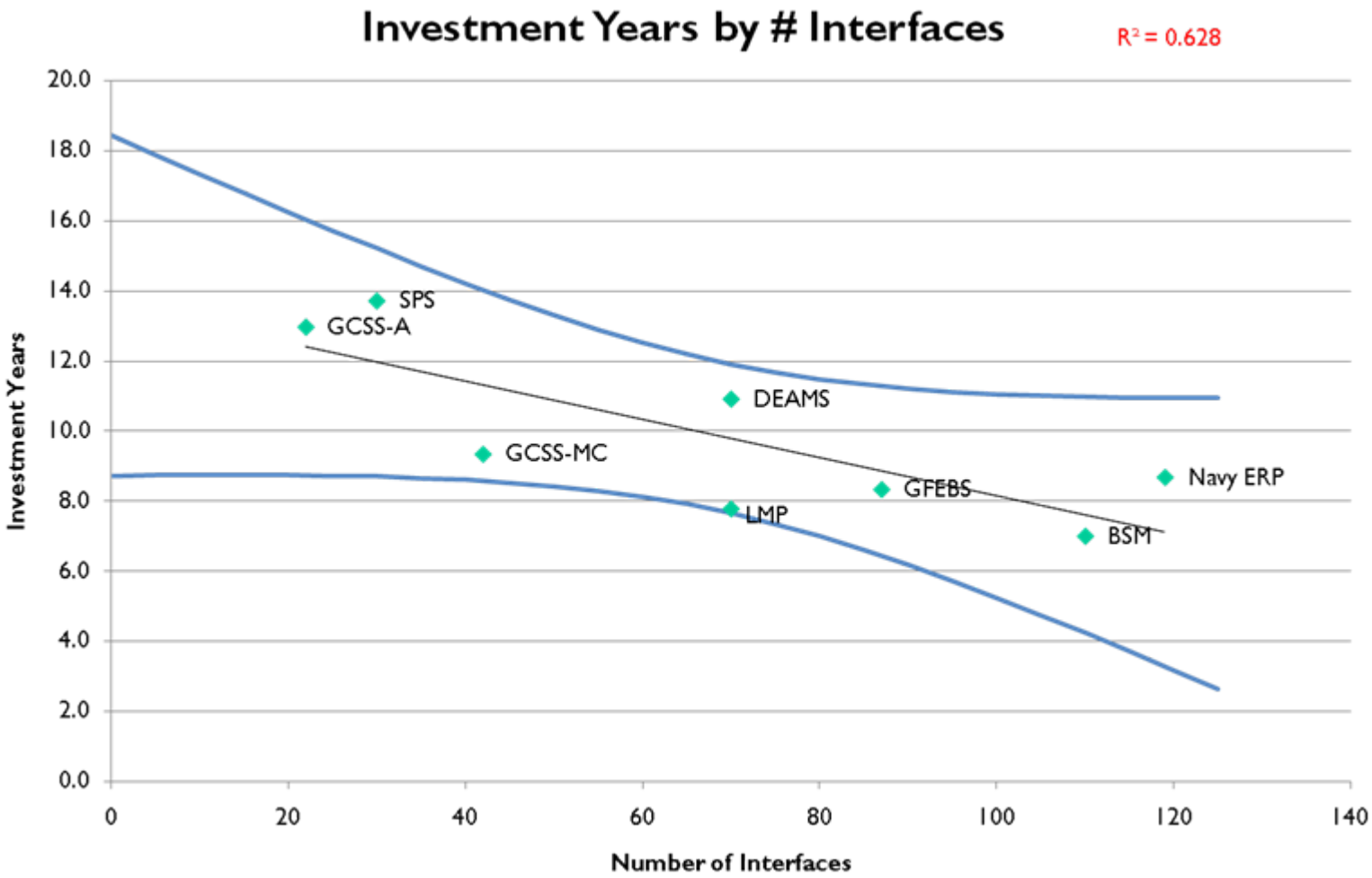
Scatter Plot Analysis

- Conclusions on Investment $ by Investment Years
  - The negative relationship between cost and time may be due to increased costs associated with compressed implementation schedules.

