

The background of the slide features a warm, golden sunset sky. In the foreground, several silhouettes of people are visible, holding up flags. The most prominent figure is a person in the center, holding a large black flag high above their head. Other smaller flags are held by people to the left and right. The overall mood is one of triumph or celebration.

The Asset Risk Management Revolution

Bayesian Approach to Assessing Risk In Wood Power Poles

Ian Hord

ABNMS November 2012

Ian Hord



- Investment Risk Manager leading the Network Risk Team at Western Power Perth WA.
- 25+ years risk engineering, insurance, consulting
- Using BBNs and Netica for past 18 months
- 24 BBNs under development

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OUR STRUCTURE OUR BUSINESS OUR PERFORMANCE SAFETY CAREER & LIFE RESOURCES

NIX Network Investment Excellence **30** 2 MAY 2012 WEDNESDAY Depot Pack

IN FOCUS

New team brings further rigour to planned interruption process

Congratulations to our Bright Sparks

Safety visits continue this week

Estimating pole failure risk

A new tool that estimates the likelihood and consequence of pole failure has been developed by the Network Risk Management team.

IN FOCUS ARCHIVE

ESS Employee Self Service

WOOD POLES

STRATEGIC DIRECTION

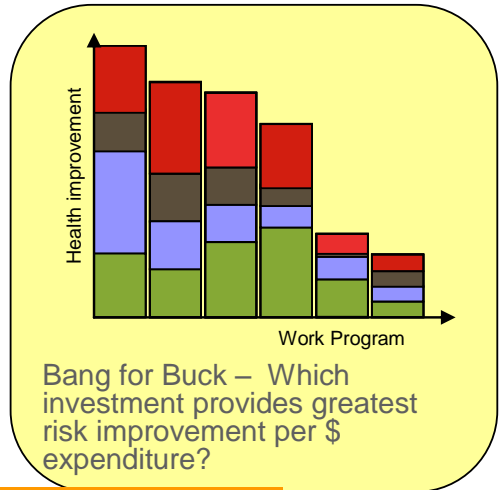
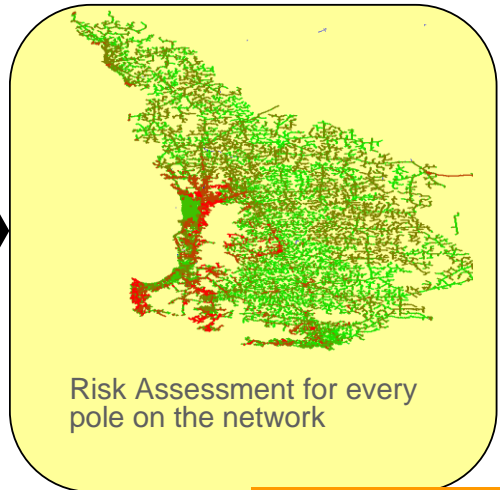
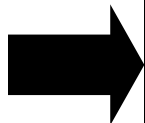
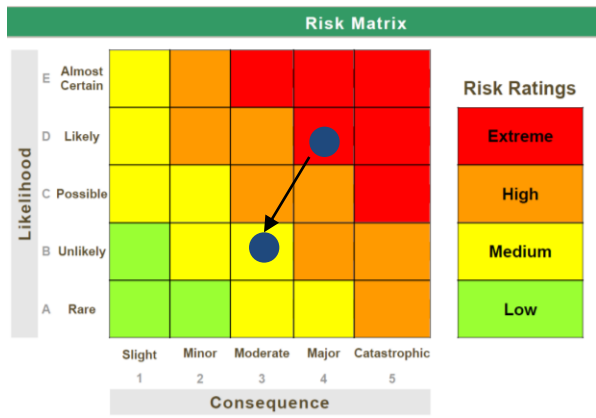
Vista

BrightSparks AWARDS

FYI **Sparky to help educate WA**
Tuesday, 01 May
Energy Minister Peter Collier today announced that Sparky the Chuditch will lead the Future Energy Alliance's (FEA) energy efficiency campaign when it is launched later this year.

