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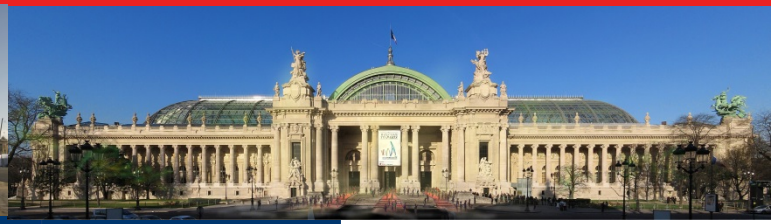

Pipeline Integrity Management System
STUDY GROUP REPORT

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WORLD GAS CONFERENCE

Presentation Content

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Scope and Purposes

In the Triennium 2012 to 2015 IGU Working Committee 3's (WOC3) Study Group 3.2 (SG3.2) has been assigned to study on enhancement of Pipeline Integrity Management Plans (IMPs) to reduce risk of failures and incidents based on Pipeline Integrity Management System (PIMS) approach to:

- define Pipeline Integrity Management System Approach.
- provide information on new development to reduce the gaps in integrity threat management.
- propose strategies to prolong the life of ageing pipelines or to reclassify the ones in use.
- describe what governments, companies and suppliers are doing to improve "Third party damage prevention" (including the application of new rules).
- identify the critical tasks that affect integrity management.
- provide appropriate competency for personnel performing critical tasks.

In addition, the SG 3.2 is assigned to build and maintain a pipeline database of WOC 3.

Methodology

- The method that WOC 3 employed to conduct the investigation was via survey of its member countries .
- Questionnaires were developed based on the following sub-topics :
  - PIMS : 21 questions
  - Pipeline database : 8 questions
  - Threats identification :12 questions
  - Third Party Damage : 50 questions
  - Managing Ageing Pipelines : 22 questions
- 21 countries corresponding to 23 companies responded to the survey questionnaires
- To add a value, 03 best practices, new technologies & lessons learnt were consolidated from three companies

Pipeline Integrity Management Systems

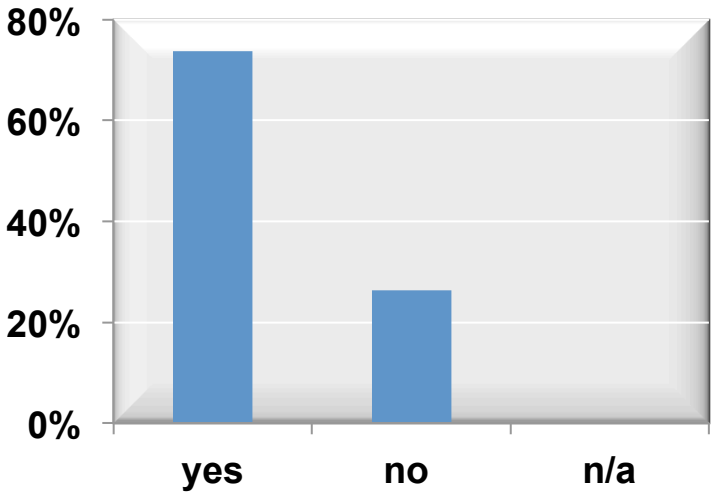
The objective is to measure the degree of maturity in the field of PIMS within the gas industry (transmission system operators). The questionnaire covered items regarding

- Policy / Strategy
- Data review / Procedure
- Risk Assessment
- GIS
- Improvements & audits

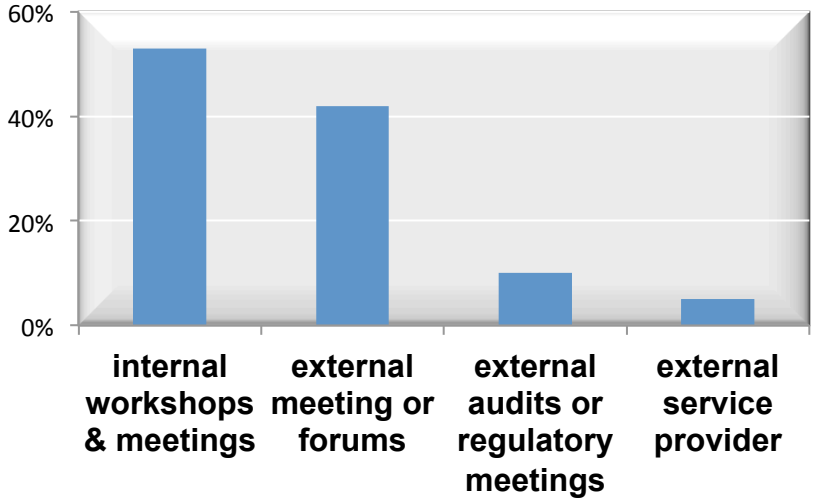
Twenty gas transmission system operators (TSO) replied

