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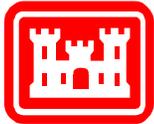
Community of Practice Workshop Vicksburg – May 2006

Coastal Structures Asset Management

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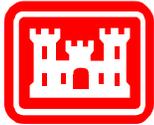


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Key Point

*We are starting with a **clean slate**, and this is an **opportunity** for us to develop a rational and consistent method for managing **O&M expenditures** on critical coastal infrastructure.*



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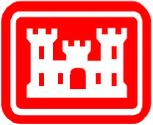
What's the Problem?

The Problem:

- Tens of Millions \$ spent each year repairing structures
- Most structures are over 50 years old (some <100 yrs!)
- Not enough funding to cover the necessary repairs

The Need:

- Rational method for assessing and prioritizing maintenance and repair of structures
- Methodology that is objective, balanced, and fair
- Useful at District, Division, and Headquarters levels



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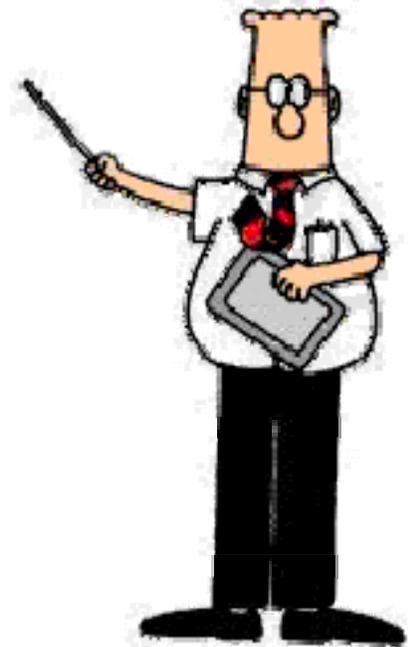
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Technical Approach

Main Tasks

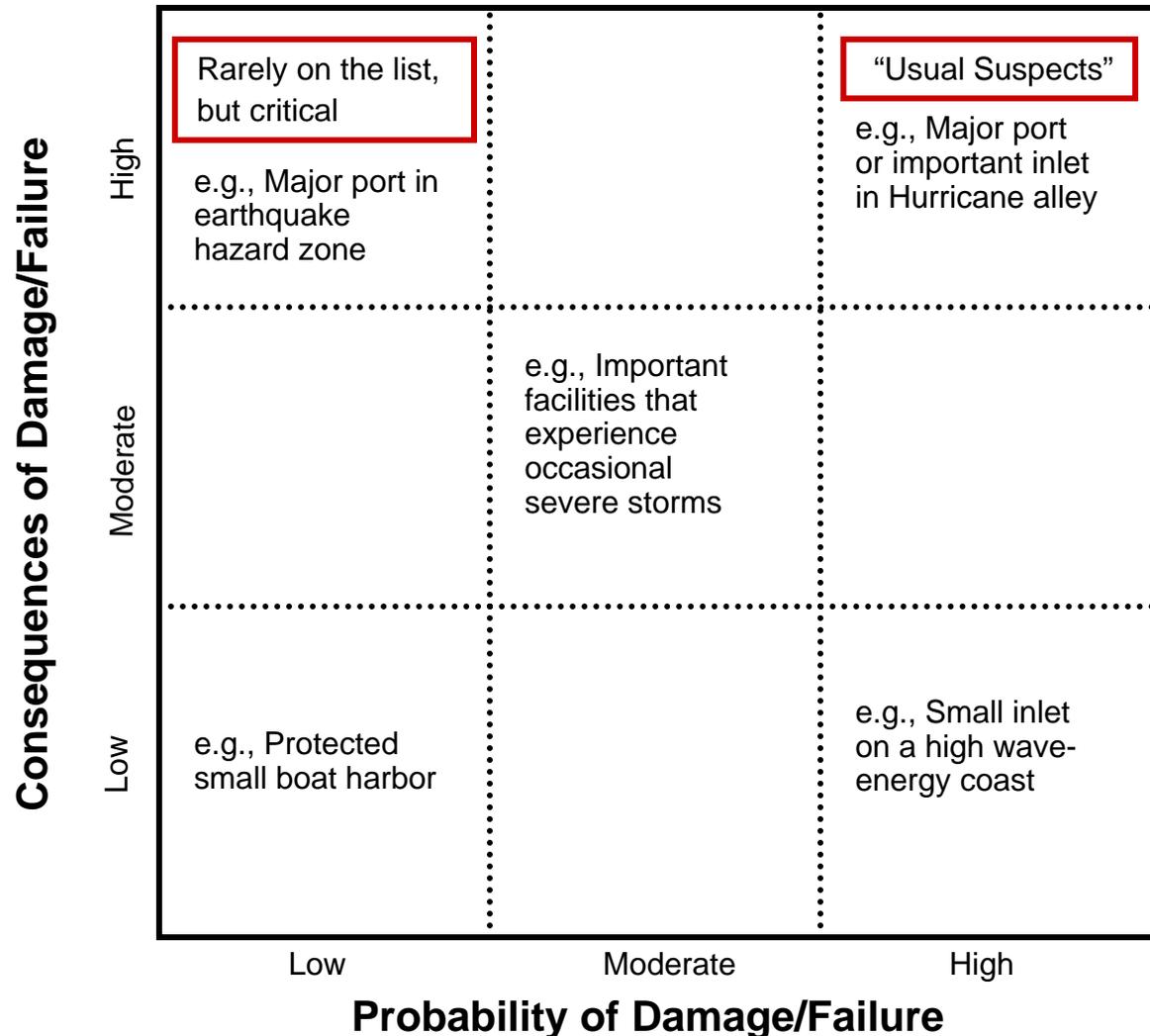
- Establish PDT of District/Division experts
- Identify Corps' critical coastal structures
- Gather data on critical structures
- Develop Asset Management Decision Tool
- Develop improved structure design guidance

