BY DATA, BE DRIVEN: IMPROVING DECISION-MAKING IN THE SAFETY MANAGEMENT STUDY PROCESS

Simon Braun (Presenter), Joe Short, Ricardo Almandoz, Michael Schorr · 2023 APGA Annual Convention & Exhibition · © ROSEN Group

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INTRODUCTION
SAFETY MANAGEMENT STUDY PROCESS IN AS/NZS 2885.6

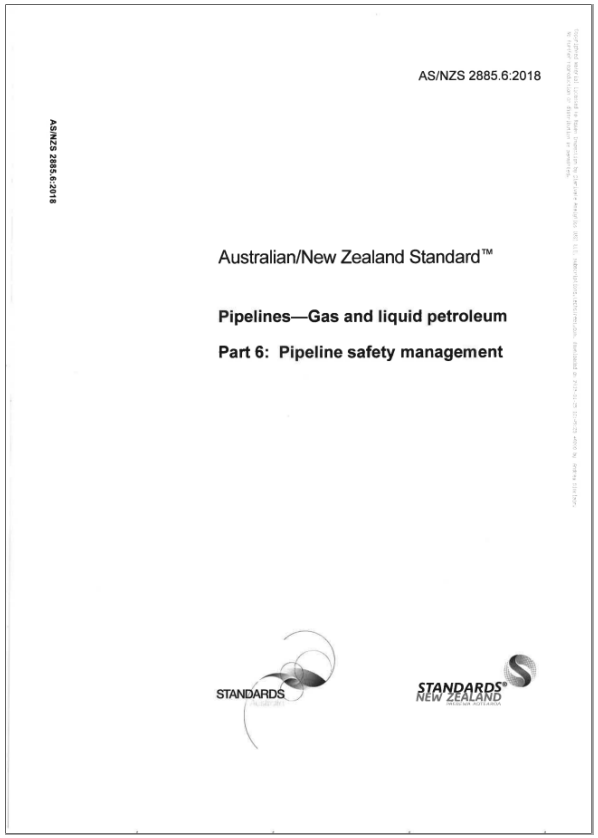
Safe operation of pipelines is of paramount importance (→ energy transition / energy security).

Key component of AS/NZS 2885.6:2018 safety management process → **Safety Management Study ('SMS')**.

Structured process to:

- apply safety management principles;
- identify relevant and credible pipeline threats;
- determine appropriate threat controls;
- determine and minimize residual risks.

Precondition: Detailed operational knowledge of the pipeline and reliable input data from multiple sources.



INTRODUCTION
SAFETY MANAGEMENT STUDY PROCESS IN AS/NZS 2885.6

The SMS in includes the following main steps:

- **Location Analysis and Classification**
- **Threat Identification** and **Threat Control** – Qualitative assessment of whether
  - a threat is location specific or not
  - a threat is credible or not
  - a credible threat is controlled or not
- **Failure Analysis and Risk Assessment** – if a threat is credible and not controlled then
  - Identification of credible failure modes and scenarios
  - Qualitative Assessment of Failure Frequency, Consequence Severity & Risk mapping to Risk Matrix
- **Risk Treatment**
  - Risk reduction measures to control &/or reduce residual risk