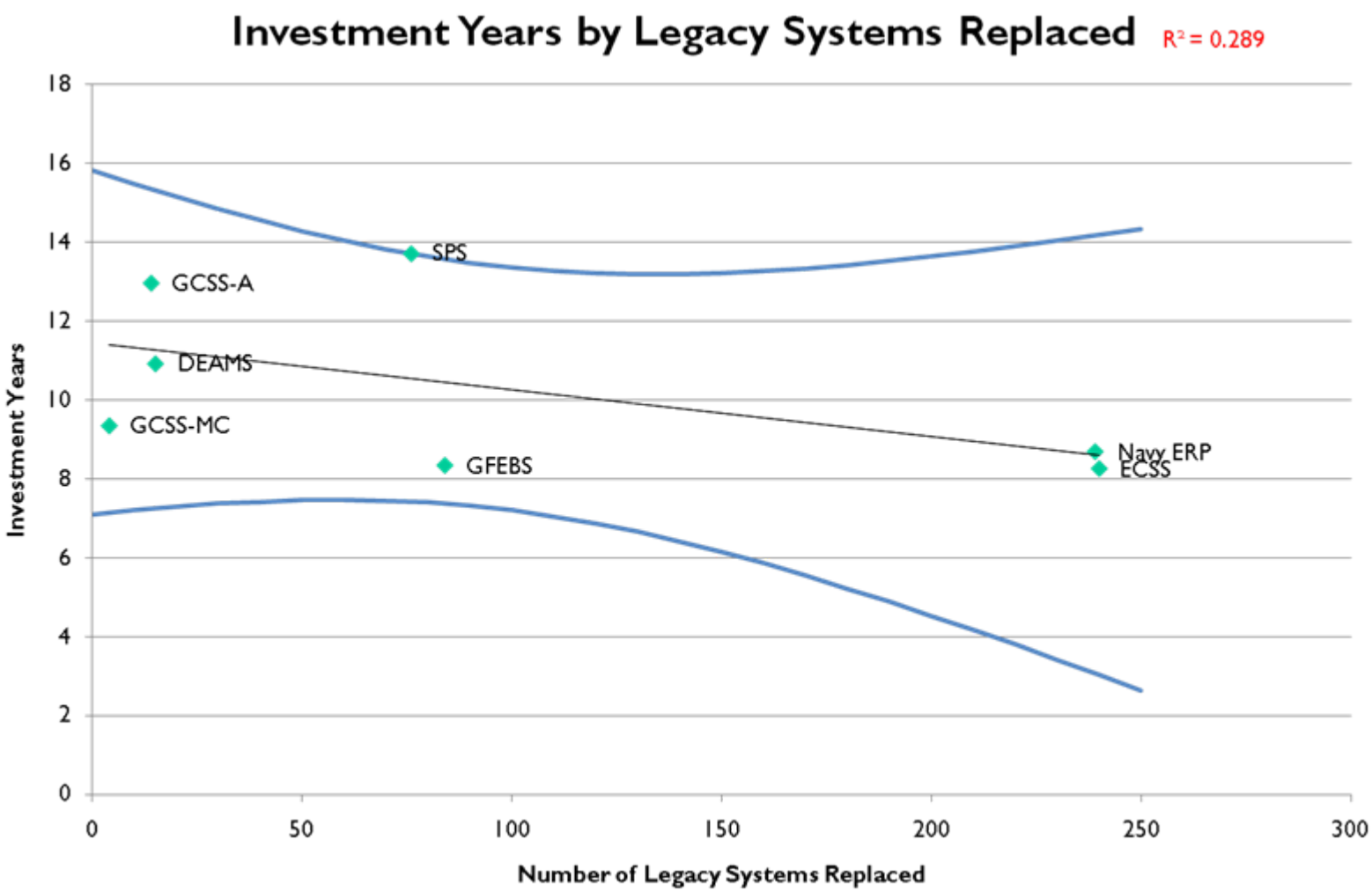
Scatter Plot Analysis



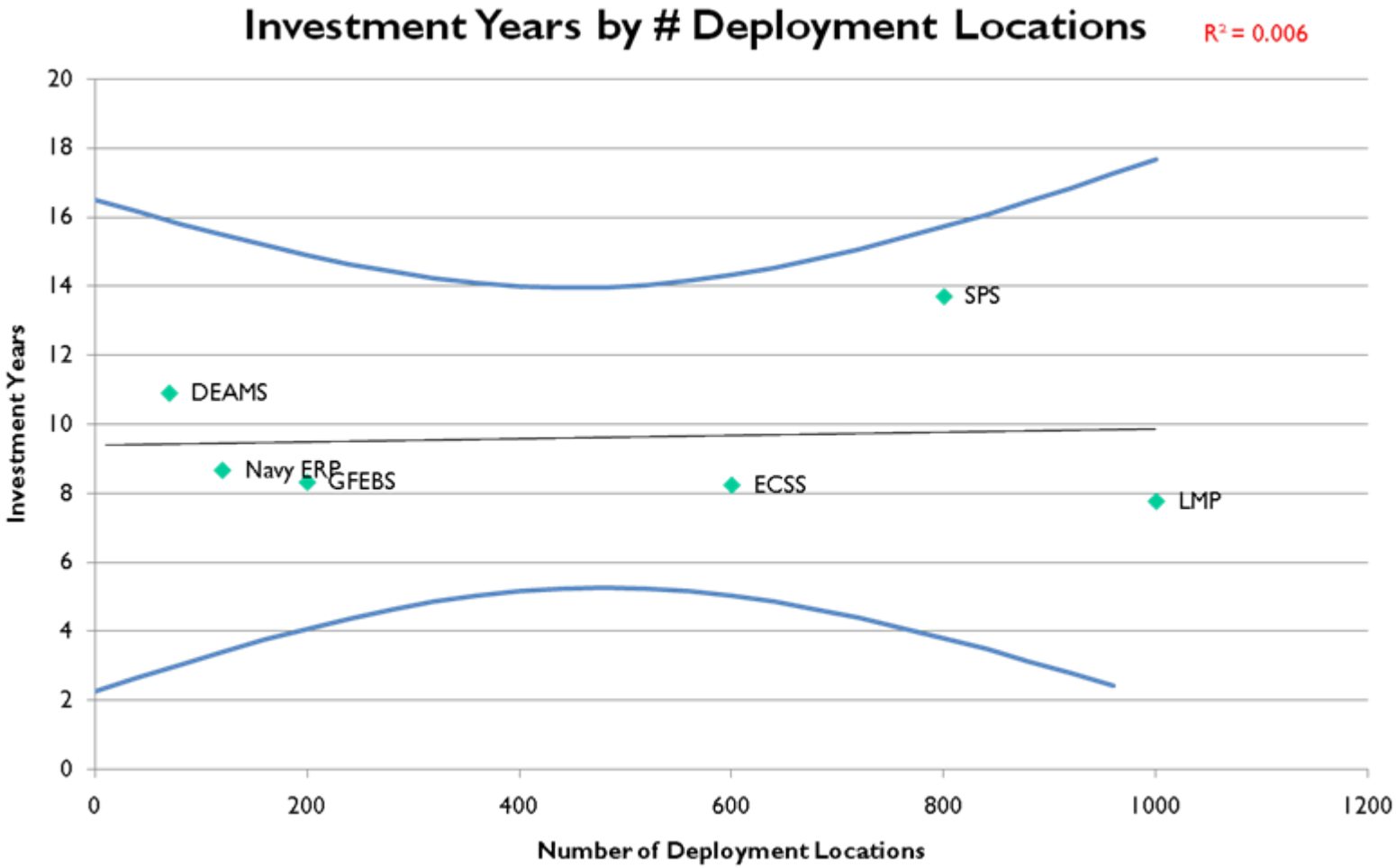
Scatter Plot Analysis



Scatter Plot Analysis



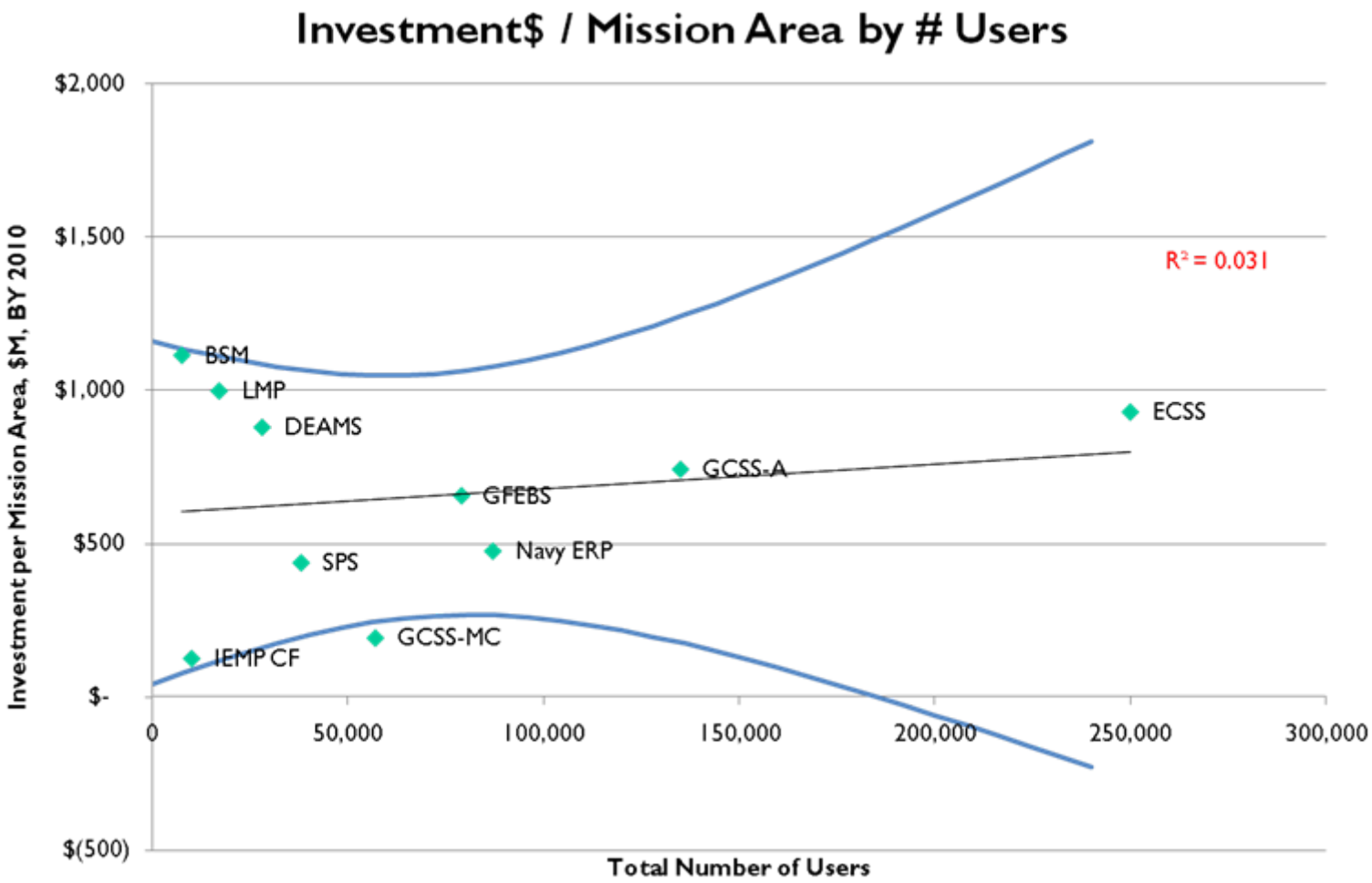