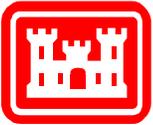
And now some details...





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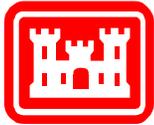


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Develop Asset Management Decision Tool

- AMDT includes consideration of...
 - Physical state of structure
 - Risk of additional damage or failure if repair is postponed
 - Decreased project functionality
 - Potential for economic loss (Corps, community, commerce)
 - Impact to Corps' navigation and dredging missions
 - Cost to repair
 - Other?

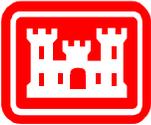


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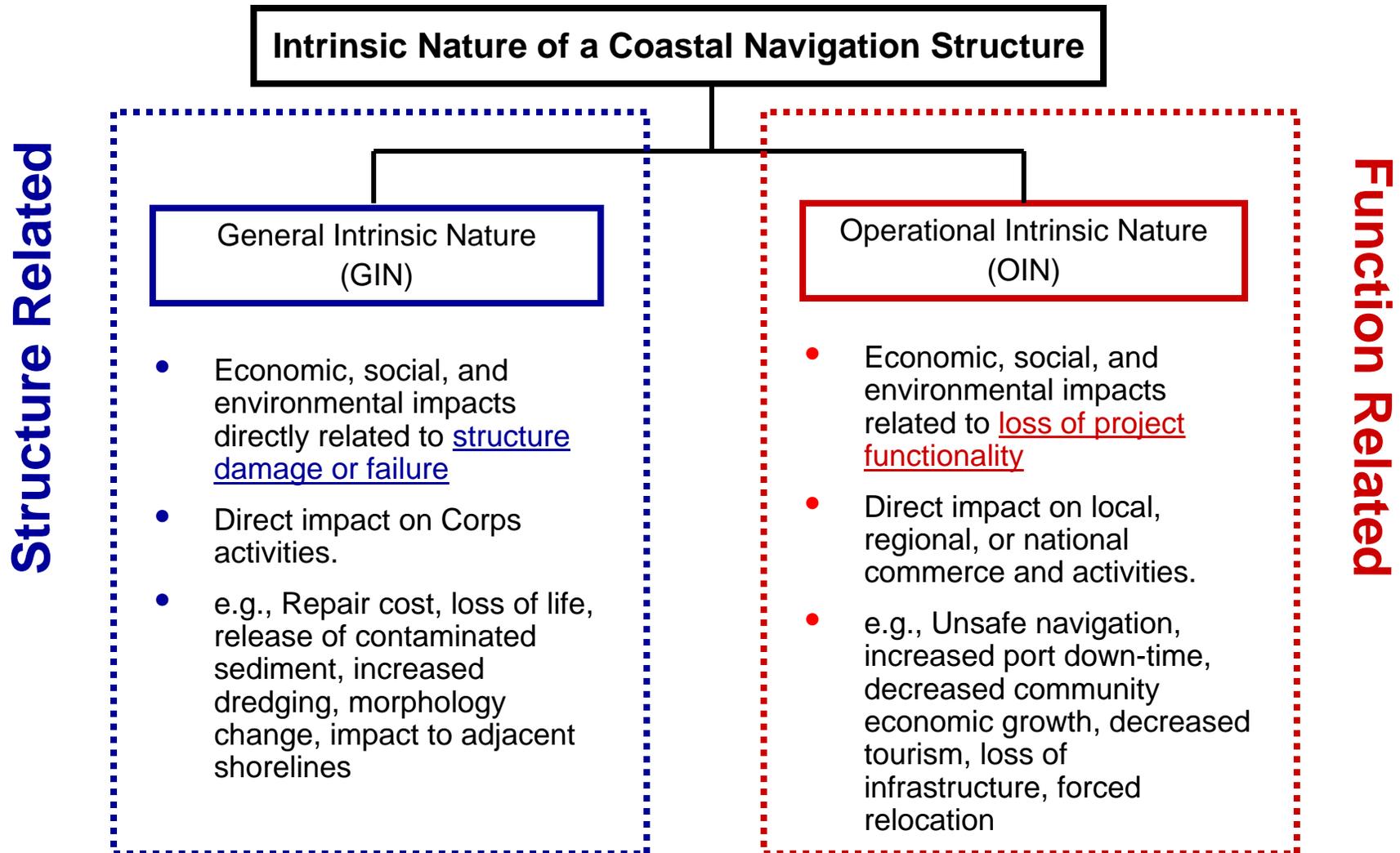
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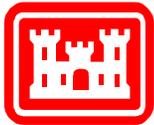
Critical Components for Evaluating Structures