SECTION 3 SAFETY MANAGEMENT PROCESS

3.1 BASIS OF SECTION

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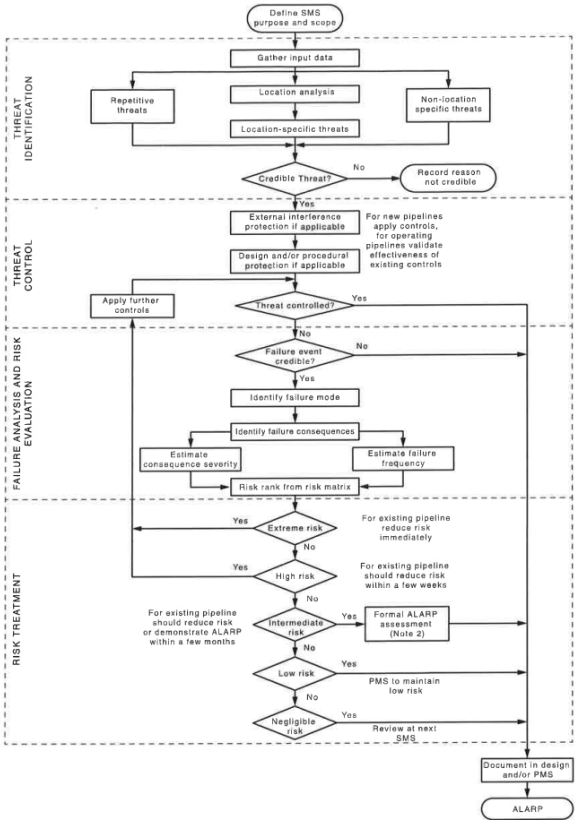
OPERATOR'S CHALLENGES
POTENTIAL CHALLENGES IN SMS PROCESS

Inherent subjectivity and generality (to a certain extent):

- Sometimes threat controls are listed without considering how applicable they are at the local level.
- Some controls are assumed to be present without data to validate assumptions (e.g. wall thickness; yield strength; …).
- Although inspection options and data may be available, often nominal values are used.

'Broad-brush approach':

- Has been necessary to some extent.
- Historically, handling various and huge data amounts within the time-bound nature of an SMS workshop setting would be impractical.



OPERATOR'S CHALLENGES
DATA MANAGEMENT CHALLENGES

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Data → Information → Decision

Data = Basis for any integrity / risk assessment

Essential input to all related processes to generate results (information), allowing operators to take data-driven actions.

Challenges faced with regard to data when performing risk assessments:

- Availability (incomplete, null or default data)
- Quality and format consistency
- Managing of huge data volumes
- Combination of data from various sources
- Human errors
- …

OPERATOR'S CHALLENGES
THE COMPLEXITY OF RISK ASSESSMENT

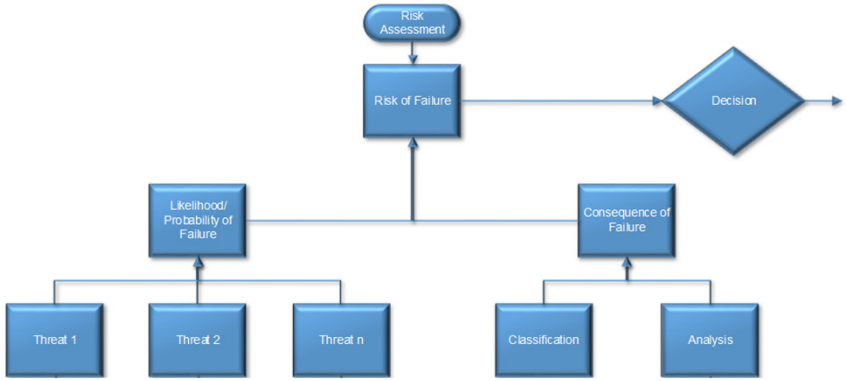
Risk assessment is an essential element in the IM process → Assessing activities to control threats and mitigate risk in a structured method.

Combination of likelihood ('frequency') that a threat will reduce the pipeline's integrity and lead to failure, together with a measure of resulting consequences ('severity').

The function looks simple, but the risk assessment process could range in complexity.

AS/NZS 2885.6 → 'Credible' and 'Not Controlled' threats shall be investigated by risk assessment.

Risk = f(PoF,CoF)



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SMS / RISK ASSESSMENT SUPPORTED BY A DATA-DRIVEN INTEGRITY MANAGEMENT PLATFORM

