

***CORONA DIVISION
NAVAL SURFACE WARFARE CENTER***



**Craig MacDougall
(951) 273-4624
craig.macdougall@navy.mil**

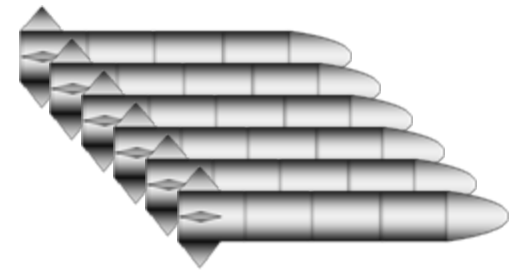
Maintenance and Tactical Decision Support Applications Utilizing In-Service Missile Reliability Models

**Craig MacDougall
(951) 273-4624
craig.macdougall@navy.mil**

THE GREAT IDEA

Reliability Models to Actionable Information

- Situational Decision Making
- Tailorable Optimization



Data → Information → Knowledge → Decisions

SITUATIONAL DECISION MAKING

NOTIONAL

**Shoot,
Shoot,
Shoot**

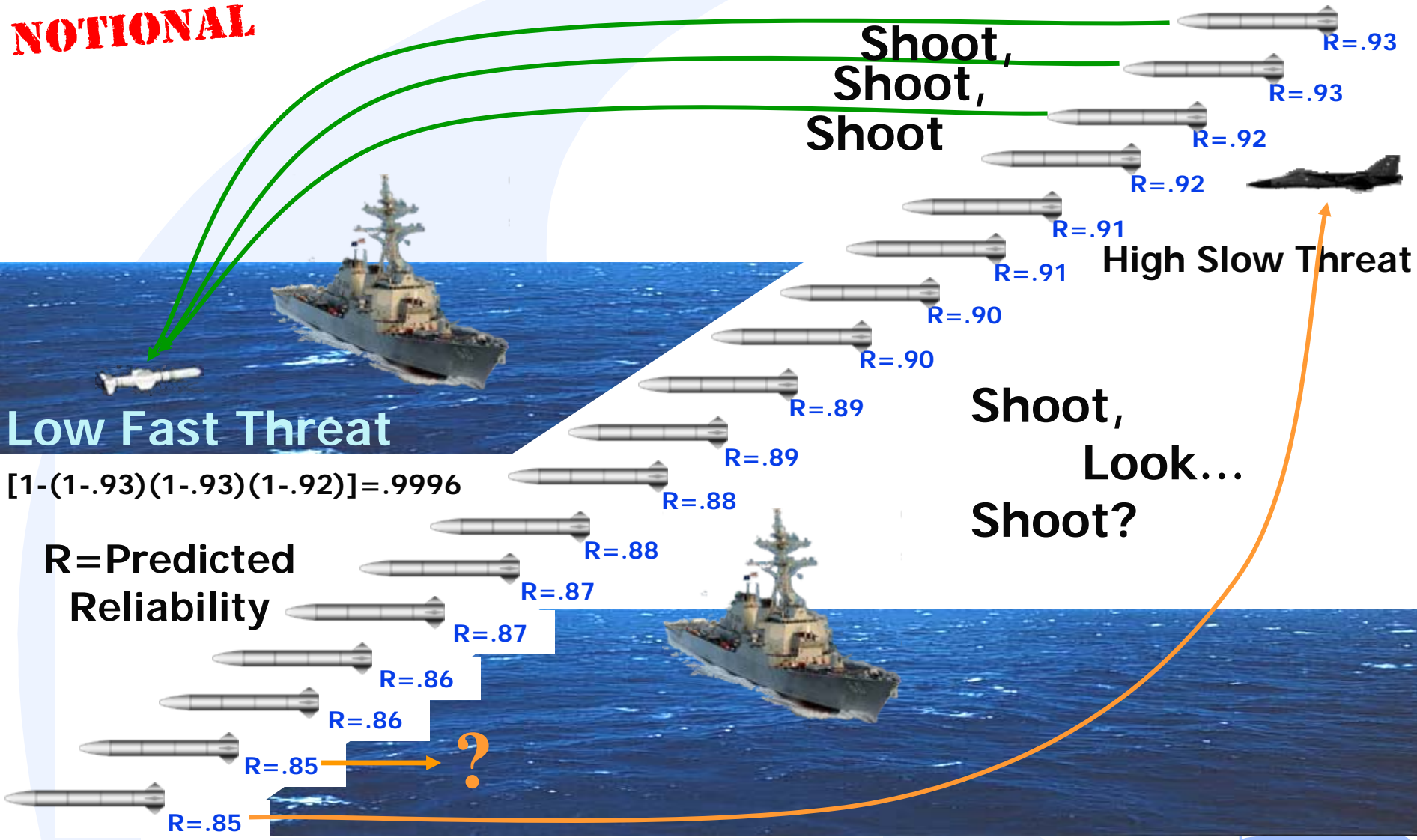
High Slow Threat

**Shoot,
Look...
Shoot?**

Low Fast Threat

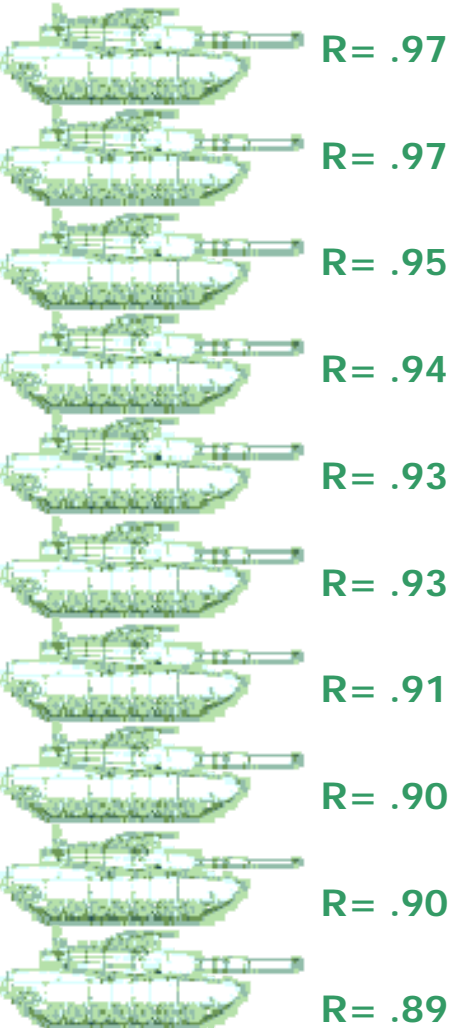
$$[1 - (1 - .93)(1 - .93)(1 - .92)] = .9996$$

**R=Predicted
Reliability**



SITUATIONAL DECISION MAKING

Tanks 100 Available



R = Predicted Reliability of Engine/Transmission for each 500Km Driven.

Required Tanks for Primary Mission = 80

Tanks to Allocate for Primary Mission = the 90 with the Highest Reliability

Primary Mission

90 Main Battle Tanks Required
Distance to Objective 450Km

Secondary Mission

10 Main Battle Tanks Required
Distance to Objective 10 Km



NOTIONAL

Required Tanks for Secondary Mission = 10

Tanks to Allocate for Secondary Mission = the Remaining 10

RELIABILITY DASHBOARD

'REAL' TIME RELIABILITY IN THE FIELD

Reliability Predictions Based on Each Missile's Pedigree

Green = Well above reliability requirement

Yellow = Marginally above reliability requirement

Red = Below reliability requirement

Predicted Reliability Report for Battle Group's GROUP1 Missiles

Total records displayed: 19

NOTIONAL

BATTLE GROUP	SHIP	AREA	MSL TYPE	SN	PREDICTED REL	EXP DATE	COUNT
GROUP1	ALL	Gulf	ALL		0.62		110
