Asset Leadership Network

ALN Th@3 - February 3, 2022

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Pittsburgh's Frick Park's Fern Hollow Bridge Collapse On January 28, 2022, A Preliminary View

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Details About Pittsburgh's Frick Park / Bridge

- Henry Clay Frick 1849 – 1919 (Pittsburgh and New York)
- Owned a coke manufacturing company and partnered with Andrew Carnegie to create U.S. Steel
- Opened in 1927
- Size -- (1 sq. miles) (Central Park in NY 1.3 sq. miles)
- Bridge opened in 1973 at a cost of ~$1.2 million
- 446.9-feet-long with four lanes
- **Weight limit** on the bridge was reduced from 36 tons to **26 tons.**
- Was used by **14,000** vehicles per day
- Owned by the city of Pittsburgh

Before -- Heavily Used Trails

Same Place After – Will Be Used Less

<u>Key Performance Indicator</u> --- Hiker to city - 2018 “I hope someone is keeping an eye on the … bridge One of the big "X" beams is rusted through entirely (I see the cables, … probably not a crisis).”

Lower left-hand leg of the X-brace was found detached in 2018 by a hiker; tensioned cables were installed.

60-foot 21-ton Bus on Collapsed Bridge

60-foot 21-ton Articulated Bus Removed

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Events

- 2014, State requires annual inspection,
- 2018 removed the rusted X shaped bracing from sub structure after citizen report,
- At some point cables were installed,
- City recognized needed repairs, not viewed as “imminent hazards”
- 2013 the cables were found loose and were tightened in 2014,
- Weight limit on the bridge being reduced from 36 tons to **26 tons,**
- Last inspection was September 2021 by international firm.

Years of declining conditions

Fern Hollow Bridge has been found in poor condition since 2011, meaning that at least one of three main structural elements received a rating of 4 or below on a 9-point scale. Government records show that each element of the structure — the deck, superstructure and substructure — declined in the past two decades.

FERN HOLLOW BRIDGE INSPECTION RESULTS, 1999-2021

Inspection Date	Overall rating	Deck	Superstructure	Substructure
2019-2021*	Poor	4 - Poor	4 - Poor	6 - Satisfactory
2011-2017*	Poor	5 - Fair	4 - Poor	6 - Satisfactory
Sept. 2009	Fair	5 - Fair	5 - Fair	6 - Satisfactory
2007-2009	Fair	5 - Fair	5 - Fair	7 - Good
1999-2005	Fair	6 - Satisfactory	5 - Fair	7 - Good

*Although the state said it began inspecting the bridge annually in 2014, only biennial scores are available publicly.

Source: National Bridge Inventory, PennDOT

Research: Joel Jacobs
graphic: Ed Yozwick/Post-Gazette

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National Bridge Inventory

- Was developed with the purpose of having a unified database for bridges to ensure the safety of the traveling public as required by the Federal-Aid Highway Act of 1968. It includes identification information, bridge types and specifications, operational conditions, bridge data including geometric data and functional description, and inspection data.
- **Current Database installed December 1995**
- https://www.fhwa.dot.gov/bridge/mtguide.pdf

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The Rating System Used – Generally Accepted

Risks are potential future events or conditions that may have a negative effect on achieving program objectives for cost, schedule, and performance. Defined by:

- **Identification** of the undesired event and/or condition
- The **probability** of an undesired event or condition occurring
- The **consequences**, or impact, of the undesired event, should it occur

Sources: DAU https://www.dau.edu/tools/se-brainbook/Pages/Management%20Processes/Risk-Management.aspx

ISO 31000 Risk Management https://www.iso.org/obp/ui/#iso:std:iso:31000:ed-2:v1:en