PIMS : Main excerpt 1/2

Part of the TSOs which have written policy and/or philosophy pertaining to pipeline reliability and integrity

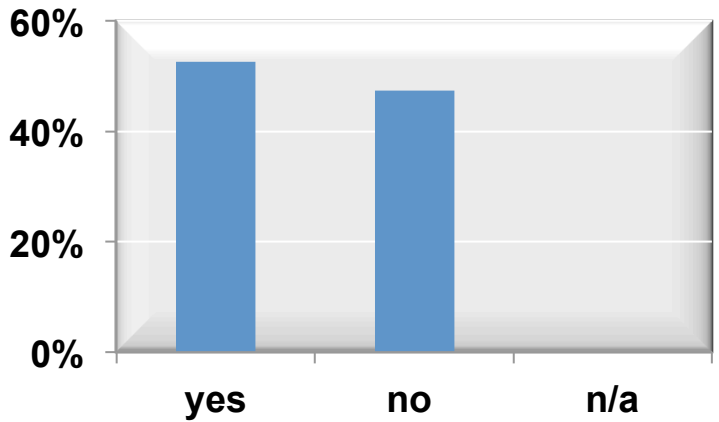


79 % of the TSOs have a specific forums to discuss/reports matters pertaining to pipeline reliability and integrity

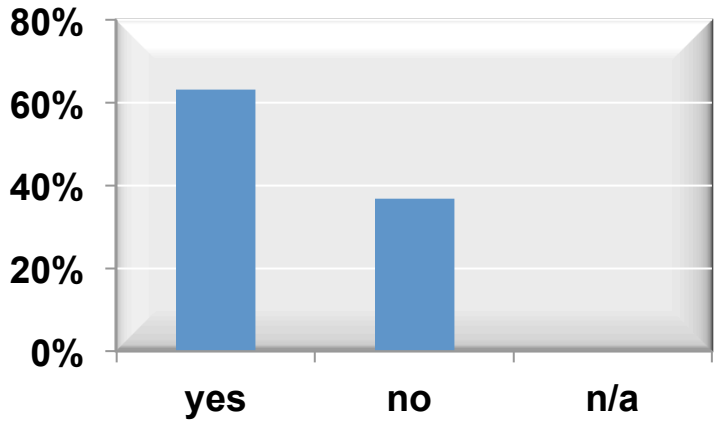


PIMS : Main excerpt 2/2

Part of the TSOs which have an authority or procedure for reviewing, endorsing or approving any technical deviation with respect to pipeline integrity management



Part of the TSOs that have specific audit or assessment plan or program for pipeline integrity management



PIMS : Lessons learnt 1/2

Policy / strategy :

- Safety and reliability are nowadays for most gas transmission operators the object of a structured policy/strategy which may be considered as a fundamental step before dealing with an integrity management tool such as PIMS.

Data review / procedure

- A solid PIMS must lean on a strong data basis in order to assess all the technical issues in which a transmission operator is involved. Most of the companies are already following this principle and the remaining ones are on their way to do so.

Risk assessment

- The notion of risk assessment is totally assimilated by gas transmission operators. (Even if the questionnaire shows that not all the TSOs are prepared to perform risk assessments, the situation is moving towards the principle of risk evaluation in order to identify and classify all the threats that any company is coping with.

PIMS : Lessons learnt 2/2

GIS :

- Linear assets like pipeline networks must undoubtedly be managed by a GIS. Not only characteristic data are to be targeted in such a system, but all the needed data in order to perform a risk assessment or even a safety study. Therefore GIS should be enriched by other relevant data : environment, maintenance acts, incidents, technical documentation, inspection reports, …

Improvements & audits :

- Any management system needs to be continuously improved. Improving requires competent personal as well as periodic reviews to measure the global performance. Audits contribute to such improvements.

Pipeline database

- The objective is to gather data on the gas transmission systems of the participant TSOs, for building and maintaining a database of the transmission systems.

