Lessons Discovered But Seldom Learned

OR

Why am I doing this if no one listens?

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Outline of Session

- **Session I**
  - **What Are Lessons Discovered**
  - **Are We Using Lessons Discovered**
  - **Why Are We Not Using Lessons Discovered**
- **Session II**
  - **The Story of the Vasa**
  - **Example Failures To Consider**
- **Session III**
  - **Key Actions Required for Success**

What Are Lessons Discovered

There have been hundreds – thousands – hundreds of thousands - millions of Lessons Discovered over the past 100 years.

Lessons Discovered on “Risks” of Human Errors, Program Management, Design, Technology, External Forces, etc.

Risk identification checklists have been accomplished on all types of government programs, operations and activities; commercial programs, individual programs and just about everything else. These have ranged from the inane to the extremely detailed – from a sentence to the Willoughby templates.

Are We Using Lessons Discovered??

BUT – Does anyone ever read these or learn from them?

HOW many programs have benefited from these Lessons Discovered at such great costs?

DO you know of any – or many????

AND how many programs do you know that did NOT benefit from Lessons Discovered on similar programs?

AND why did they not benefit ????

So Why Are We Not Learning From Lessons Discovered???

Are the lessons not detailed sufficiently to be useful?

Are we not researching to see if there are useful ones?

Are people not developing Lessons Discovered because they are embarrassed?

Are we not training our engineers to want to examine the past to see if there are useful facts/lessons available?

Are we not rewarding our managers for successful programs and punishing them for failures?

Why We Are Not Using Lessons Discovered

When you identify a Lesson Discovered, you are calling into question the wisdom of earlier decisions made by yourself, others or your management. Most managers and organizations do not take kindly to "criticism". How many people will admit to the details of a wrong decision?

Even if an organization gets the development of Lessons Discovered mandated for their programs, excuses and creative explanations will emerge if a Lesson Discovered threatens some cherished program or mode of operation.

And to consider that one might make the same "bad decisions" in the future is simply out of the question.

Why We Are Not Using Lessons Discovered

Another major stumbling block to actual use of Lessons Discovered is that managers and developers are very seldom (if ever) held responsible for unsuccessful programs.

Not responsible for simply failing – failure happens and provides people with experience. Managers should be held responsible for failures that occur from the same or similar root cause(s) every time.

This indicates that management and/or developers and/or operators are refusing to learn from past mistakes – their "Lessons Not Discovered". Change of one's opinion or method of operation is difficult – why do it if nothing bad happens to me when I fail?

Why We Are Not Using Lessons Discovered

And there are other problems as well. "Lessons Discovered" often become twisted to support - or at least not impact - pet projects.

Who really wants a totally dispassionate look at Lessons Discovered. No one wants the chips to fall where they may. Too much collateral damage that way.

Yet, in the end, the true meaning of each Lesson Discovered will be there on the next program or operation or activity, whether you have come up with the best implementation of the lesson or not. ***But does anyone care?***

Cost Growth Studies

- 1993 RAND Report:
  - "An Analysis of Weapon System Cost Growth"
  - SAR data from 1960s to 1990
  - 20% average annual cost growth
- 1999 Christensen:
  - "The Impact of the Packard Commission's Recommendations on Reducing Cost Overruns on Defense Acquisition Contracts"
  - DAES data from 1988 to 1995
  - 20% average annual contract cost growth
- 2003 Holbrook Thesis:
  - "An Analysis of the Implementation of Acquisition Reform Initiatives and Cost Variance"
  - DAES data from 1994 to 2001
  - No significant difference between pre-reform and post-reform periods