JUST IN **Between the Lines out now**
01 May
The latest edition of *Between the Lines* has been delivered to the residential address of every Western Power employee.
Update - Free Dress Friday nets \$1,000 for Kids Helpline
27 April
The business collected nearly \$1,000 for Kids Helpline in February. James

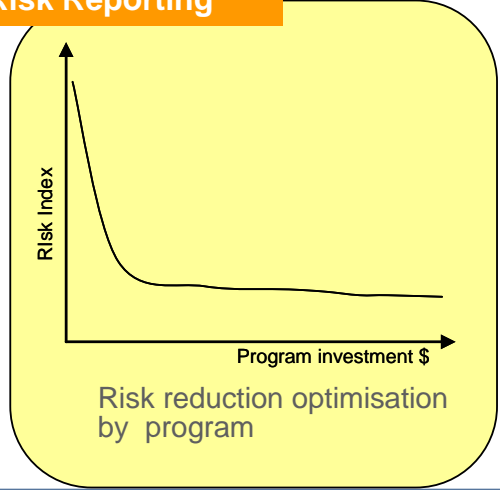
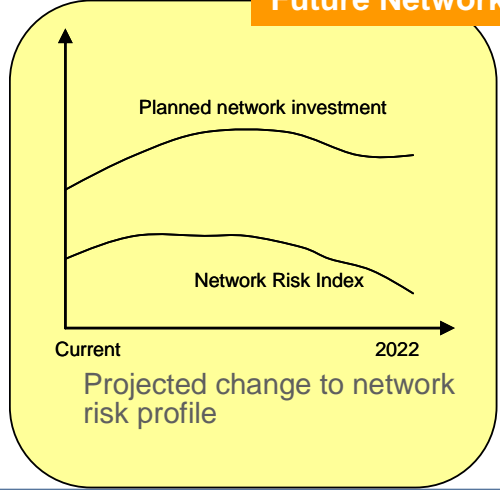
Risk Reporting Goals



Current Network Risk Reporting

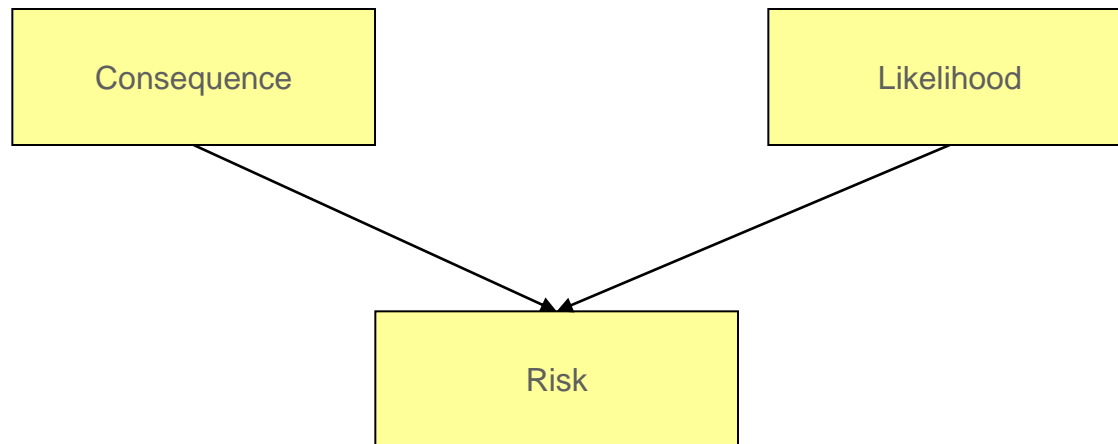
Future Network Risk Reporting

“Think of the Network Risk Management Tool as calculating an individual insurance premium for every pole, conductor bay, customer service connection, transformer, etc..”
Ilan Hord. Investment Risk Manager