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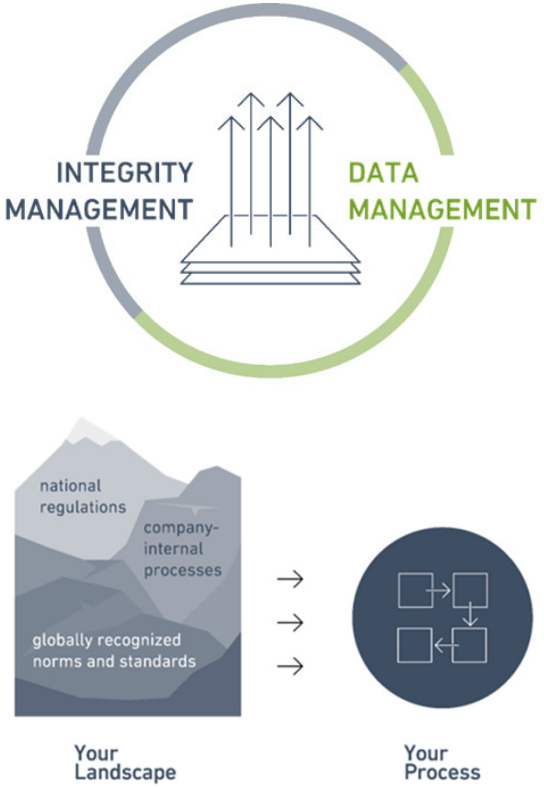
Risk assessment should lead to a decision being made. However, this process could be quite complex.

How can we become more efficient in the SMS?

Operators would require a tool that:

- provides a single interface for SMS participants;
- manages multiple, disconnected datasets;
- acts as decision support tools supported by customizable risk models and processes;
- helps pipeline operators completing a periodic operational phase SMS.

But how could this work?



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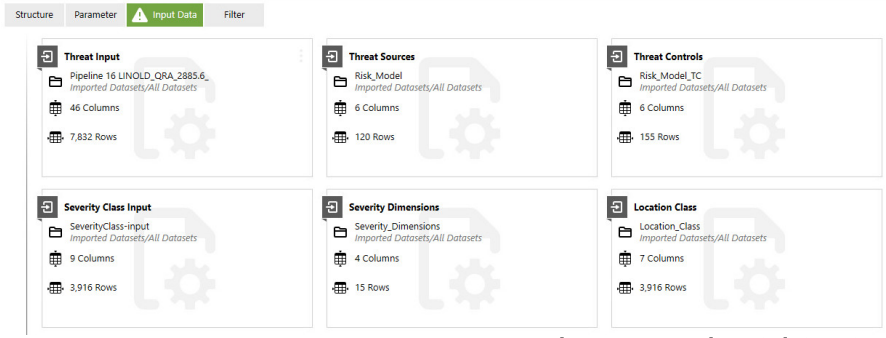
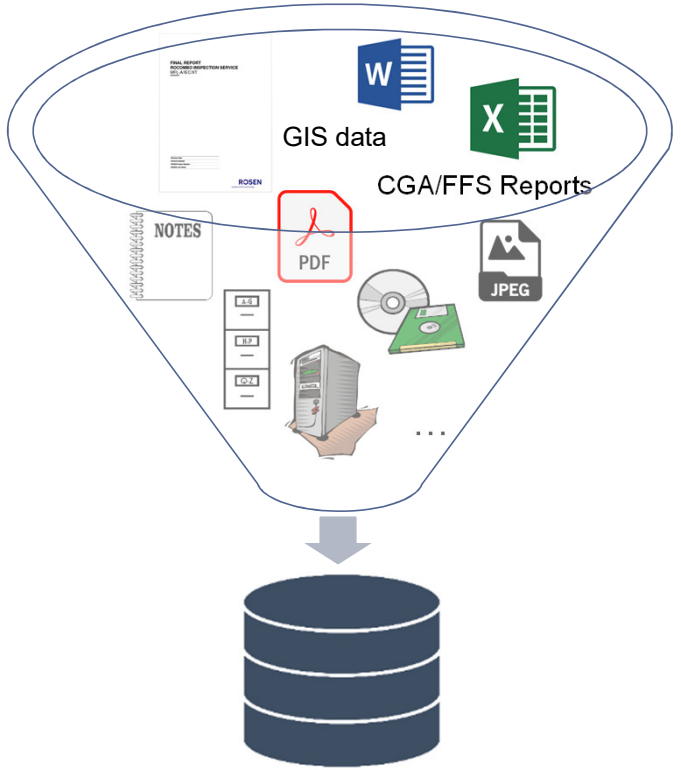
Managing Data Input (AS/NZS 2885.6, sec. 5.2, J3.4, …)

- SMS / risk assessment require a huge variety of input parameters.
- First steps: data collection, processing/transformation, integration and alignment.
- Modern day software solutions support data management process.
- Best-practice:
  - One structured system of record as a single source of information
  - Avoiding data silos
  - Traceable, verifiable and complete data records



… and many more input datasets.