- The WOC 3's 2014 transmission system database, fulfill the following gas pipeline conditions: Made of steel – Onshore - High pressure

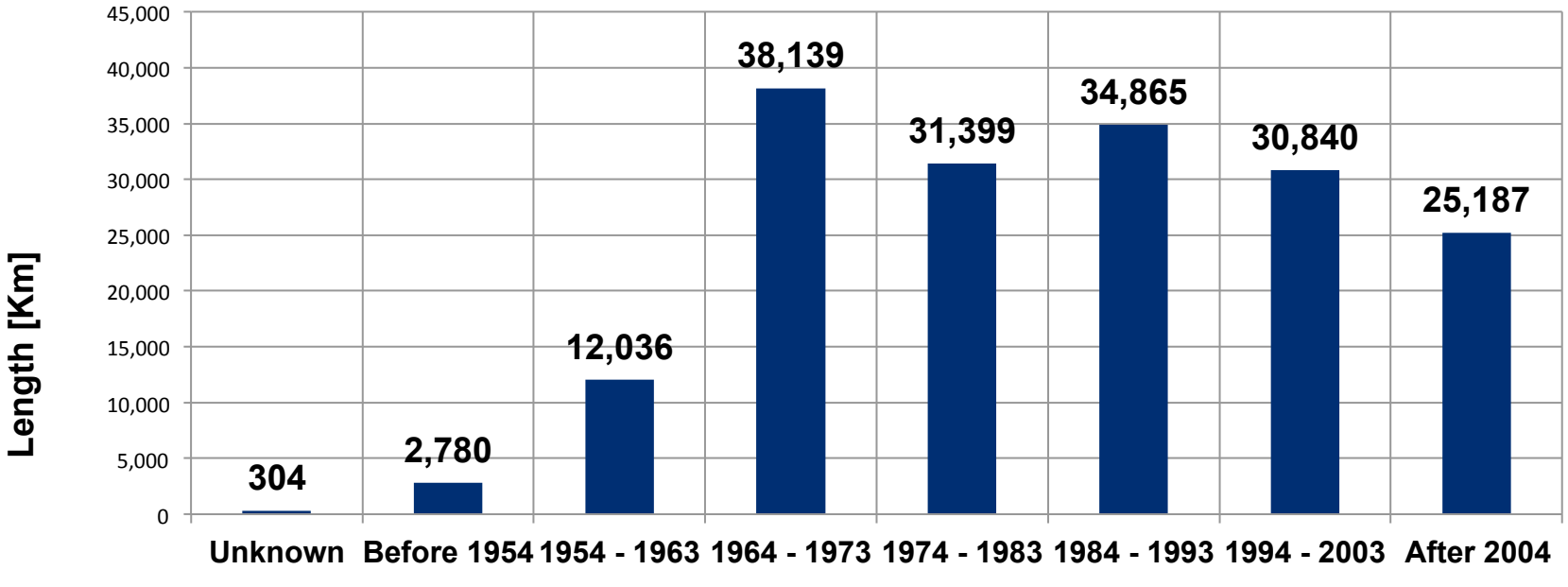
- And include the following main information:
  - Nominal Diameter and wall Thickness - Material grade
  - Year of construction - Cover Depth - Operating Pressure - Coating type

- 22 TSOs transmitted their gas transmission data, which is valuable source of information and reference that is used to help TSOs when utilizing the different results gotten from the PIMS's report

Pipeline database : Main excerpt 1/2

Total length :

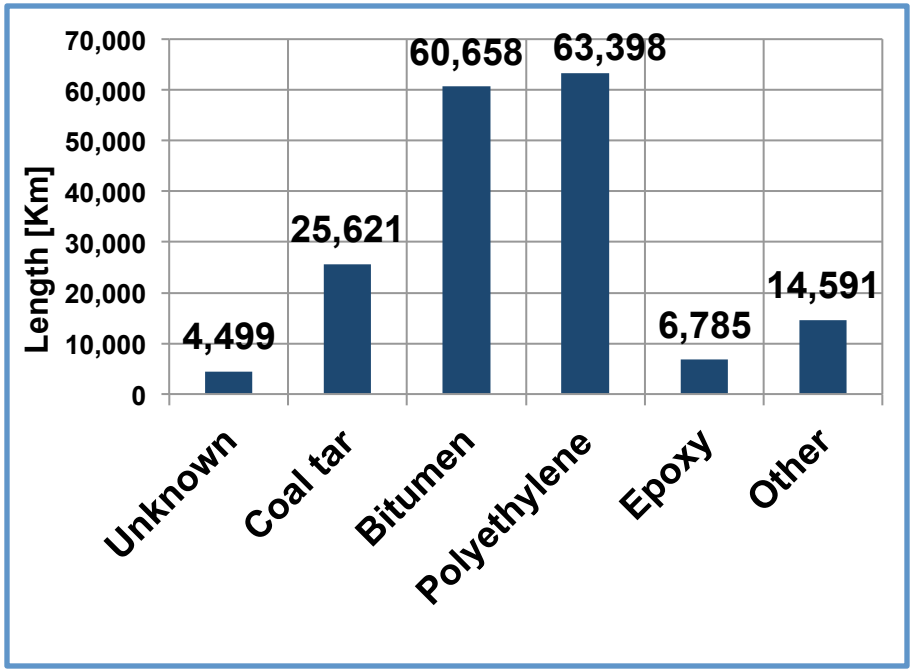
The total length of the 22 TSOs, which participated during the year 2014, is **175 551** Km