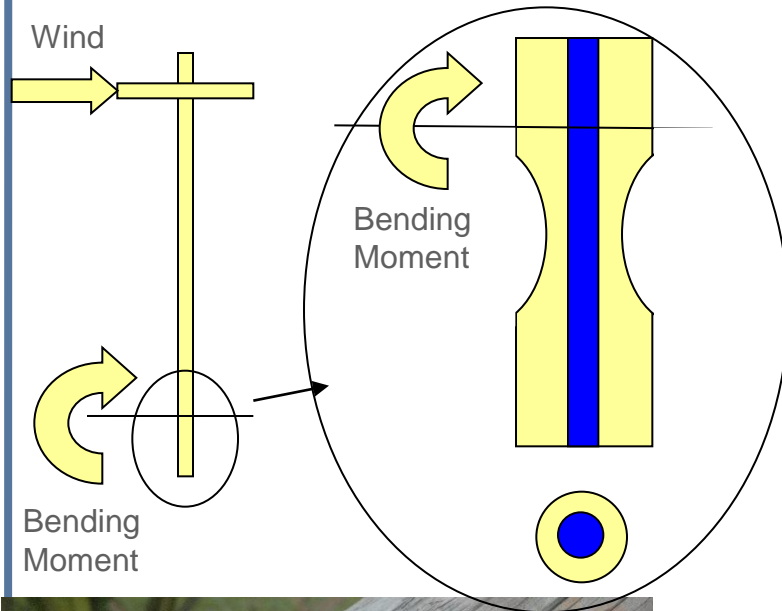


Risk Context

- Risk = f(Likelihood, Consequence)
- “the effect of uncertainty on objectives – ISO31000 Risk Management Standard
- Objectives: Bushfire, Safety, Service Reliability



Wood Pole Failure (Likelihood)

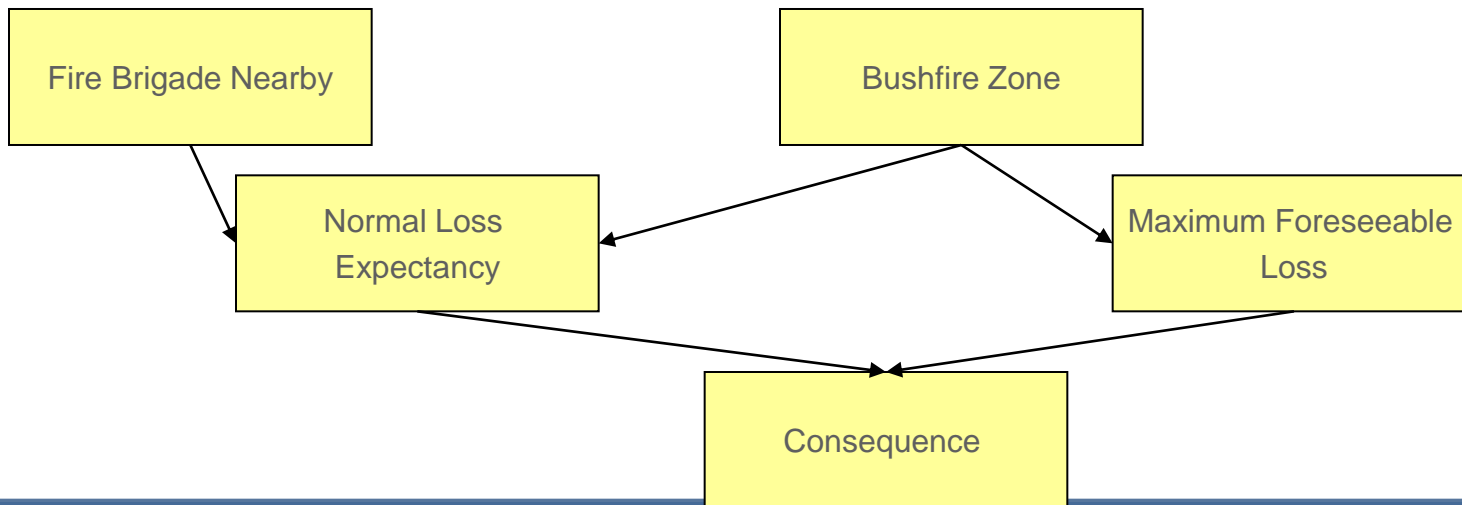
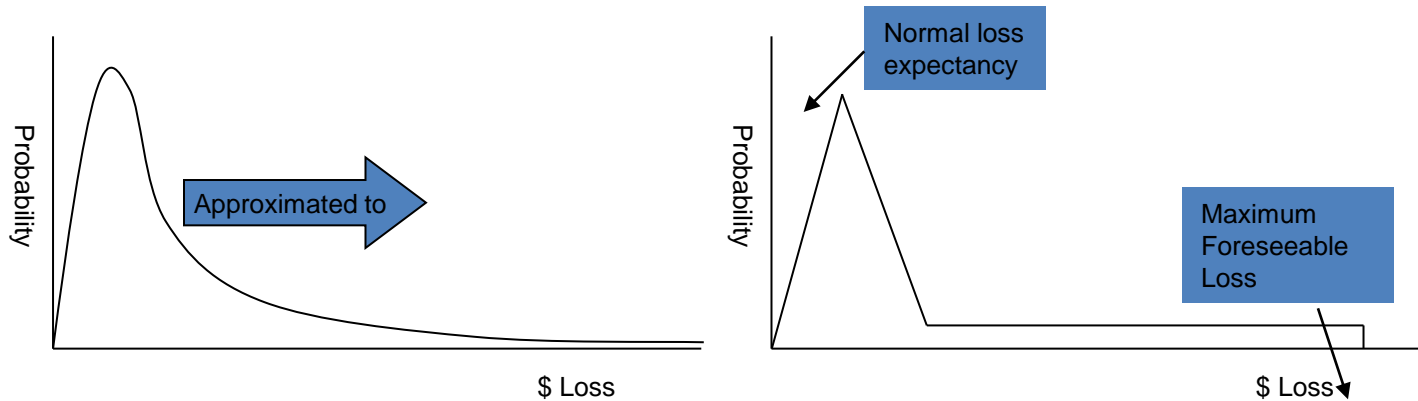