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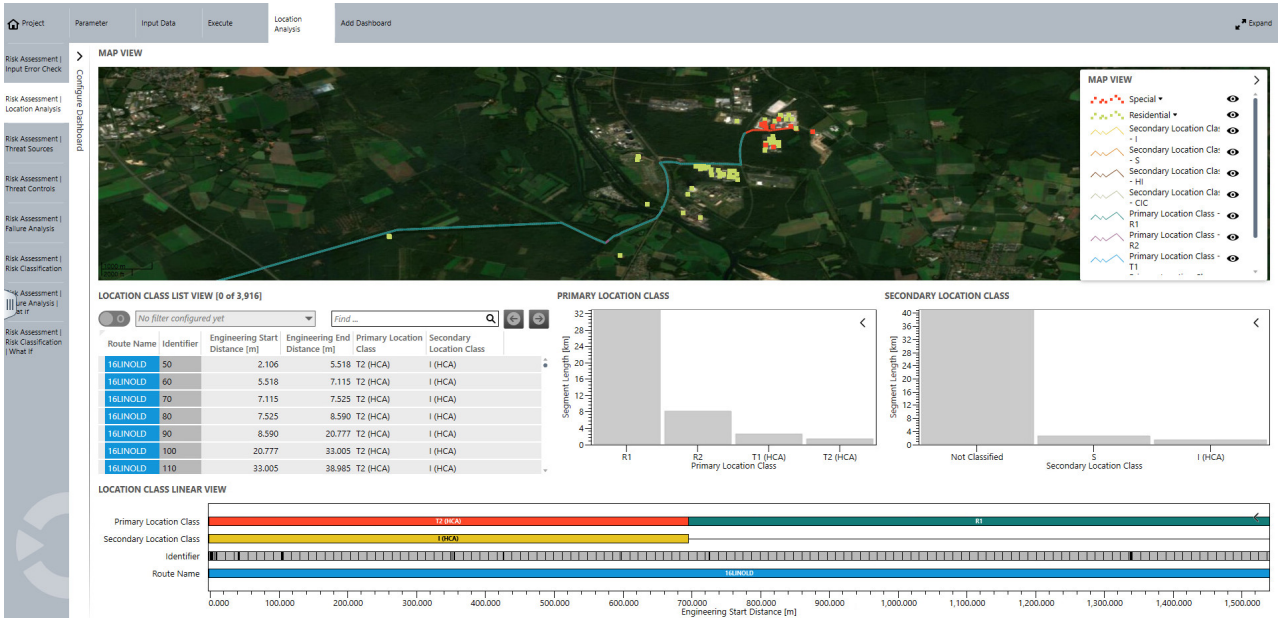
Location Analysis and Classification (AS/NZS 2885.6, sec. 2)

- Process-based approach implemented in modern day software solutions.
- Visualize Primary and Secondary Location Classes (including HCA) along pipeline route.
- Collate, overlay and display large quantities of pipeline data (at pipe joint level).



SECTION 3 SAFETY MANAGEMENT PROCESS

3.1 BASIS OF SECTION

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The pipeline route shall be sectioned according to land use, and each section allocated LOCATION CLASSES that reflect threats to PIPELINE SYSTEM integrity, and risks to people, property and the environment. The primary LOCATION CLASS shall reflect the population density. Where appropriate, one or more secondary LOCATION CLASSES reflecting special land uses shall be allocated to locations along the route.

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Threat Identification / Threat Control (AS/NZS 2885.6, sec. 3.2 / 3.3)

- Threat identification shall generate sufficient information about each threat to allow effective threat controls to be identified and applied.
- For each identified Threat Category → Classification of Threat Sources and Threat Controls at each pipeline segment in accordance with AS/NZS 2885.6.
- Threat Sources and Threat Controls are matrices containing conditional statements based in the form of questions.