> 30 years	**43,23 %**	> 40 years	**23,40 %**	> 50 years	**6,84 %**

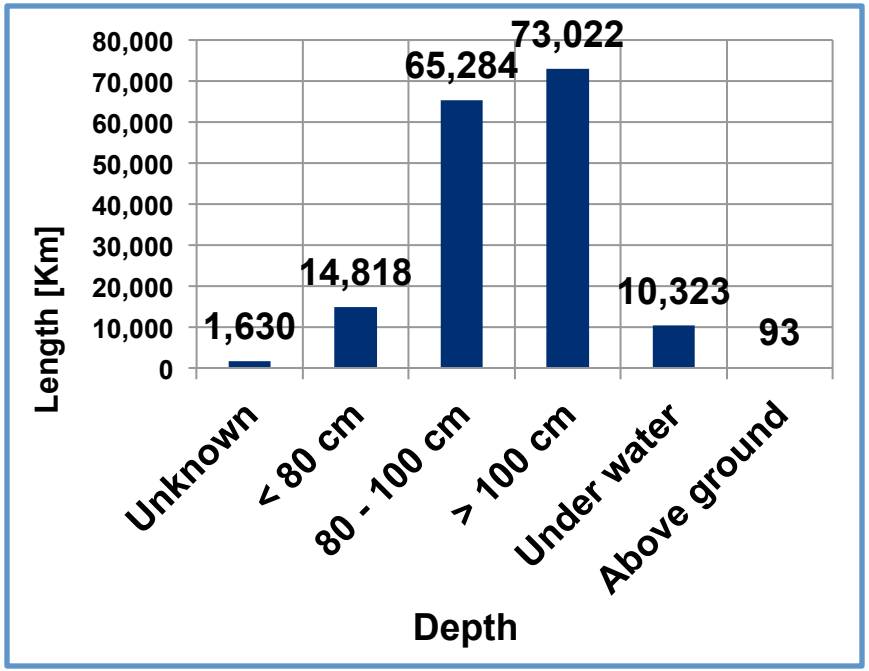
Pipeline database : Main excerpt 2/2

Coating type:



Bitumen	35%	Polyethylene	36%

Cover depth:



80 - 100 cm	40%	> 100 cm	44%

Threat Identification

- The objective is to identify opportunities to strengthen the current threat mitigation practices for managing pipeline integrity.

- The questionnaire were developed for the purpose of analyzing the threats and possible gaps in ensuring future management of pipeline integrity would be more effective, efficient and cost optimum:

  - Third Party Interference - External Corrosion - Geotechnical Hazards
  - Operator Error - Manufacturing Defects - Welding and Fabrication Defects/ Construction Errors - Stress Corrosion Cracking - Internal Corrosion.

- Twenty gas transmission system operators (TSO) replied

Threat Identification：Main excerpt 1/2

Third Party Interference

77% of TSOs classified “Third Party Interference” as one of the top five threats to their pipelines.