- Estimate the repair cost and **repercussions** associated with a damaged or failed structure
- Determine the **risk of additional damage** and the associated repercussions if repair is postponed
- Need some indicator of **confidence level** in the estimates
 - **Low** – Based on minimal quantitative information (SWAGs)
 - **Medium** – Some quantitative estimates and some approximate guesses
 - **High** – Based on detailed studies and analyses
- Need proper **weighting** when summing all the diverse elements of assessing risks and consequences arising from a damaged structure



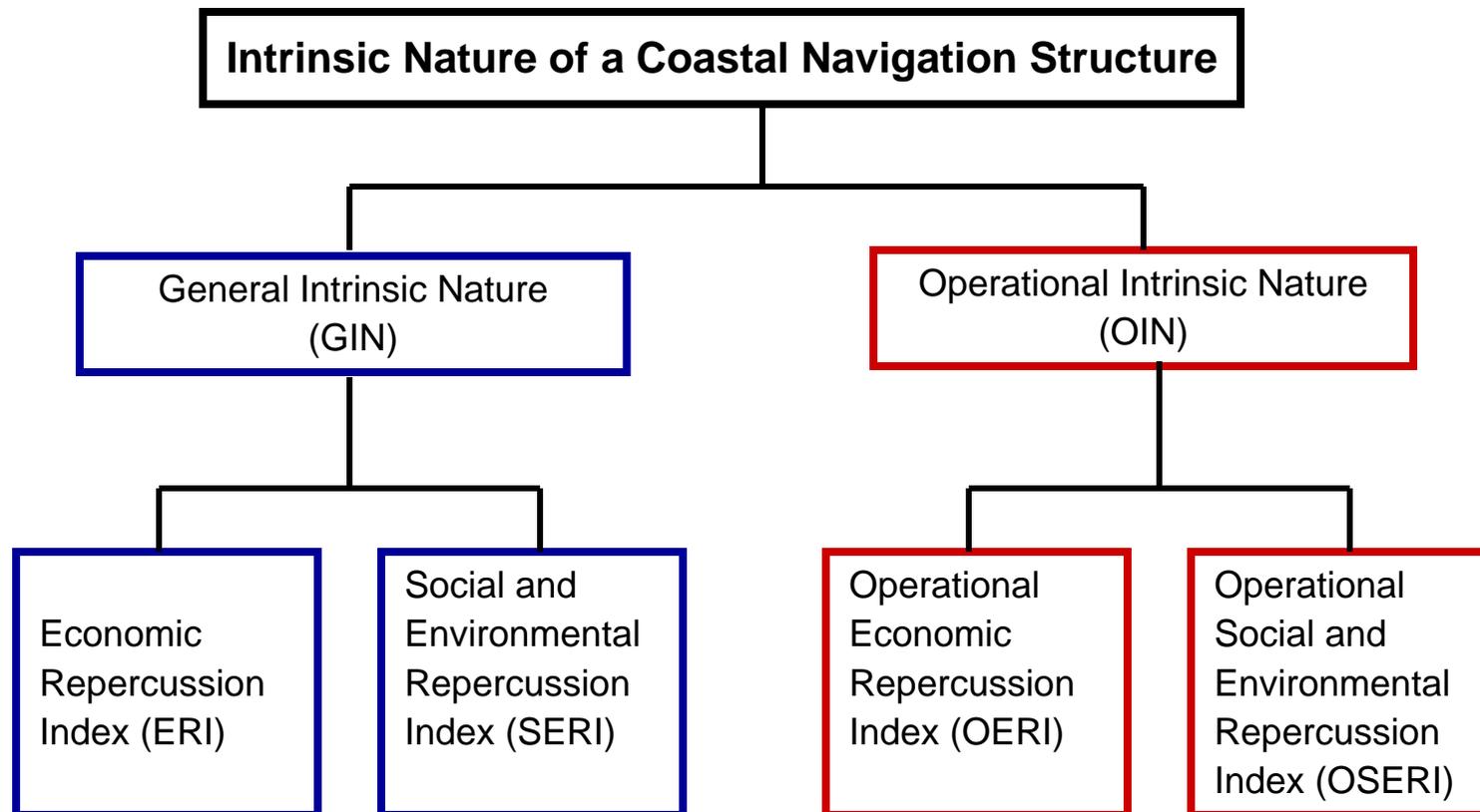
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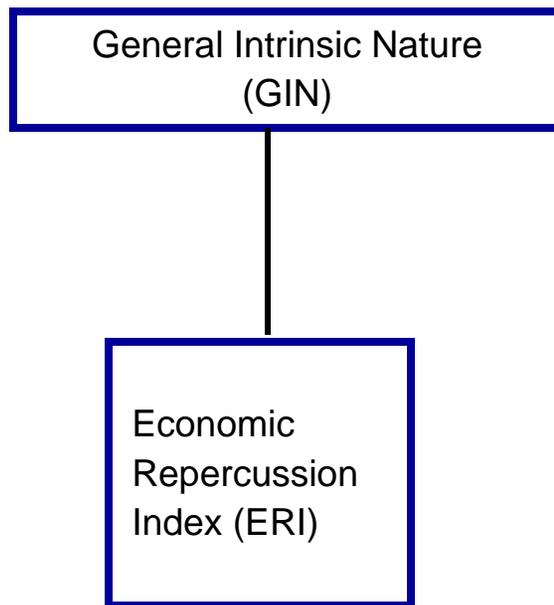
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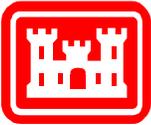