The maximum wind load (N) that can be applied at the tip is calculated as a function of Outside Radius at ground level, R_o (m), Internal Radius R_i (m) at ground level, the modulus of rupture for the fibres MOR (Pascals), the height of the pole H (m)

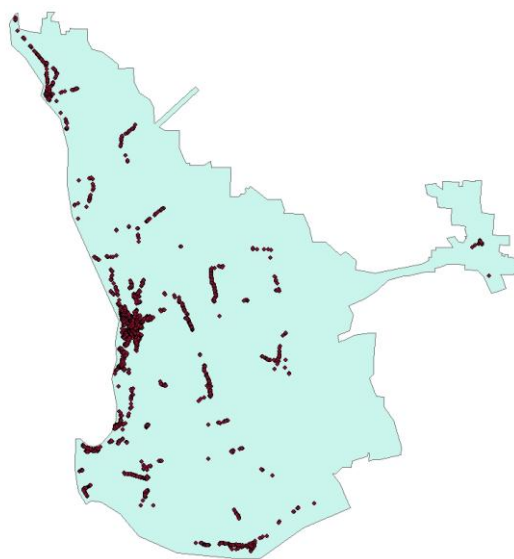


$$FailureTipLoad = \frac{\pi \times (R_o^4 - R_i^4) \times MOR}{4 \times H \times R_o}$$