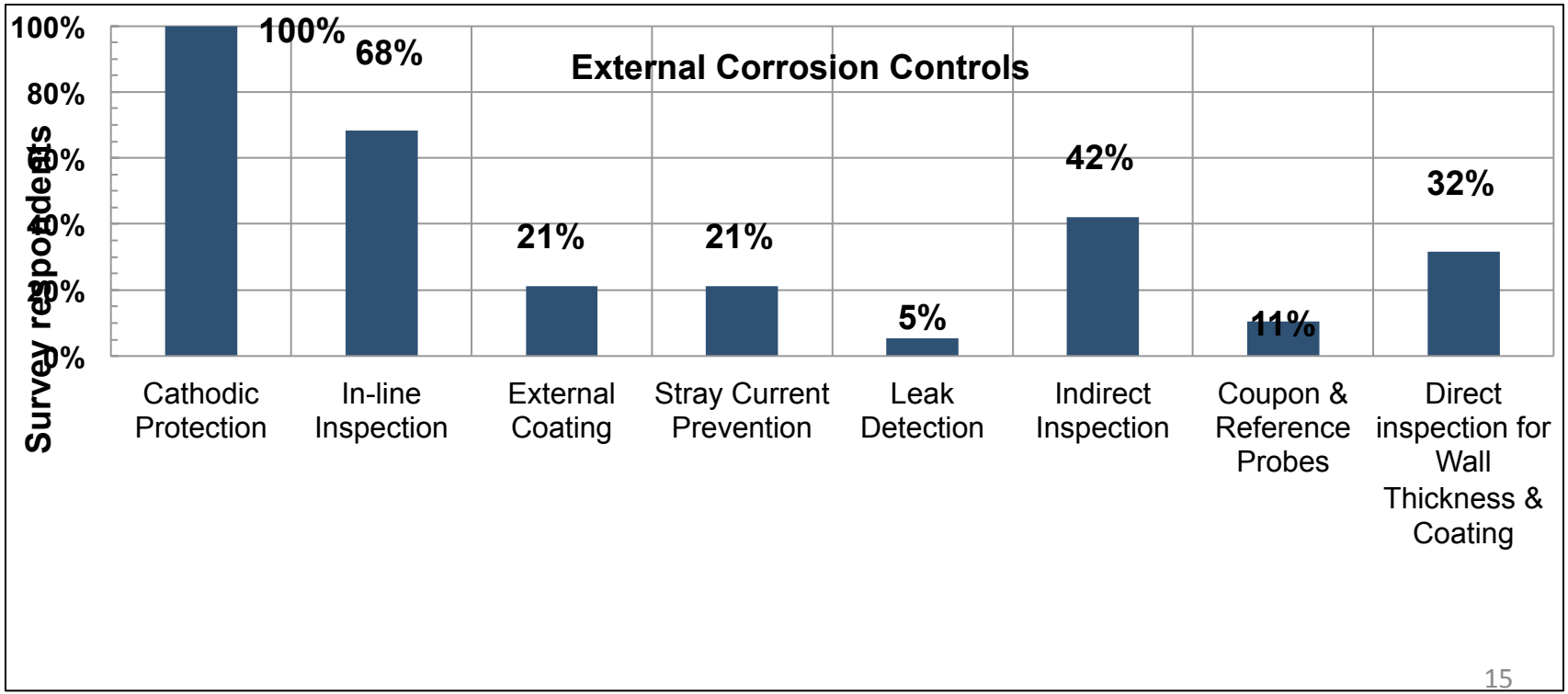
Five most common controls or mitigations implemented by global TSOs to prevent the threat of TPI are listed below in order of their preference (from top-to-down):

- Patrolling (Ground and Aerial)
- Stakeholder and Community Consultation
- Warning Signage and Marker Posts
- Protection by separation (depth of cover, concrete slab, conduit)
- Design (pressure regulation, wall thickness

The analysis of the survey results indicate that approximately 80% TSOs rank patrolling and stake holder consultation as the major controls in preventing TPI

Threat Identification：Main excerpt 2/2

External Corrosion : Identified as the second biggest risk to pipeline integrity.



Third Party Damage

- Third Party Damage has been deemed to be the biggest threat to pipelines by global Transmission System Operators.

- In order to identify the most commonly used measures by TSO to reduce TPD, the questionnaire covered items regarding :

  - Pipe design legislation
  - Requirement of civil engineering work
  - Survey and proactive control
  - Emergency plan