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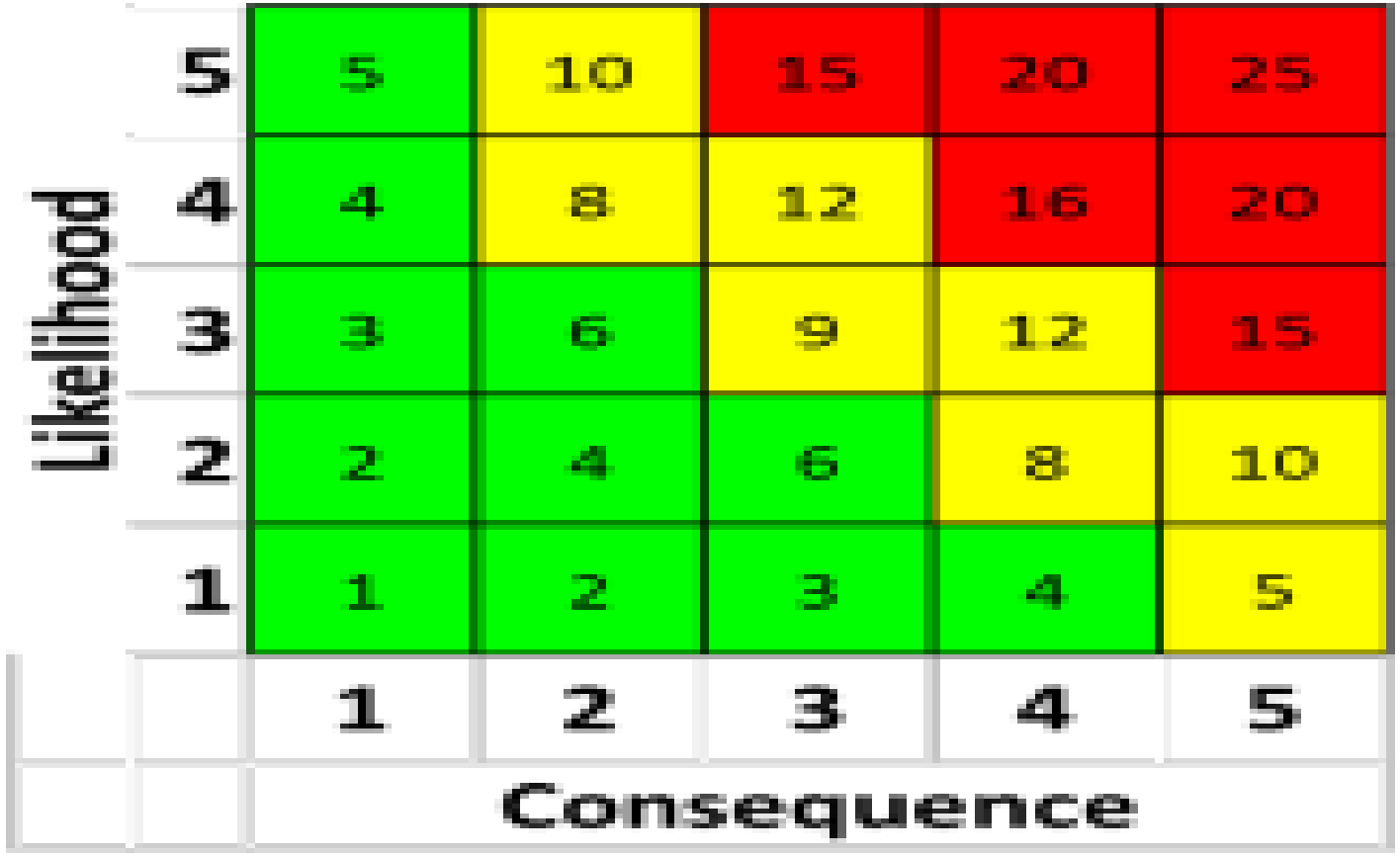
Risk Cube



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The DOT Risk Model Failed as a Predictor

-A Better Model Would be the FICO Credit Score Type Model,

-They should have adopted a new model years ago --ISO 31000 Risk Management,

-The sum of risk may not reliably indicate probability of failure but may be good for budgeting,

-**A bridge is only as strong as its weakest critical element.**

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The Bridge is of a "K-frame" Structure

- FROM PennDot – "This is a design where **weight is placed on single supports** that have no secondary backup."
  - That is a single point (or source) of failure. Common wisdom **– in systems, avoid designs with a single point of failure,**
  - When the NTSB report is published, it will surely identify this.
- For asset management -- acquisition, use/maintenance and disposition – the lesson is to understand and react to situations with a single point of failure.

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So, What Probably Happened?

- The design had a single point of failure, but where?
- Bridge was 446.9-foot-long with four lanes with a **weight limit of 26 tons?**
- Snow, ice and freezing probably caused additional stress,
- Unreliable reporting of condition, inadequate maintenance and undue risk,
- The bridge appears to be top heavy.

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Lessons for Asset Management

- Use the Internal Control Framework – Effective and efficient Operations – Reliable Reporting and Compliance –laws, regulations/ standards –Annual audits,
- Be aware of potential hazards -- say something – and again,
- "I told you so" after the fact – provides little satisfaction,
- Find the right empowered advocate,
- Eventually you, your family or others could be victims,
- Understand concept a single point of failure,
- Use the building blocks of standards: quality, risk, principles, safety…,
- Trust and empower yourself.

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