GROUP1	Mahn	Gulf	ALL		0.58		35
GROUP1	Mahn	Gulf	1	900	0.56	1/29/2009	1
GROUP1	Mahn	Gulf	1	901	0.56	1/30/2009	1
GROUP1	Mahn	Gulf	1	902	0.56	1/31/2009	1
GROUP1	Mahn	Gulf	1	903	0.67	2/1/2009	1
GROUP1	Mahn	Gulf	1	904	0.50	2/2/2009	1
GROUP1	Mahn	Gulf	1	905	0.96	2/3/2009	1
GROUP1	Mahn	Gulf	1	906	0.99	2/4/2009	1
GROUP1	Mahn	Gulf	1	907	0.92	2/5/2009	1
GROUP1	Mahn	Gulf	1	908	0.65	2/6/2009	1
GROUP1	Mahn	Gulf	1	909	0.99	2/7/2009	1
GROUP1	Mahn	Gulf	1	910	0.98	2/8/2009	1
GROUP1	Mahn	Gulf	1	911	0.64	2/9/2009	1
GROUP1	Mahn	Gulf	1	912	0.76	2/10/2009	1
GROUP1	Mahn	Gulf	1	913	0.90	2/11/2009	1
GROUP1	Mahn	Gulf	1	914	0.99	2/12/2009	1
GROUP1	Mahn	Gulf	1	915	0.45	2/13/2009	1
GROUP1	Mahn	Gulf	1	916	0.95	2/14/2009	1

RELIABILITY BASED ON MISSILE PEDIGREE

Initial Missile Pedigree

Component	Serial Number	Expiration (year)
Motor	154	2009
Guidance	152	
Autopilot	17	
Battery	91	2015

Maximize Availability with a Customized Configuration

NOTIONAL

Inspection/ Test Due (year)	Predicted Reliability = Minimum Reliability Specification (year)	Limiting Component	Action
2009	2012	Motor	Replace motor
2015	2012	Reliability	Replace with higher rel. autopilot
2015	2015	Multiple	Replace battery, higher rel. guidance section

THE KEY



Informed Decisions are based on getting the right information to the right people at the right time.

- Right information is founded on sound analysis of quality data.
- Getting timely information to the decision-makers requires designing and maintaining the right interfaces.

Data → Information → Knowledge → Decisions

CONCLUSION

Points to Address When Applying this Idea to Your System

- **Data**
 - Quality
 - Scope (broad, complete, to the “eaches”)
- **Knowing what affects the reliability
...and by how much**
- **Providing the knowledge**