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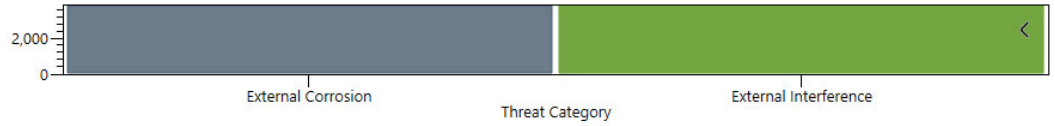
a wide range of THREAT categories that should be considered:

(a) External interference.
(b) Corrosion.
(c) Natural events.
(d) Faults in design, materials or construction.
(e) Faults in operations, maintenance and management systems.
(f) Intentional damage.

PLEASE SELECT ONE OF THE THREAT CATEGORIES TO VIEW ITS INPUTS



THREAT SOURCES [0 of 40 REDUCED VIEW]

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Threat Category	TS ID	Threat Source	TS Answer
External Interference	1	Disposition	Buried
External Interference	1	Disposition	Above Ground
External Interference	2	Vehicular traffic parallel or crossing the right of way (road/rail)	None
External Interference	2	Vehicular traffic parallel or crossing the right of way (road/rail)	Unknown
External Interference	2	Vehicular traffic parallel or crossing the right of way (road/rail)	Rail way
External Interference	2	Vehicular traffic parallel or crossing the right of way (road/rail)	Yes, Road
External Interference	3	Primary Class Location	Location Class R2

THREAT CONTROLS [0 of 66 REDUCED VIEW]

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Threat Category	TC ID	Threat Control	TC Answer
External Interference	1	Protection of the ROW (e.g. fencing, concrete barriers, planting)	Yes - Good Condition
External Interference	1	Protection of the ROW (e.g. fencing, concrete barriers, planting)	Not Required
External Interference	1	Protection of the ROW (e.g. fencing, concrete barriers, planting)	Yes - Poor Condition or unknown
External Interference	1	Protection of the ROW (e.g. fencing, concrete barriers, planting)	No
External Interference	2	ROW Patrol frequency	Daily
External Interference	2	ROW Patrol frequency	Not Required
External Interference	2	ROW Patrol frequency	Weekly Daily

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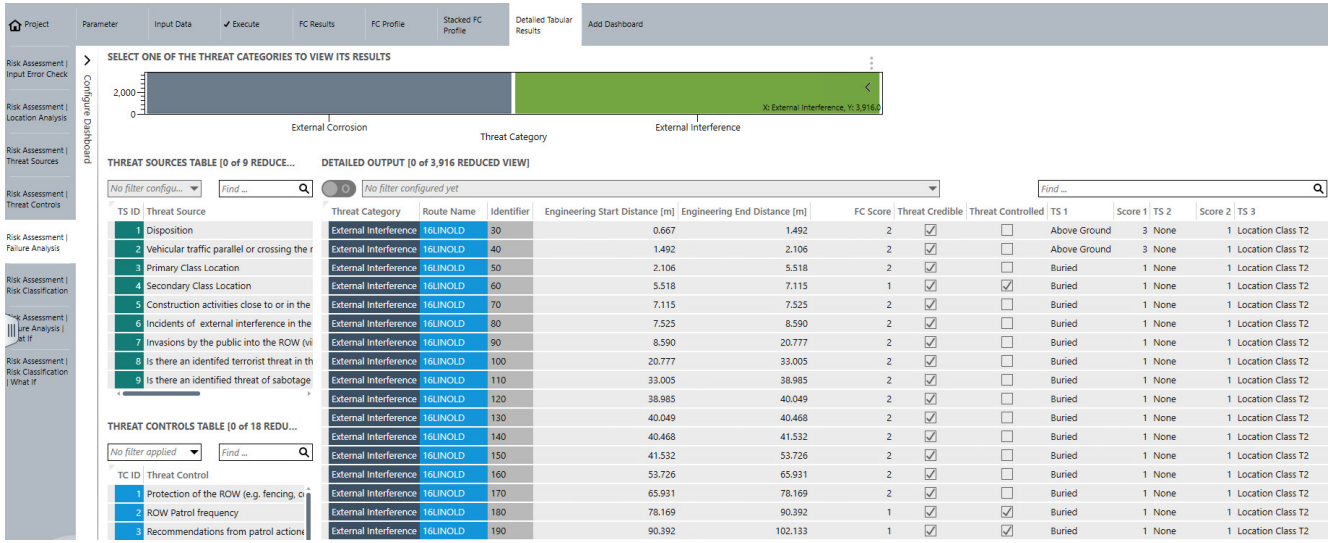
Failure Analysis / Frequency Classes (AS/NZS 2885.6, sec. 3.4 / 3.5.3)