Phase I – Aircraft Results

Annual Adjusted Cost Growth Factors

Program	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
B1-B (Lancer)	1.00	1.03									
C130-J (Hercules)							1.31	1.29	1.38	1.38	1.05
C-17 (Globemaster III)	1.43	1.61	2.52	2.47	2.26	2.23	2.26	2.21	2.22	2.22	1.96
KC-135R (Stratotanker)	0.81	0.82	0.82	0.82							
AV-8B (Harrier)	0.91	0.92									
AV-8B (Harrier Remanufacture)					1.08	1.03	1.00	1.03	1.04	1.03	1.03
F-14D (Tomcat)	1.27	1.27	1.26								
F-16 (Fighting Falcon)	1.98	1.95	1.98	2.02							
F-22 (Raptor)		0.99	1.00	1.00	1.04	1.03	1.06	1.07	1.08	1.08	1.22
FA-18 E/F (Super Hornet)			1.00	1.01	1.02	0.97	0.95	0.48	0.48	0.73	0.77
FA-18 (Hornet)	1.52	1.56	1.57	1.56							
T-6A (JPATS)						0.99	0.97	0.97	0.97	0.97	0.79
T-45-TS (Goshawk)	1.57	1.59	1.73	2.26	2.25	2.25	2.16	2.05	2.33	2.33	2.29
Average Annual ACGF	**1.31**	**1.30**	**1.48**	**1.59**	**1.53**	**1.42**	**1.39**	**1.30**	**1.36**	**1.39**	**1.30**

Overall Aircraft Weapon Systems Average = 1.40

Phase I – Missile Results

Annual Adjusted Cost Growth Factors

Program	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
AGM-65D (Maverick)	1.85	1.86									
AGM-84A (Harpoon)	1.62										
AGM-88 (HARM USN)	1.46	1.46	1.45								
AGM-114 (Hellfire)	1.57	1.59	1.56								
AGM-114K (Hellfire Longbow)	1.01	1.44	1.35	1.06	1.14	1.16	1.17	1.16	1.17	1.17	1.21
AIM-9X (Sidewinder)						1.00	1.00	1.00	1.00	1.00	1.00
AIM-54C (Phoenix)	0.37										
AIM-120 (AMRAAM)	1.55	1.84	1.77	1.80	1.80	1.77	1.70	1.70	1.70	1.70	1.70
ATACMS P3I (BAT)	1.00	1.13	1.18	1.28	1.27	1.28	1.37	1.58	1.95	2.12	2.25
BLU-108 JSOW AIWS		1.00	1.03	0.99	1.09	1.08	1.08	1.06	1.07	1.07	1.27
BLU-108 JSOW Unitary					0.97	1.09	1.10	1.33	1.20	1.20	1.60
CBU-97B SFW	1.09	1.08	1.02	1.05	1.16	1.23	1.24	1.19			
FGM-148A Javeline AAWS	1.14	1.40	1.78	1.62	1.65	1.72	1.79	1.98	2.05	2.15	2.11
JDAM					1.00	0.99	1.02	1.09	1.11	1.11	1.17
MIM-104 Patriot	1.08	1.08									
MIM-104 Patriot PAC3				1.00	1.04	1.26	1.30	1.63	1.58	1.27	1.43
Navy Area TBMD							1.00	1.11	1.14	1.14	1.48
RGM-109 Tomahawk MMM	0.76	0.83	0.83	0.78	0.78	0.78					
RIM-66M/67D (SM-2 MR/ER)	0.98	1.04	1.05	1.04	1.08	1.05	1.07	1.08	1.09	1.09	1.13
SADARM 155mm Projectile	1.02	1.04	1.15	1.35	1.46	1.47	1.62	1.71			
SADARM 155mm Rocket	0.74	0.92	0.73								
Annual Average	**1.15**	**1.26**	**1.24**	**1.20**	**1.20**	**1.22**	**1.26**	**1.35**	**1.37**	**1.36**	**1.49**

Overall Missile Systems Average = 1.28

EXAMPLES OF ACQUISITION FAILURE IN TRADITIONALLY MANAGED PROGRAMS

Weapons Systems

Aquila UAV
A-12 Avenger
AH-56A Cheyenne
RAH-66 Comanche
Condor AGM
Crusader SPH
Dart SSM
Field Army BMDS
Main Battle Tank (MBT-70)
Rigel SSM
M247 Sgt York DIVAD
Tri-Service Stand-Off Atk Msl

Symptoms

Test Failures
Cost Overruns
Schedule Delays

Causes

Development, Integration, Production of Advanced Technologies
Requirements Creep
Funding Instability
Duplication of Effort