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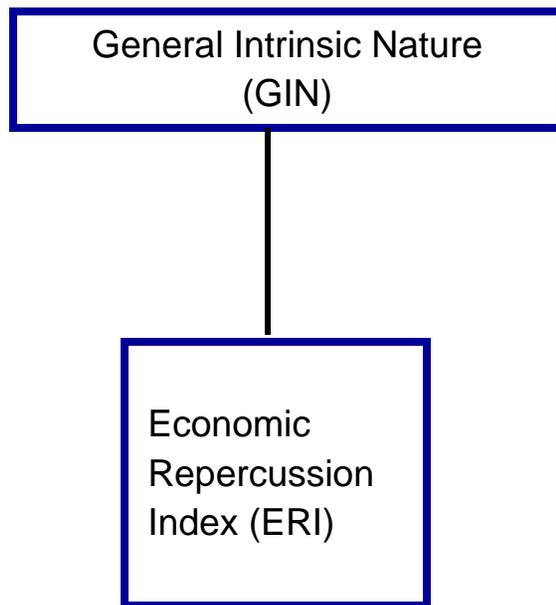
- ERI is a quantitative assessment of foreseeable economic repercussions related to failure of, or damage to, the structure (does not include costs related to loss of functionality)
- The ERI index consists of...
 - **Structure-related costs** (C_{SG}): Total cost incurred by the Corps and cost-share partners to return the structure to functional operation.
 - **Project-related costs** (C_{PG}): Annual project costs incurred by the Corps (and partners) while the structure is in a degraded condition awaiting repair. (Assumes no further structural damage occurs.)
 - **Normalizing factor** (C_{OM}): FY O&M budget?
- ERI is calculated as