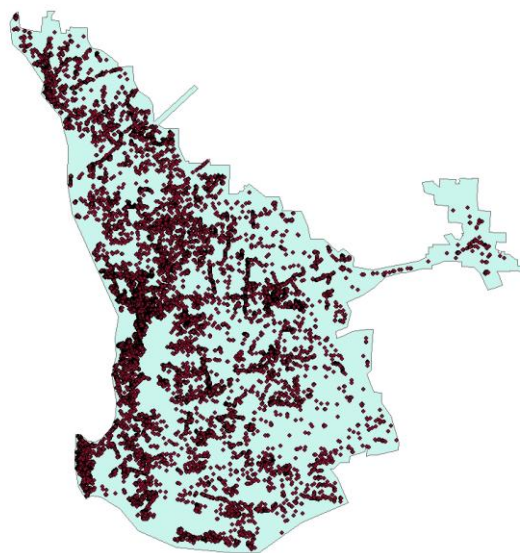
Consequence Model



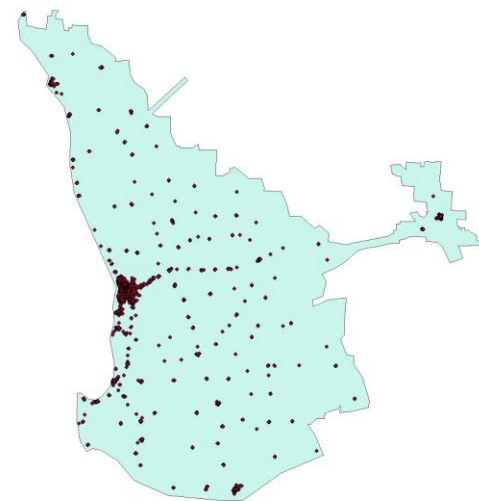
Initial Findings – High Risk Poles



Customers



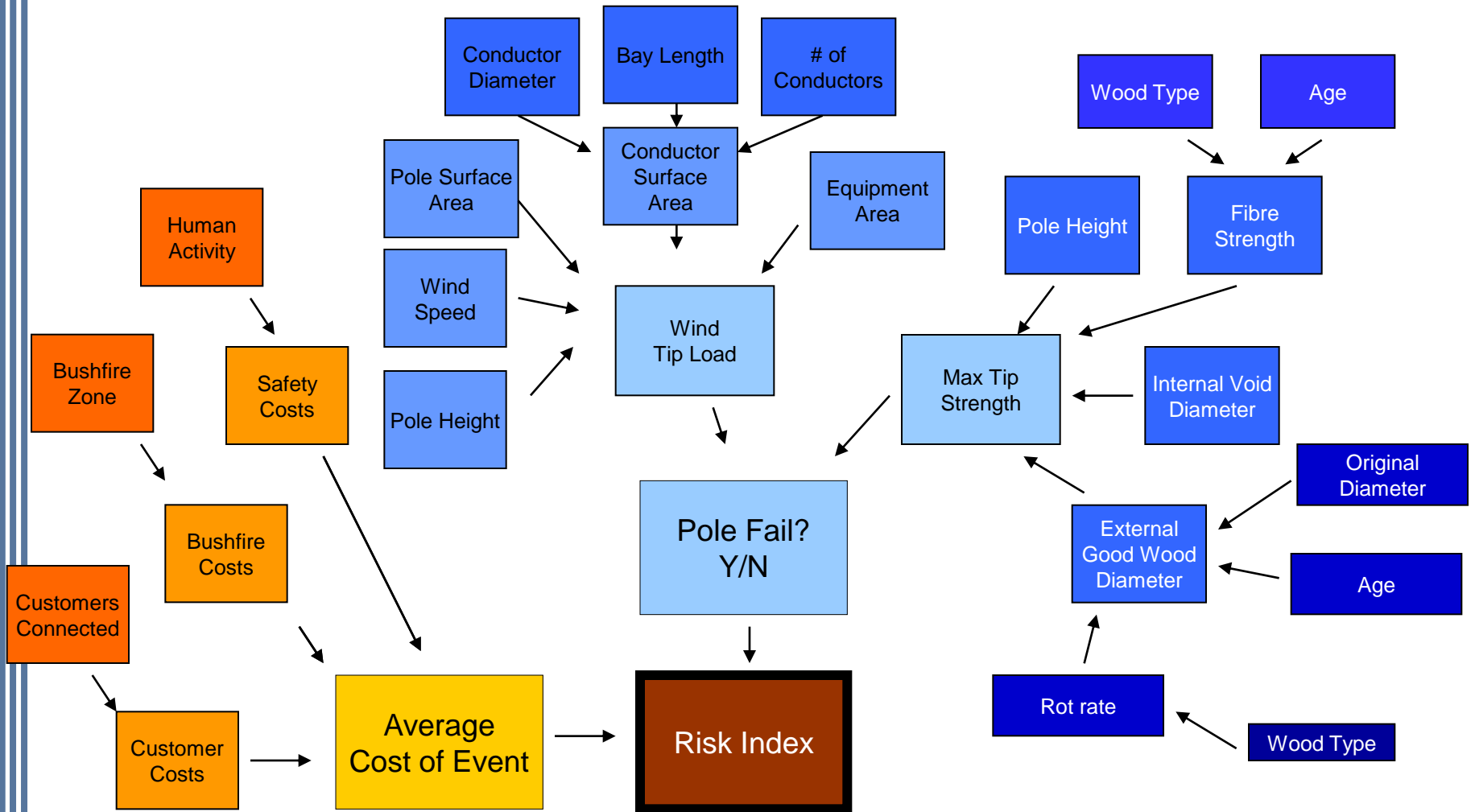
Fire



Safety

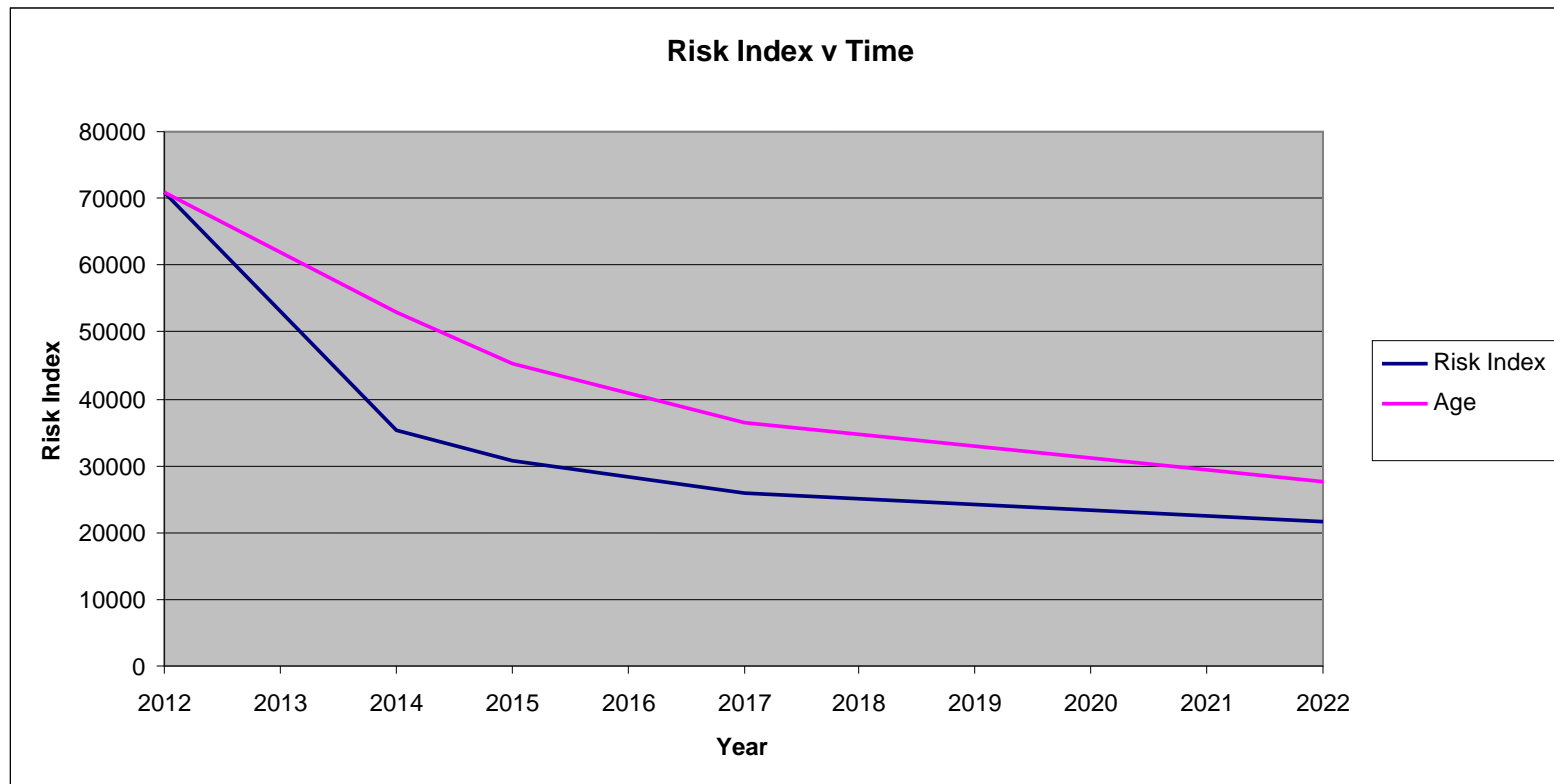
Bayesian Belief Network

Wood Pole Example



Initial Findings – Age v Risk Index replacement strategies

- Aged line represents risk index improvements when targeting old poles first
- Risk index represents targeting low strength poles in high consequence areas first