Scatter Plot Analysis



Scatter Plot Analysis

- Conclusions:
  - None of the data available appear to be good candidates for a schedule estimating relationship.
  - The strongest correlation is to # of legacy systems. However, the negative slope does not match a real-world, explainable relationship.

Scatter Plot Analysis



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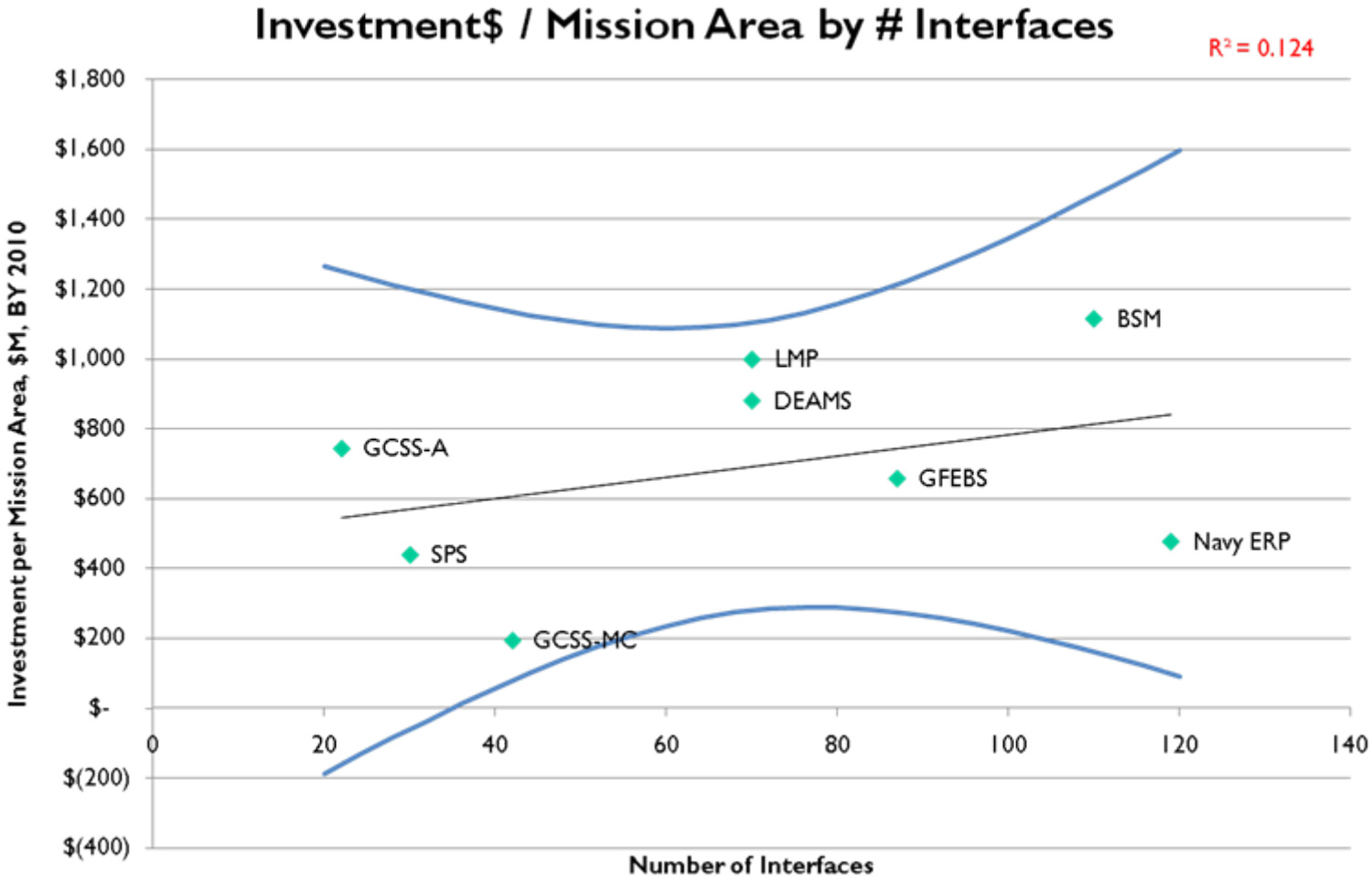