$$ERI = \frac{C_{SG} + C_{PG} (N \text{ years})}{C_{OM}}$$

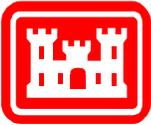


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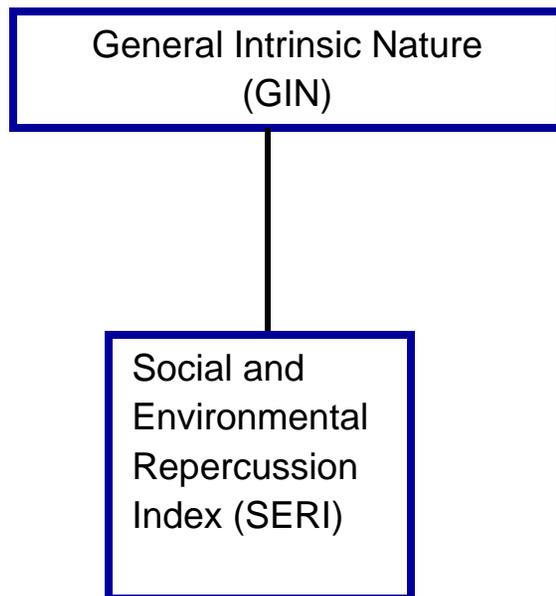


- **Estimate of C_{SG}** (structure-related costs)
 - Evaluated through detailed studies for actual damage incurred
 - Estimated a priori for different values of structural condition index
 - For total failure – updated initial investment (replacement cost)
- **Estimate of C_{PG}** (project-related costs)
 - Evaluated through detailed studies, site investigations, or modeling studies
 - Annual cost if repair spans multiple years



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- SERI is a qualitative assessment of social and environmental repercussions related to failure of, or damage to, the structure (does not include impacts related to loss of functionality).
- Three factors are included in the SERI index...
 - **Loss of human lives** ($SERI_1$): Evaluates the possibility and scope of loss of human lives due to a damaged or failed structure.
 - **Environment, historical significance, and cultural heritage** ($SERI_2$): Evaluates damage to the environment and/or historical and cultural heritage due to structure damage or failure.
 - **Social disruption** ($SERI_3$): Evaluates social disruption directly attributable to structure damage

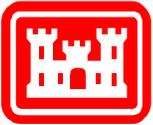


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Loss of human lives ($SERI_1$):

- *Remote* – Injury to people is improbable.
- *Low* – Loss of human life is possible (accidental), but not probable. Few people affected.
- *High* – Loss of human life is very probable. Affects a relatively small number of people.
- *Catastrophic* – Loss of human life and injury to people is serious and widespread. Regional medical facilities affected.

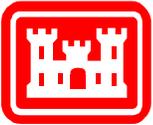


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Environment and historical/cultural heritage (SERI₂):

- *Remote* – Damage is improbable.
- *Low* – Damage is slight, and reversible within one year. Losses are of little value.
- *Moderate* – Damage is important, but reversible within 5 years, or there is loss of important elements of historical and artistic value.
- *High* – Damage to ecosystem is irreversible, and there is loss of important historic and artistic elements.
- *Very High* – Irreversible ecosystem damage, extinction of protected species, destruction of protected natural resources, or loss of a large number of important elements of historical or artistic value.



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Social disruption ($SERI_3$):

- *Low* – No signs of any significant social disruption associated with damage or failure of the structure.
- *Moderate* – There is minimum social disruption associated with *high* values of the $SERI_1$ and $SERI_2$ indexes.
- *High* – There is minimum social disruption associated with a *catastrophic* value of the $SERI_2$ index.
- *Very High* – There is a maximum degree of social disruption due to a high value of the $SERI_2$ index.