Note: Network aging not taken into consideration



Bayesian Model

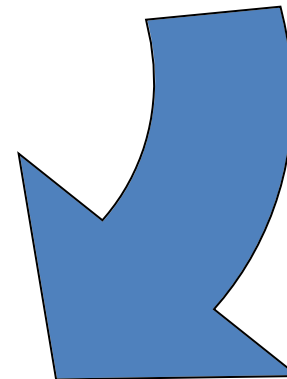
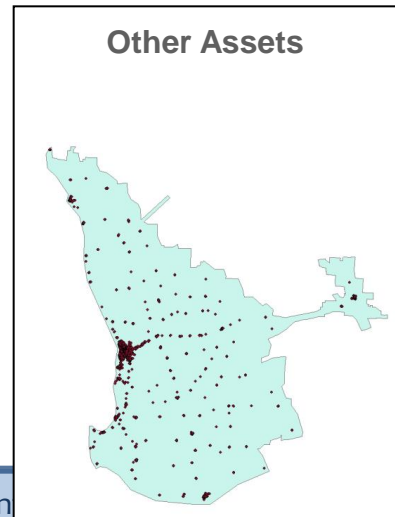
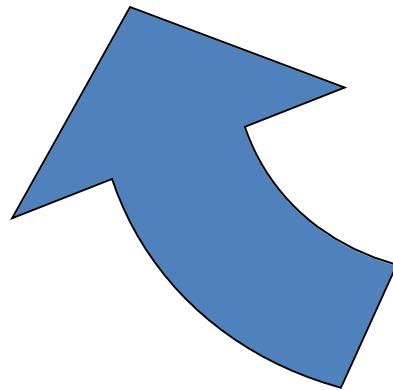
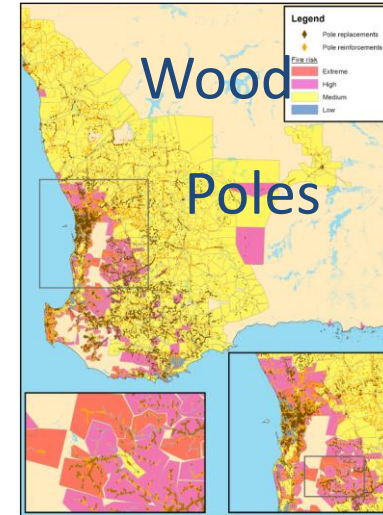
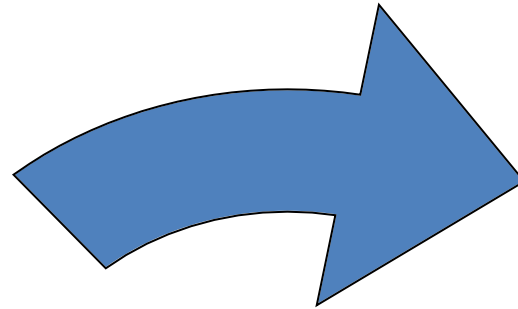
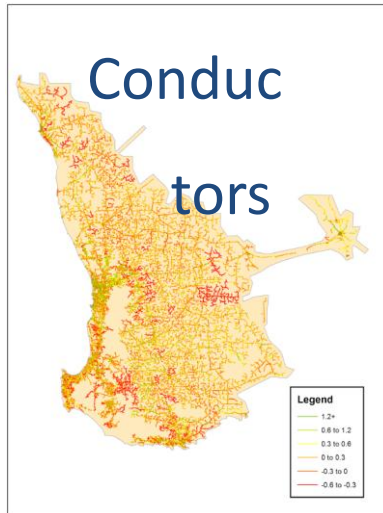
- Calculating probability of failure where tip load is greater than tip strength
- Can be used where inspection data is available or not available
- Clearly shows sensitivity of inputs
- Includes re-enforcements
- Some inputs are calculated outside the model

Next models - Conductor Clashing



Pick ID	117600
Working sep	710.425
Residual K	-0.449167
Length	83.49
Age	38
Covered	No
Conductor Weight	3.32
Voltage	HV22
Condition Index	8
Tension	1065
Cross-arm 1	HVDeltaShort
Cross-arm 2	HVDeltaShort
Wind Turbulence	High
Past Break	None
Past Clash	High
Damaged/joined	None
Slack Phase	None
Damaged Pole	Moderate
Pole Split	Low
Ties Unserviceable	None
Tap Issues	None
Loose Cross-arm	None
Missing Stay	None
Stay Near Conductor	None

Multi asset planning



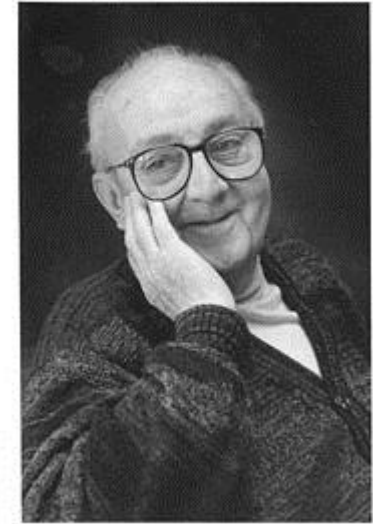
Conclusion

Goals

- Apply Quantitative Risk Management techniques to justify and accelerate risk reduction across the Western Power Network
- Provide a framework to allow assets to be managed proactively