- Answers to Threat Sources and Threat Controls are processed along the pipeline route to identify if any threat category is ‘Credible/Not Credible’ and ‘Controlled/Not Controlled’.
- Failure is considered likely to occur for any threat category at any location (a particular segment) that is classed as ‘Credible’ and ‘Not Controlled’.
- Resulting Frequency Class (FC score) is determined as per AS2885.6 definitions.



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FREQUENCY CLASSES

	Frequency class	Frequency description
FC 5	Frequent	Expected to occur once per year or more
FC 4	Occasional	May occur occasionally in the life of the pipeline
FC 3	Unlikely	Unlikely to occur within the life of the pipeline, but possible
FC 2	Remote	Not anticipated for this pipeline at this location
FC 1	Hypothetical	Theoretically possible but would only occur under extraordinary circumstances

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Severity Classes (AS/NZS 2885.6, sec. 3.5.2)

- Severity Dimensions (People, Supply and Environment) are assessed as per AS2885.6.
- Severity Class profiles provide a qualitative measure of the impact to Severity Dimensions.

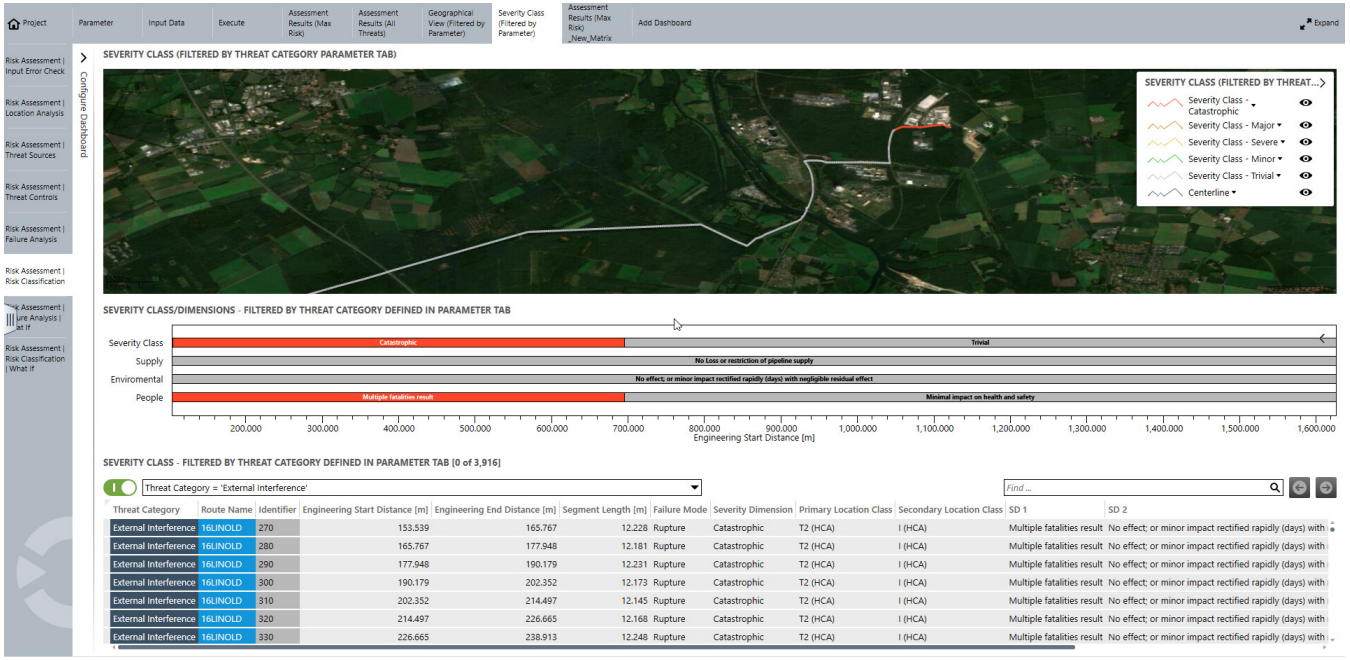

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TABLE 3.1
SEVERITY CLASSES

Dimension	Severity class				
	Catastrophic	Major	Severe	Minor	Trivial
	Measures of severity				
People	Multiple fatalities result	One or two fatalities; or several people with life-threatening injuries	Injury or illness requiring hospital treatment	Injuries requiring first aid treatment	Minimal impact on health and safety
Supply (see Note)	Widespread or significant societal impact, such as complete loss of supply to a major city for an extended time (more than a few days)	Widespread societal impact such as loss of supply to a major city for a short time (hours to days) or to a localized area for a longer time	Localized societal impact or short-term supply interruption (hours)	Interruption or restriction of supply but shortfall met from other sources	No loss or restriction of pipeline supply
Environment	Impact widespread; viability of ecosystems or species affected; or permanent major changes	Major impact well outside PIPELINE CORRIDOR or site; or long-term severe effects; or rectification difficult	Localized impact, substantially rectified within a year or so	Impact very localized and very short-term (weeks), minimal rectification	No effect; or minor impact rectified rapidly (days) with negligible residual effect

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Risk Ranking/Classification (AS/NZS 2885.6, sec. 3.5.4)

- Results of the Failure Analysis (Frequency Class) and Severity Dimensions Class are combined to provide a qualitative measure of risk as per AS2885.6 matrix categorization.
- Visualization of areas of higher and lower residual risk for particular threats and clarity on local residual risks (=outputs of SMS) on pipe joint level.