Satellite Failures

Space Systems
Hubble Telescope - $250M (to fix)
Infrared Telescope - $246M (loss)
Deep Probe 2 - $29M (loss)
Mars Express and Beagle 2 - $246M (loss)
Astra 1K Satellite $280M (loss)
Galaxy 4 and 7 Satellites $307M (loss)
Solidaridad Satellite $250M (loss)
Telstar 401 Satellite $132.5M (loss)
Midori II Satellite - $759M (loss)
Gamma Ray Observatory $670M (loss)
EarthWatch Quick Bird 1 $60M (loss)

Symptoms
Optics ground incorrectly
Electronics stop functioning
Anomaly occurred
Circuit failures
Faulty connections

Causes
Quality process not followed
Manufacturing process not followed
Faulty design
Production process not followed

CGRO

Launch Systems Failures

Launch Systems
Ariane 5 Rocket – Initial Launch
Pegasus Booster - NASA X-43A
VLS Rocket - Brazil
Titan 4A Rocket
Titan 4B Rocket
Athena Rocket
Delta 3 Rocket
Trident

Symptoms
Explosions
Loss of launch vehicle and payload
Costs - $50B+

Causes
Software
Design flaw
Electronics fault
Rocket engine and motor problems
Manufacturing flaw

Structural Failures

800 cases of structural failure in which 504 people were killed, 592 people injured, and millions of dollars of damage incurred. When engineers were at fault, the researchers classified the causes of failure as follows:

- Insufficient knowledge - 36%
- Underestimation of influence - 16%
- Ignorance, carelessness, negligence - 14%
- Forgetfulness, error - 13%
- Relying upon others without sufficient control - 9%
- Objectively unknown situation - 7%
- Imprecise definition of responsibilities - 1%
- Choice of bad quality - 1%
- Other - 3%

Program Failures

California's Department of Motor Vehicles decided to merge its driver and vehicle registration systems in 1987. At the time, it was estimated that this seemingly straightforward project would be completed by 1993. Instead, the completion date moved to 1998 and the projected cost exploded to 6.5 times the original estimate. In December 1993, seven years **and more than $49 million dollars after its initiation, the project was abandoned**. As a result, the DMV had to use a system written in 1965 in assembler to process the registrations!

Program Failures

The Denver Airport program allocated about $193 million to create a state-of-the-art baggage-handling system. This computerized system was designed to move up to 1700 bags per minute using 4000 telecars running over 20 miles of track and 6 miles of conveyor belt.

This complex project suffered costly delays with enormous financial costs due to software problems. It took the developers of the system more than sixteen months and a $45 million extra effort to fix the bugs in the software to make it operational.

The unavailability of the system delayed the opening of the facility costing the airport's planners more than $700 million in operation costs, a demotion of their bond rating to junk, and a lengthy investigation by the Securities and Exchange Commission.

Program Failures

In the late 1980’s, the London Ambulance Service, which is the largest ambulance service in the world, initiated its first computerization project that would allow dispatchers to transmit information to the vehicles.

After spending $11.25 million for its development, the service abandoned the project because it was not able to handle its daily load. Within a year, another project was initiated to introduce a more sophisticated, computer aided dispatch system.

The system went live on October 26, 1992 and was shut down the next day because of massive “exception reports” and “lost emergency calls”. After attempting to operate the system in a semi-manual mode for a few weeks, the system was totally abandoned.

Program Failures

In 1988, a consortium comprised of Hilton Hotels, Marriott, and Budget Rent-A-Car Corporations subcontracted to AMRIS (a subsidiary of American Airlines) for the development of a leading edge travel industry reservation system (CONFIRMS).

Originally, the system was expected to cost $55.7 million. During the life of the projects, various delays and cost re-estimates were announced.

Three-and-half years after the project had begun and **a total of $142 million had been spent, the project was cancelled.** This led to multimillion dollar legal battles between the partners (which led to an out-of-court settlement in 1994) and the firing of many top executives by AMRIS.