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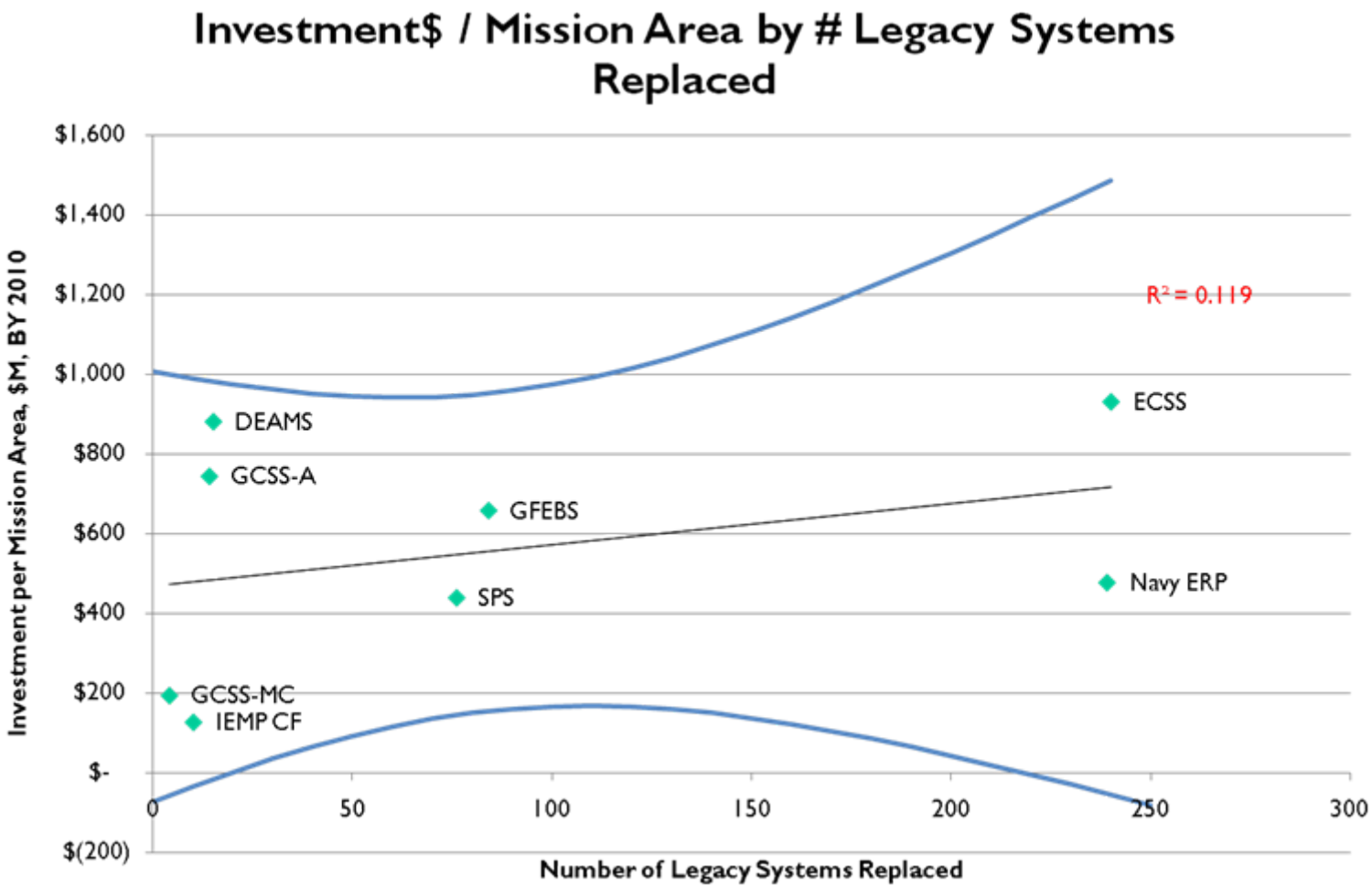
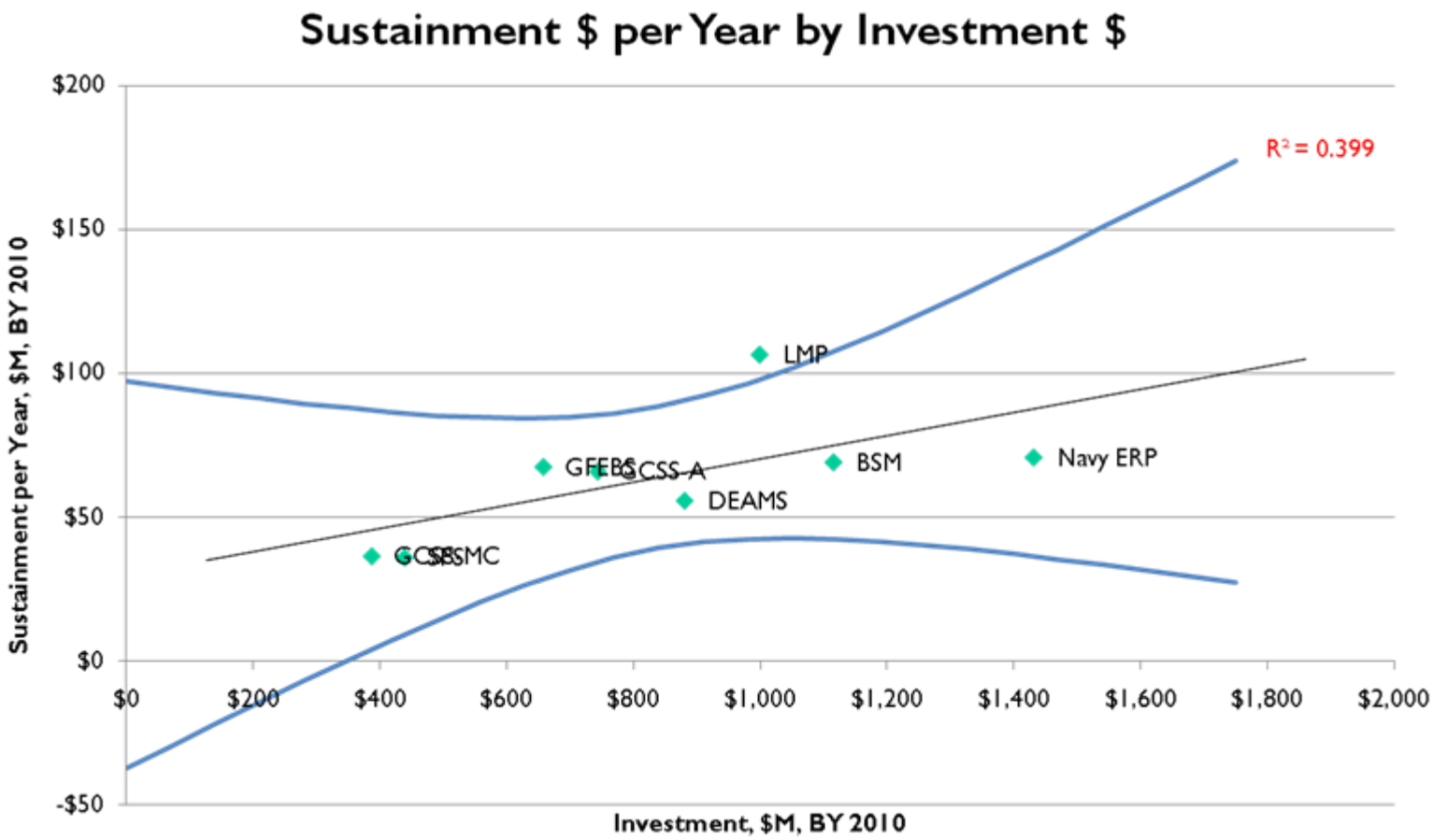