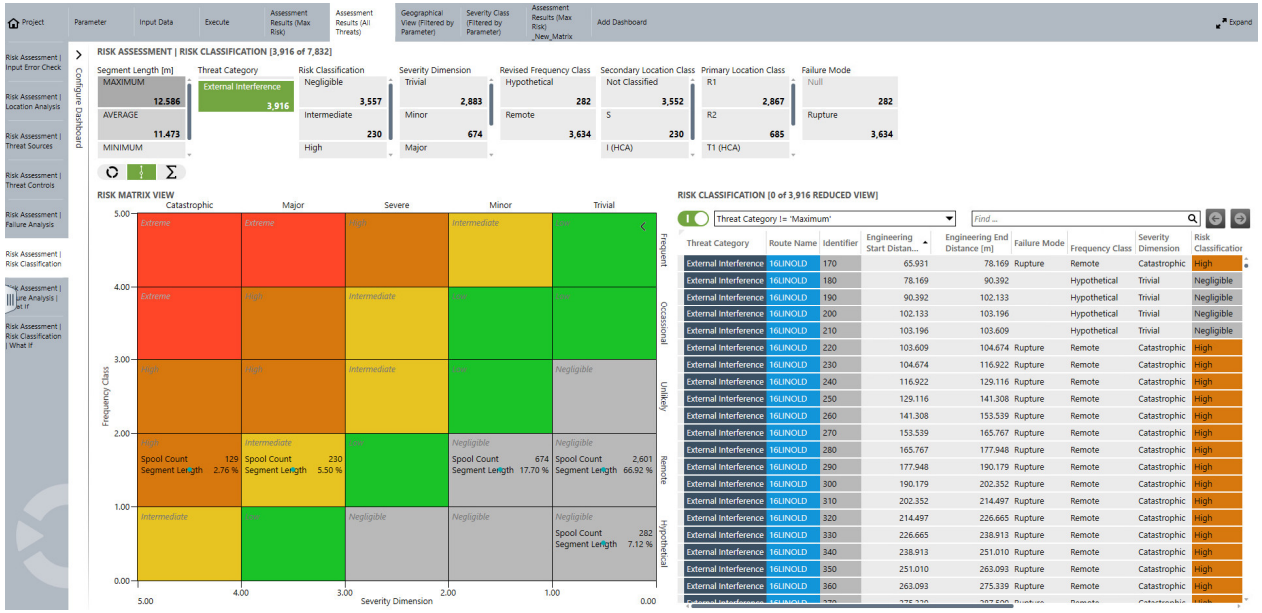

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TABLE 3.3
RISK MATRIX

	Catastrophic	Major	Severe	Minor	Trivial
Frequent	Extreme	Extreme	High	Intermediate	Low
Occasional	Extreme	High	Intermediate	Low	Low
Unlikely	High	High	Intermediate	Low	Negligible
Remote	High	Intermediate	Low	Negligible	Negligible
Hypothetical	Intermediate	Low	Negligible	Negligible	Negligible

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Risk Treatment (AS/NZS 2885.6, sec. 3.6)

- Appropriate risk treatment action(s) shall be assessed.
- What-if analyses assess the sensitivity of changing threat sources, threat control measures &/or severity dimensions values at areas of interest (→ enabled by data!)
- This helps to (re-)assess risk treatment measures and the relative level of risk reduction.

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RISK TREATMENT ACTIONS

Risk rank	Required action
Extreme	Modify the THREAT, the frequency or the consequences so that the risk rank is reduced to Intermediate or lower. For an in-service pipeline, the risk shall be reduced immediately.
High	Modify the THREAT, the frequency or the consequences so that the risk rank is reduced to Intermediate or lower. For an in-service pipeline, the risk shall be reduced as soon as possible. Risk reduction should be completed within a timescale of not more than a few weeks.