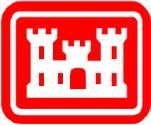
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Approximation of SERI

$SERI_1$	Value	$SERI_2$	Value	$SERI_3$	Value
Remote	0	Remote	0	Low	0
Low	3	Low	2	Moderate	5
High	10	Moderate	4	High	10
Catastrophic	20	High	8	Very high	15
		Very high	15		

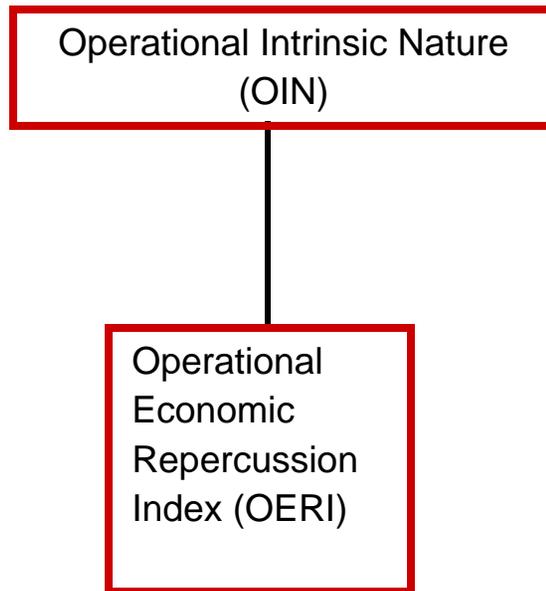
$$SERI = \frac{SERI_1 + SERI_2 + SERI_3}{50}$$

(SERI index varies between 0 and 1)

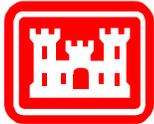


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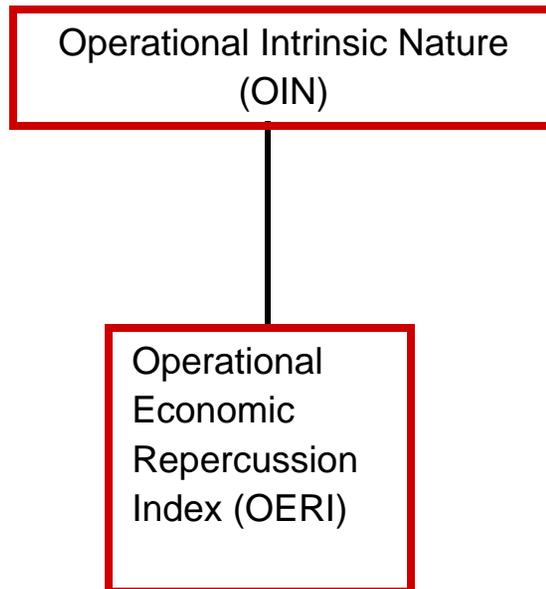
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- OERI is a quantitative assessment of foreseeable economic repercussions related to loss of project functionality.
- Applicable costs consists of...
 - **Loss of income or productivity:** (C_{EO}) Annual losses directly related to decreased project functionality. Does not directly impact Corps of Engineers budget, but does impact local, regional, or national economies
 - **Loss of potential future development:** (C_{FO}) Annual costs related to delay of planned development that was expected to boost the economy at local, regional, or national level.



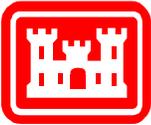
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- OERI is calculated as a fraction of structure repair costs as...

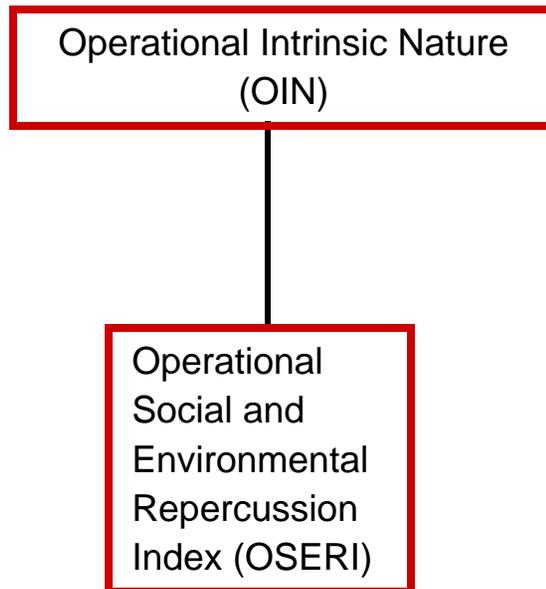
$$OERI = \frac{(C_{EO} + C_{FO}) (N \text{ years})}{C_{OM}}$$

- **Estimate of C_{EO} :**
 - Evaluated through detailed studies
 - Includes direct economic loss and any additional costs incurred to compensate (e.g., fishing harbor)
- **Estimate of C_{FO} :**
 - Based on actual development in planning stages
 - Difficult to quantify