Scatter Plot Analysis



Scatter Plot Analysis

- Conclusions:
  - As a cost to cost relationship, sustainment appears to be correlated with investment.

Multivariate Regressions

Investment Models:

Program	$M,BY10 Investment	Total Users	Interfaces	Legacy Systems Replaced
DEAMS	$ 880.38	28,000	70	15
GCSS-A	$ 743.30	135,000	22	14
GCSS-MC	$ 386.93	56,965	42	4
GFEBS	$ 657.53	79,000	87	84
Navy ERP	$ 1,430.76	87,000	119	239
SPS	$ 438.81	38,000	30	76

	Legacy Systems Replaced	Interfaces	Total Users	INT
Coefs	1.224366326	5.801589279	0.002555	129.85
SE's	2.60939546	6.154096213	0.003725	419.2535
R^2, SE(y)	0.734557044	308.5797129		
F, DF	1.844858508	2		
SSR, SSE	527010.2469	190442.8784		
T stats	0.47	0.94	0.69	0.31
P values (t)	0.6851	0.4453	0.5637	0.7861
Adj R^2, MSE, CV	0.3364	95,221	40.8%	
P values (f)	0.3704			

Program	$M,BY10 Investment	Total Users	Interfaces
DEAMS	$ 880.38	28,000	70
GCSS-A	$ 743.30	135,000	22
GCSS-MC	$ 386.93	56,965	42
GFEBS	$ 657.53	79,000	87
LMP	$ 998.70	17,000	70
Navy ERP	$ 1,430.76	87,000	119
SPS	$ 438.81	38,000	30
BSM	$ 1,115.10	7,500	110

	Interfaces	Total Users	INT
Coefs	8.335943676	0.001469536	175.9638
SE's	2.64172917	0.002218446	262.3696
R^2, SE(y)	0.667383596	239.1553973	
F, DF	5.016165677	5	
SSR, SSE	573802.2423	285976.5203	
T stats	3.16	0.66	0.67
P values (t)	0.0252	0.5370	0.5322
Adj R^2, MSE, CV	0.5343	57,195	28.8%
P values (f)	0.0638		