- Nineteen transmission system operators (TSO) replied

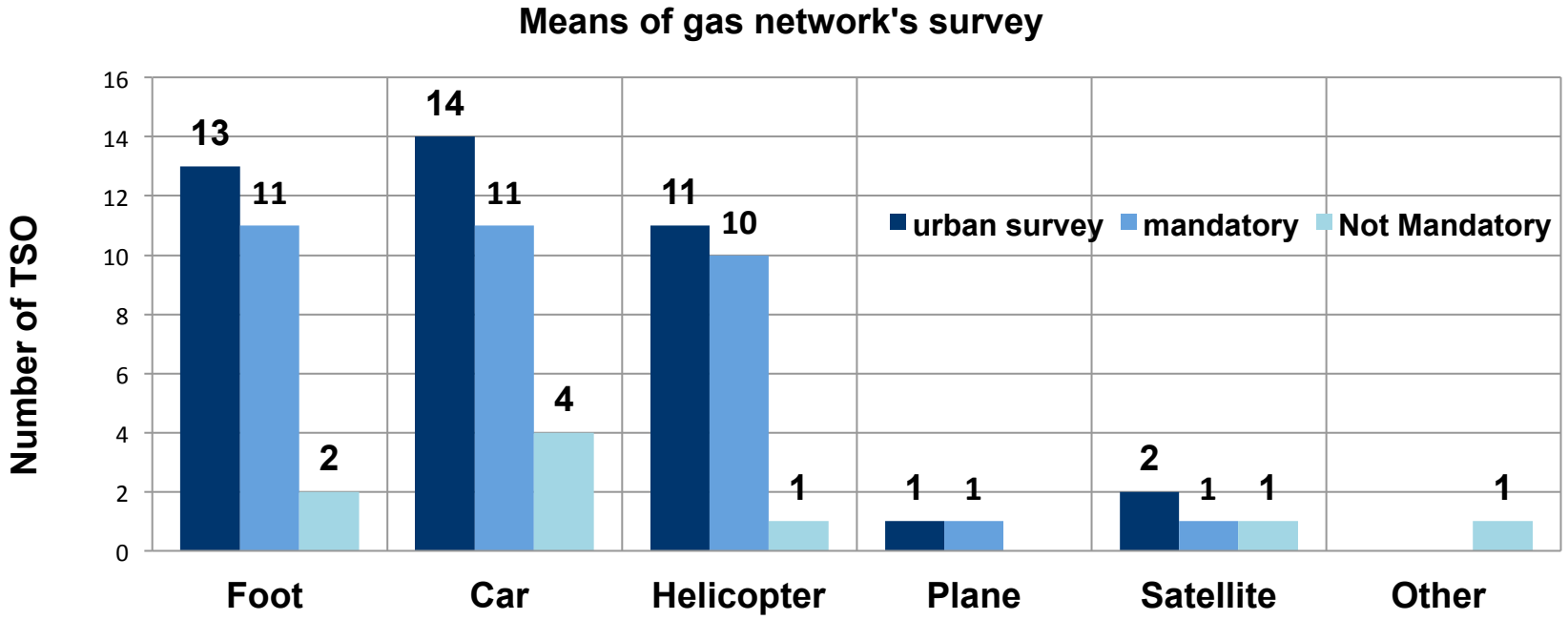
Third Party Damage Main excerpt 1/2

Restricted zones in the vicinity of gas network

Zone where	Having **national legislation** : 17					**Without** national legislation : 02	
	Distance to the pipe D[m]			Remarks		D[m]	
	min	max	Average			min	max
mechanical works are forbidden	**0.3**	**25**	**8.5**	One TSO answered 0	For the average we didn't take into account the distance of 200 m given by 04 TSOs.	***1***	**1.5**
the gas company must be informed for any kind of works	**2.5**	**200**	**14.4**	*Two TSO answer a minimum of 0*		**0**	**2.5**
a systematic removal of trees in the pipeline right of way is performed	**2**	**15**	**5.7**	One TSO answered 0		**-**	**3**

Third Party Damage Main excerpt 2/2

Means of survey



Managing Ageing Pipelines

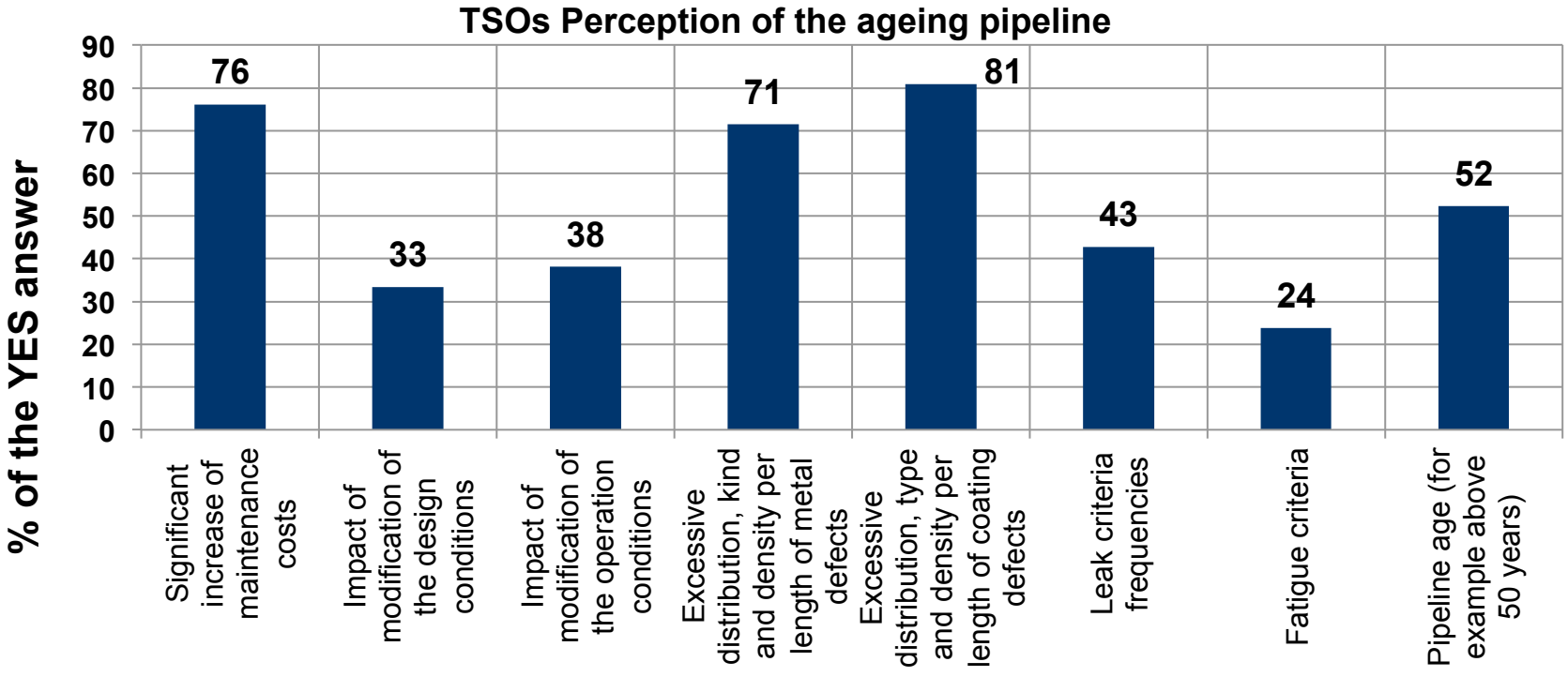
- The objective is to extract some basic TSOs internal procedures which are deployed locally in order to reach as much as possible an objective decision related to steel pipeline rehabilitation, replacement or downgrading, the questionnaire covered items regarding :