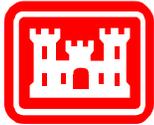


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- OSERI is a qualitative assessment of social and environmental repercussions related to loss of project functionality.
- Three factors are included in the OSERI index are the same as used in the SERI index...
 - **Loss of human lives** (OSERI₁): Evaluates the possibility and scope of loss of human lives due to loss of project functionality.
 - **Environment, historical significance, and cultural heritage** (OSERI₂): Evaluates damage to the environment and/or historical and cultural heritage due to loss of project functionality.
 - **Social disruption** (OSERI₃): Evaluates social disruption directly attributable to loss of functionality
- OSERI is estimated using the same method as SERI



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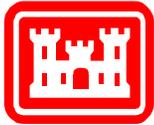
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Total Damage Repercussions Index

$$DRI = \underbrace{W_E (ERI) + W_{OE} (OERI)}_{\text{tangible costs}} + \underbrace{W_S (SERI) + W_{OS} (OSERI)}_{\text{intangible repercussions}}$$

where W_E , W_{OE} , W_S , and W_{OS} are weighting factors

- Assumes no additional structure damage occurs between the present and the time in the future when repairs are made.
- Major obstacle is assigning the weighting factors
- Needs to have an associated indicator of DRI quality



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Future Damage Repercussions Index

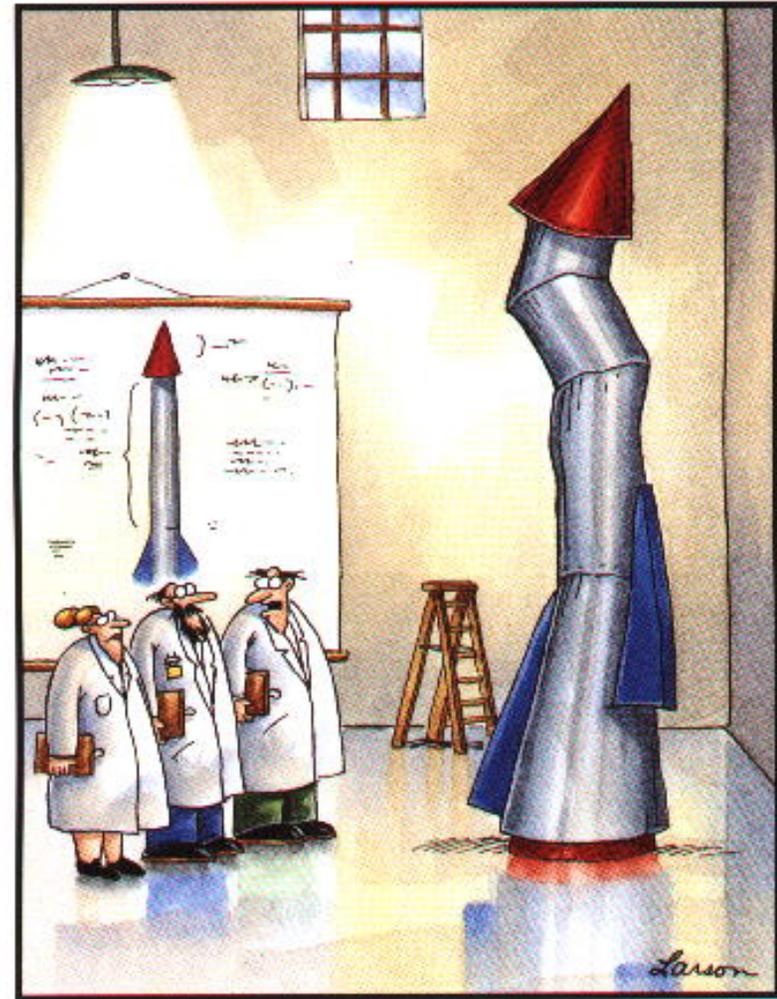
- Probability distribution of DRI values associated with the risk of additional structure damage.
- Gauges the consequences of **NOT** undertaking repairs at this time. Essentially an indicator of repair *urgency*.
- Uses traditional risk analysis to determine probability (and extent) of additional damage, then assigns an estimate of the DRI index for that damage level.
- Also carries along an indicator of DRI estimate quality



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Questions?



"It's time we face reality, my friends. ...
We're not exactly rocket scientists."