Multivariate Regressions

Program	$M,BY10 Investment		Total Users	Interfaces	Business Functions			Business Functions	Interfaces	Total Users	INT
DEAMS	$ 880.38		28,000	70	1		Coefs	18.15417301	8.13835385	0.001331	172.3382
GCSS-A	$ 743.30		135,000	22	1		SE's	165.7675168	3.457241447	0.00278	294.7643
GCSS-MC	$ 386.93		56,965	42	2		R^2, SE(y)	0.668377942	266.983896		
GFEBS	$ 657.53		79,000	87	1		F, DF	2.687307937	4		
LMP	$ 998.70		17,000	70	1		SSR, SSE	574657.1598	285121.6028		
Navy ERP	$ 1,430.76		87,000	119	3		T stats	0.11	2.35	0.48	0.58
SPS	$ 438.81		38,000	30	1		P values (t)	0.9181	0.0782	0.6570	0.5902
BSM	$ 1,115.10		7,500	110	1		Adj R^2, MSE, CV	0.3368	71,280	31.6%	
							P values (f)	0.1821			

Program	$M,BY10 Investment		Total Users	Legacy Systems Replaced			Legacy Systems Replaced	Total Users	INT
DEAMS	$ 880.38		28,000	15		Coefs	3.411750931	0.003132853	256.8851
ECSS	$ 1,860.25		250,000	240		SE's	1.287865879	0.001669357	144.3165
GCSS-A	$ 743.30		135,000	14		R^2, SE(y)	0.852036653	261.1410216	
GCSS-MC	$ 386.93		56,965	4		F, DF	14.39607632	5	
GFEBS	$ 657.53		79,000	84		SSR, SSE	1963470.287	340973.1658	
Navy ERP	$ 1,430.76		87,000	239		T stats	2.65	1.88	1.78
SPS	$ 438.81		38,000	76		P values (t)	0.0455	0.1194	0.1352
IEMP CF	$ 126.7		10,000	10		Adj R^2, MSE, CV	0.7929	68,195	32.0%
						P values (f)	0.0084		

Multivariate Regressions

Program	$M,BY10 Investment	Interfaces	Legacy Systems Replaced
DEAMS	$ 880.38	70	15
GCSS-A	$ 743.30	22	14
GCSS-MC	$ 386.93	42	4
GFEBS	$ 657.53	87	84
Navy ERP	$ 1,430.76	119	239
SPS	$ 438.81	30	76

	Legacy Systems Replaced	Interfaces	INT
Coefs	1.753682629	4.652239383	343.1331
SE's	2.261933073	5.37344047	255.1523
R^2, SE(y)	0.672130459	280.0184676	
F, DF	3.074990399	3	
SSR, SSE	482222.0987	235231.0265	
T stats	0.78	0.87	1.34
P values (t)	0.4947	0.4503	0.2713
Adj R^2, MSE, CV	0.3443	78,410	36.5%
P values (f)	0.1877		

Program	$M,BY10 Investment	Total Users	Interfaces	Locations
DEAMS	$ 880.38	28,000	70	70
ECSS	$ 1,860.25	250,000	0	600
GFEBS	$ 657.53	79,000	87	200
LMP	$ 998.70	17,000	70	1000
Navy ERP	$ 1,430.76	87,000	119	120
SPS	$ 438.81	38,000	30	800

	Locations	Interfaces	Total Users	INT
Coefs	0.322832905	6.48642057	0.006536	-55.795
SE's	0.64284607	7.054389097	0.002899	868.7105
R^2, SE(y)	0.740689459	419.9613148		
F, DF	1.904253377	2		
SSR, SSE	1007545.256	352735.0118		
T stats	0.50	0.92	2.25	-0.06
P values (t)	0.6654	0.4549	0.1529	0.9546
Adj R^2, MSE, CV	0.3517	176,368	40.2%	
P values (f)	0.3443			

Multivariate Regressions

O&S Models:

	$M, BY10 Sustainment per year			Total Users	Locations			Locations	Total Users	INT
DEAMS	$ 55.7			28,000	70		Coefs	0.020419989	3.87566E-05	56.37528
GFEBS	$ 67.4			79,000	200		SE's	0.051436633	0.000706143	54.4837
LMP	$ 106.5			17,000	1000		R^2, SE(y)	0.097995226	34.69344604	
Navy ERP	$ 70.7			87,000	120		F, DF	0.108641582	2	
SPS	$ 35.9			38,000	800		SSR, SSE	261.5296637	2407.270396	
							T stats	0.40	0.05	1.03
							P values (t)	0.7297	0.9612	0.4095
							Adj R^2, MSE, CV	-0.8040	1,204	51.6%
							P values (f)	0.9020		

	$M, BY10 Sustainment per year		Interfaces	Total Users			Total Users	Interfaces	INT
DEAMS	$ 55.7		70	28,000		Coefs	6.52566E-06	0.269294766	44.5615
GCSS-A	$ 65.8		22	135,000		SE's	0.000222266	0.264675078	26.28683
GCSS-MC	$ 36.4		42	56,965		R^2, SE(y)	0.18223758	23.96100031	
GFEBS	$ 67.4		87	79,000		F, DF	0.557122631	5	
LMP	$ 106.5		70	17,000		SSR, SSE	639.7211153	2870.647678	
Navy ERP	$ 70.7		119	87,000		T stats	0.03	1.02	1.70
SPS	$ 35.9		30	38,000		P values (t)	0.9777	0.3556	0.1508
BSM	$ 69.1		110	7,500		Adj R^2, MSE, CV	-0.1449	574	37.8%
						P values (f)	0.6047		