  - Design Life - Assessment of the pipeline technical current state
  - Pipeline replacement, downgrade or rehabilitate - Use of a decision procedure or a tool
  - Basis of assessment (Technical or technical and financial tool, Financial or technical-financial tool)
  - Replacement program.

- Twenty one gas transmission system operators (TSO) replied

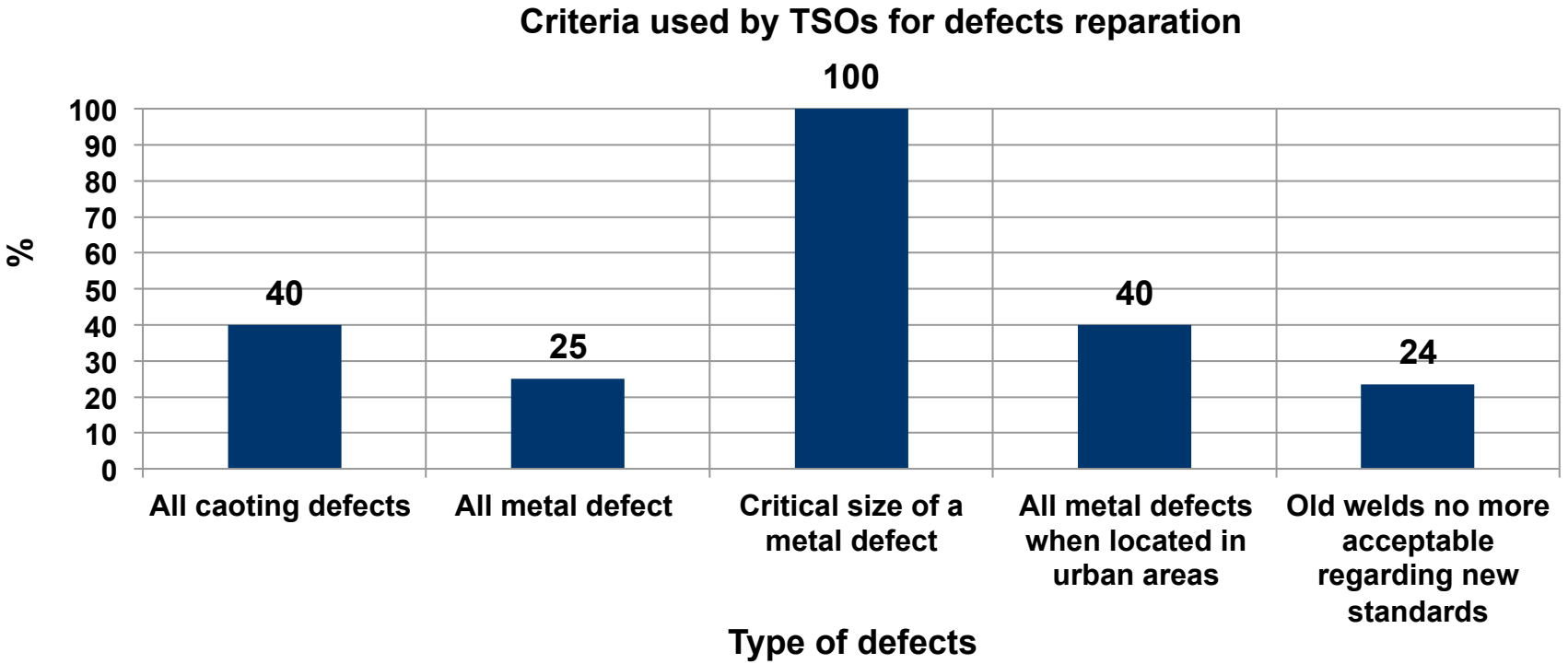
Managing Ageing Pipelines Main excerpt 1/2

What is an aged pipeline ?