Program Failures

- Based on a survey of 6,700 projects, Jones (1996) estimates that over 23% of all projects are likely to be cancelled (for large projects, the likelihood of cancellation can be as high as 65%). Of the large systems that are completed, about 2/3 experience schedule delays and cost overruns (which may be as high as 100% of the original estimates).
- According to a survey of 150 corporate IS managers by the Center for Project Management, half of all projects become runaways (LaPlante, 1995).

Program Failures

- According to a survey of 365 firms (representing 8,380 projects) by The Standish Group International, 31.1% of all ISD projects are cancelled before completion; 52.7% of them cost more than 180% of their original estimate; the average project schedule overrun is 222%; and only 16.2% of ISD projects are completed on-time and on-budget (for large companies, this estimate is a low 9%) (SGI, 1995).
- According to Gibbs (1994), for every 6 new large-scale systems that are put into operation, 2 others are cancelled.
- According to a survey of 300 large companies by KPMG Peat Marwick, 65% of organizations have gone “grossly” over budget on at least one project.

Forces That Impact Software Programs

- **Poor prioritization of projects**
- **Poor management of people to projects**
- **Poor management of requirements and scope**
- **Poor visibility into and across the process**
- **Poor process automation governing consistency across teams and time zones**
- **Poor understanding of what it takes to roll an app into production**

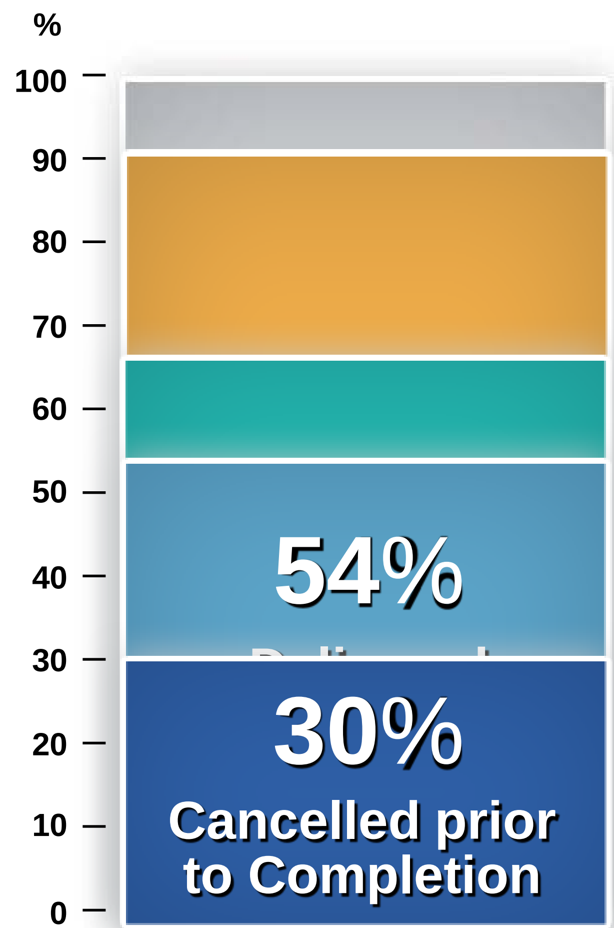
- **These forces come from DECISION MAKERS!**
- **These forces come from OPERATIONAL MANAGERS!**

But the Industry Is Failing!!

Project failure statistics are scary…

Software delivery is still an art, not a science.

It has never been more difficult to manage delivery of software in a predictable and reliable manner!



Source: THE STANDISH GROUP 2003

Overall Need:
Increase the predictability of quality delivery, on time, and within budget

Here’s Why They’re Failing

- Competing business priorities & resources
- Constant change & and shorter release cycles
- Distributed teams & external resources
- Increased complexity & mixed-IT environments
- Inability to deploy even though developed on time
- Higher performance and availability expectations

Summary of Session 1 - Why Are We Doing This?

What Causes Failures/Mishaps/Problems/Issues ?

90+% - Human Error

~5% - Unknown Situation – Concatenation of Circumstances

~5% - Unexpected Change of Environment

Have We Learned From Failures/Mishaps/Problems? ?

90+% - Software Programs “failed”.

128% - Average Annual Cost Growth Missile Programs

140% - Average Annual Cost Growth Aircraft Programs