Intermediate	Repeat THREAT identification and risk evaluation processes to verify the risk estimation; determine the accuracy and uncertainty of the estimation. Where the risk rank is confirmed to be "intermediate", where reasonably practicable modify the THREAT, the frequency or the consequence to reduce the risk rank to "low" or "negligible". Where it is not reasonably practicable to reduce the risk rank to "low" or "negligible", action shall be taken to— (a) remove THREATS, reduce frequencies and/or reduce severity of consequences to the extent practicable; and (b) formally demonstrate ALARP (see Section 4). For an in-service pipeline, the reduction to "low" or "negligible" or demonstration of ALARP shall be completed as soon as possible. Risk reduction or demonstration of ALARP should be completed within a few months.
Low	Determine the management plan for the THREAT to prevent occurrence and to monitor changes that could affect the classification.
Negligible	Review at the next relevant SMS (for periodic operational review, LAND USE CHANGE, ENCROACHMENT, or change of operating conditions).

CONTENT

CONCLUSION

Risk assessment is an important factor of integrity management → key element of the SMS.

Modern day integrity management software support gathering, processing, and integrating large data quantities in a consistent and structured way.

Granular, location-specific risk assessments at pipe joint resolution → more informed, realistic SMS.

Compared to ‘traditional approaches’, integrity management software solutions provide a single interface for all SMS participants and enable improved **decisions driven by data**.

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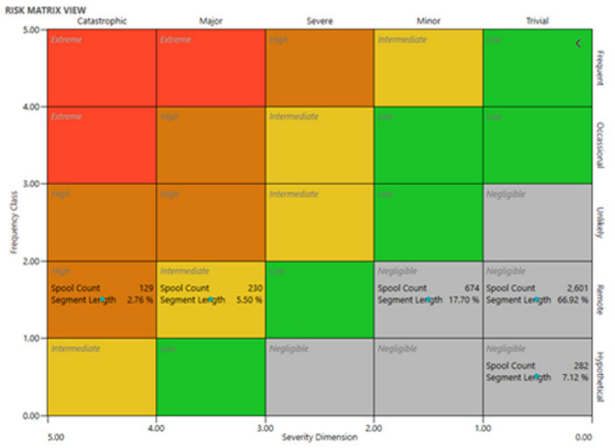

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