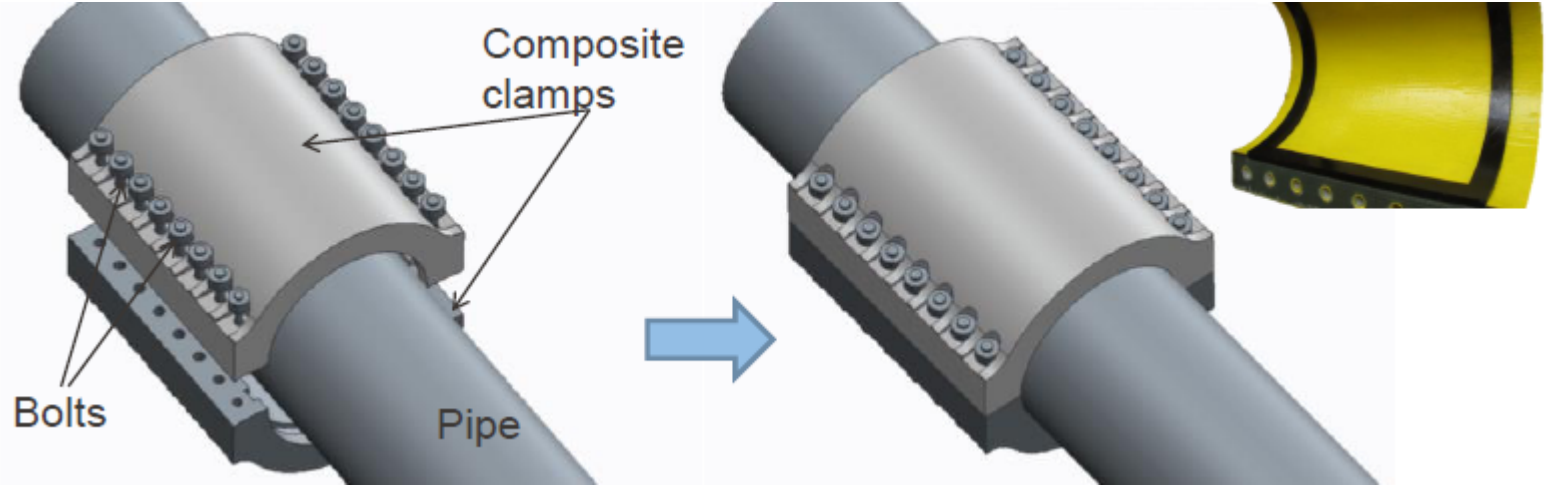
Managing Ageing Pipelines Main excerpt 2/2

Criteria used by TSOs for defect reparation



Best Practices, New Technologies & Lessons learnt

- Kogas : Remaining life prediction using statistical analysis of ILI pigging data
- TGS :External Corrosion Threat Management
- PETRONAS : Composite Repair Clamp for Pipeline & Piping Leak Repairs



Conclusions and Recommendation

- TSOs in WOC 3 are implementing PIMS anchored on six critical elements i.e. policy and strategies, data management and establishment of related procedures, conducting risk assessment of pipelines to prioritize inspections and maintenance activities, utilizing GIS to aid in decision making, performing audits/reviews for continuous improvement, and having comprehensive emergency response management particularly in managing failures and incidents
- TSOs are already mature in implementing various mitigation and control measures in managing the integrity threats
- TSOs evaluate any pipeline technically and economically before arriving to decision of replacement or downgrading or rehabilitation/repair. Although technical evaluation can be considered mature and established, survey results found out that economic evaluation using CAPEX and OPEX i.e. life cycle cost analysis (LCCA).
- The importance of human factor in PIMS i.e. competent engineers; field and control room technicians/operators are the ‘KEY’ success factor in overall pipeline integrity management.

Conclusions and Recommendation

- For further improvement of PIMS that can be beneficial both technically and commercially to worldwide TSOs, it's recommended :

  –To conduct conceptual study for utilizing artificial intelligence in overall pipeline integrity management from data acquisition, analysis, decision support, repair and rehabilitation.

  –To perform situational assessment or gap analyses on the low utilization of real-time remote monitoring of third party interference and life cycle cost analysis (LCCA) tool as one of decision making tools for aging pipeline management.

  –To study to establish standardized framework on structured technical capability to develop program for pipeline engineers and technicians .

Thank you for you attention