Multivariate Regressions

	$M, BY10 Sustainment per year		Total Users	Legacy Systems Replaced				Legacy Systems Replaced	Total Users	INT
DEAMS	$ 55.7		28,000	15			Coefs	0.070212534	0.000230808	33.96329
GCSS-A	$ 65.8		135,000	14			SE's	0.069471925	0.00015847	12.8949
GCSS-MC	$ 36.4		56,965	4			R^2, SE(y)	0.545931881	13.64329393	
GFEBS	$ 67.4		79,000	84			F, DF	1.803469096	3	
Navy ERP	$ 70.7		87,000	239			SSR, SSE	671.3935609	558.418408	
SPS	$ 35.9		38,000	76			T stats	1.01	1.46	2.63
							P values (t)	0.3866	0.2413	0.0781
							Adj R^2, MSE, CV	0.2432	186	24.7%
							P values (f)	0.3060		

	$M, BY10 Sustainment per year		Interfaces	Legacy Systems Replaced				Legacy Systems Replaced	Interfaces	INT
DEAMS	$ 55.7		70	15			Coefs	0.001609429	0.250312211	39.77591
GCSS-A	$ 65.8		22	14			SE's	0.130511982	0.310043818	14.72211
GCSS-MC	$ 36.4		42	4			R^2, SE(y)	0.363208648	16.1568729	
GFEBS	$ 67.4		87	84			F, DF	0.855559629	3	
Navy ERP	$ 70.7		119	239			SSR, SSE	446.678343	783.1336259	
SPS	$ 35.9		30	76			T stats	0.01	0.81	2.70
							P values (t)	0.9909	0.4785	0.0737
							Adj R^2, MSE, CV	-0.0613	261	29.2%
							P values (f)	0.5082		

Multivariate Regressions

	$M, BY10 Sustainment per year			Legacy Systems Replaced	Locations			Locations	Legacy Systems Replaced	INT
DEAMS	$ 55.7			15	70		Coefs	-0.03687782	0.064677395	61.714
GFEBS	$ 67.4			84	200		SE's	0.015783661	0.056102012	9.251328
Navy ERP	$ 70.7			239	120		R^2, SE(y)	0.887331027	9.150438601	
SPS	$ 35.9			76	800		F, DF	3.93777896	1	
							SSR, SSE	659.4246118	83.73052659	
							T stats	-2.34	1.15	6.67
							P values (t)	0.2575	0.4549	0.0947
							Adj R^2, MSE, CV	0.6620	84	15.9%
							P values (f)	0.3357		

	$M, BY10 Sustainment per year			Interfaces	Locations			Locations	Legacy Systems Replaced	INT
DEAMS	$ 55.7			70	70		Coefs	0.055492878	0.799038809	-17.1443
GFEBS	$ 67.4			87	200		SE's	0.02877391	0.384028228	38.94548
LMP	$ 106.5			70	1000		R^2, SE(y)	0.714541873	19.51705238	
Navy ERP	$ 70.7			119	120		F, DF	2.503140757	2	
SPS	$ 35.9			30	800		SSR, SSE	1906.969393	761.8306669	
							T stats	1.93	2.08	-0.44
							P values (t)	0.1936	0.1730	0.7028
							Adj R^2, MSE, CV	0.4291	381	29.0%
							P values (f)	0.2855		

Multivariate Regressions

	$M, BY10 Sustainment per year		Interfaces	Legacy Systems Replaced	Total Users			Total Users	Legacy Systems Replaced	Interface	INT
DEAMS	$ 55.7		70	15	28,000		Coefs	0.000293859	-0.0592761	0.382518	15.24266
GFEBS	$ 67.4		87	84	79,000		SE's	0.000117823	0.082536258	0.194657	13.26116
GCSS-A	$ 65.8		22	14	135,000		R^2, SE(y)	0.845069912	9.76050401		
GCSS-MC	$ 36.4		42	4	56,965		F, DF	3.636349445	2		
Navy ERP	$ 70.7		119	239	87,000		SSR, SSE	1039.277092	190.5348771		
SPS	$ 35.9		30	76	38,000		T stats	2.49	-0.72	1.97	1.15
							P values (t)	0.1301	0.5472	0.1883	0.3693
							Adj R^2, MSE, CV	0.5352	95	17.4%	
							P values (f)	0.2157			

	$M, BY10 Sustainment per year			Legacy Systems Replaced			Legacy Systems Replaced	INT		
DEAMS	$ 55.7			15		Coefs	0.077495867	49.98049257		
GFEBS	$ 67.4			84		SE's	0.076727852	8.298085555		
GCSS-A	$ 65.8			-		R^2, SE(y)	0.203206201	15.65172954		
GCSS-MC	$ 36.4			-		F, DF	1.020119392	4		
Navy ERP	$ 70.7			239		SSR, SSE	249.9054187	979.9065503		
SPS	$ 35.9			76		T stats	1.01	6.02		
						P values (t)	0.3696	0.0038		
						Adj R^2, MSE, CV	0.0040	245	28.3%	
						P values (f)	0.4385			