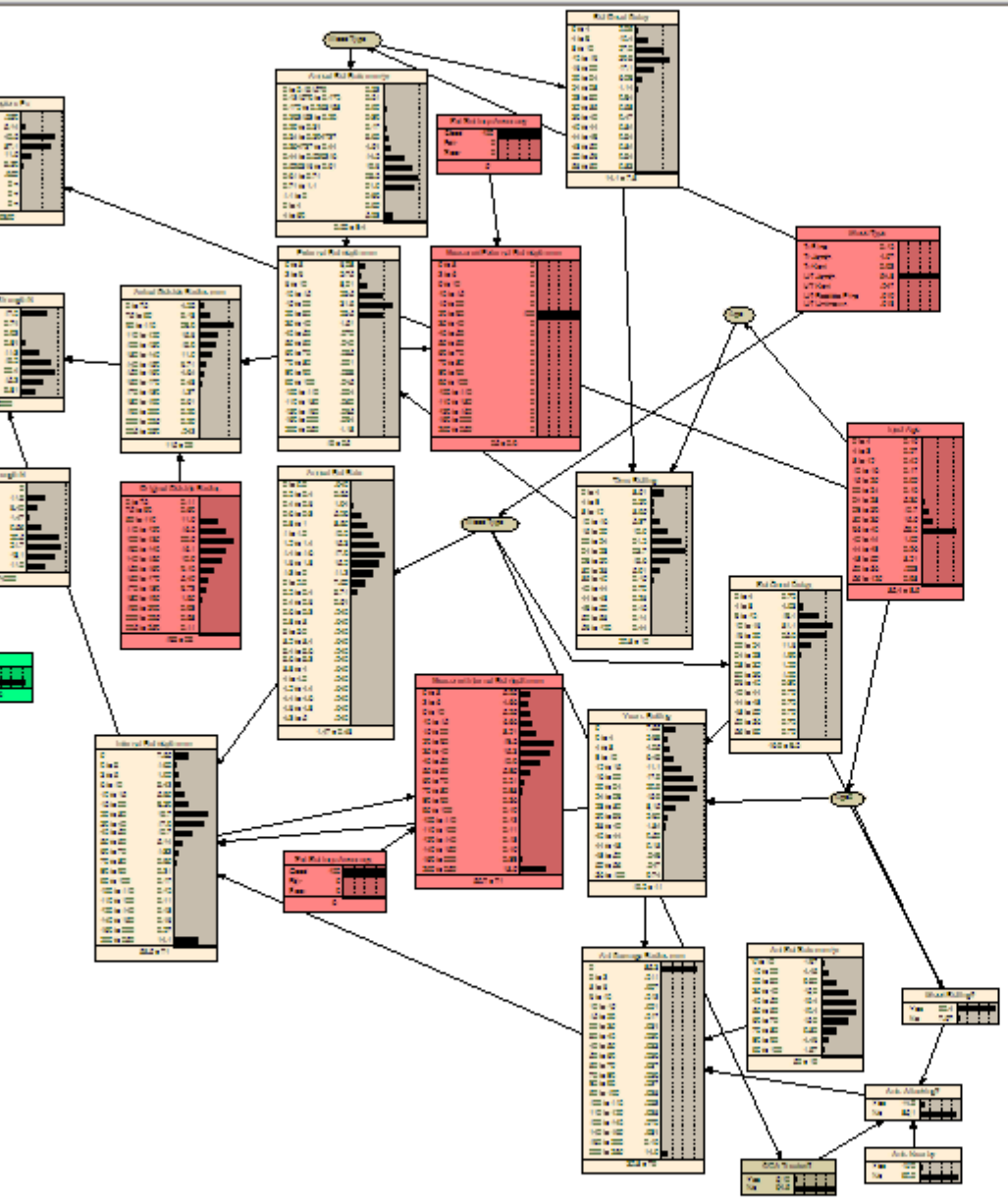
Next Steps

- Model 24 Priority Assets Work with Asset Managers to embed network risk tool in strategy development
- Embed NRMT as a strategic reporting tool in the data warehouse
- Enhance the current work packaging to optimise risk reduction
- Strengthen quantitative risk analysis and data analytics capabilities



“We have a large reservoir of engineers (and scientists) with a vast background of engineering know how. They need to learn statistical methods that can tap into the knowledge.”

George E.P. Box Statistician



Thank you

- Many thanks to all the organisers of the conference for providing me with the opportunity to share this work.
- If you have any questions or comments, please contact me,
- Ian Hord, ian.hord@westernpower.com.au