Development of a Global Information System and Network to support the improvement of Occupational Radiation Protection in Industrial Radiography - ISEMIR (IR)

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"ALARA in Industrial Radiography - How can it be improved?"

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International Atomic Energy Agency

ISEMIR
Information System on Occupational Exposure in Medicine, Industry and Research

Background to ISEMIR

- Information System on Occupational Exposure in Medicine, Industry & Research
- There are some areas in medicine, industry and research where radiation uses can lead to significant occupational exposures
  - Both in normal operations and in accident situations
- But detailed information at the operational level is lacking

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ISEMIR – the launch

- January 2009, for an initial 3 year period, to help improve occupational radiation protection in targeted areas
  - 2 Working Groups, initially
    - Interventional Cardiology, commenced Feb 2009
    - Industrial Radiography, commenced Jan 2010

ISEMIR

Information System on Occupational Exposure in Medicine, Industry and Research

What are the objectives?

- improving occupational radiation protection
- facilitate the implementation of ALARA practices and effective exposure management
- efficient collection and maintenance of data on occupational exposure and radiation practices
- analysis of occupational doses of individuals in IR
- benchmarking individual performances against global or regional data
- defining follow-up actions to address identified gaps and disseminate lessons learnt

ISEMIR

Industrial Radiography (IR)

- based around annual information reported from NDT companies

What is ISEMIR?
https://nucleus.iaea.org/isemir/

- Is an **online web-based tool** for radiation protection optimization
- ISEMIR project was initiated by the IAEA in January **2009** assisted by an Advisory Group (with representatives of international organisations such as UNSCEAR, EC, NEA/OECD as well as the five main world regions)
- The Advisory Group identified two topical areas where occupational radiation protection for the workers faces unresolved issues and gaps:

  INDUSTRIAL RADIOGRAPHY and

  INTERVENTIONAL CARDIOLOGY

Working Group Industrial Radiography (WGIR)

From left to right: Christian Lefaure, Francisco Da Silva, Kamal Sahaimi, Gonzague Abela, Richard van Sonsbeek, Matthias Purschke, A. Razak Hamzah, John Le Heron
(Thomas Levey is not on the picture)

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Composition of WGIR

Name	Region	Stakeholder
G. Abela	Europe	Client
M. Purschke	Europe	NDT Society
T. Levey	North America	Operating Company
A. Razak Hamzah	Asia	Technical Service Organization
K. Sahaimi	Africa	Training provider
F. Da Silva	Latin America	Technical Service Organization
R. Van Sonsbeek	Europe	Operating Company
J. Le Heron	Scientific Secretary	IAEA
C. Lefaure	Consultant	IAEA

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Objectives of our effort

Keeping ALARA:

1. the dose due to normal exposure
   - if normal exposure is justified!
2. the risk of exposure due to accidents
   - (risk: combination of probability for and consequence of an accident)

Please note that we have not (yet) focused on the security of radioactive sources.

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Agreed Mandate

- To draw an overview picture of the situation concerning occupational exposures and radiation protection of staff in Industrial Radiography (radiographers and other industry and client staff members) all over the world.
- To identify both good practices and shortcomings and define all types of actions (training, managerial, behavioural…) to be implemented for assisting the industry, clients, and regulatory bodies in avoiding exposures to accidents, and implementing the ALARA principle.
- To propose recommendations for harmonising monitoring procedures.
- To set up a system for regularly collecting occupational doses for these individuals and for dissemination of this information.

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WGIR conducted a world-wide survey

- to gain insight into the current practice of occupational radiation protection in industrial radiography
- respectively addressed to
  - Regulatory Bodies (Licensing bodies for radiation protection)
  - Operating Companies (Licensees)
  - Industrial Radiographers (“Operators”)

Subjects of questionnaires

1. qualifications and training of radiographers in radiation protection,
2. learning from incidents (accidents, near misses, deviations from normal operations),
3. systems and procedures in place for safe operation,
4. emergency preparedness and response, and
5. individual monitoring.

The IAEA Specific Safety Guide on Radiation Safety in Industrial Radiography (IAEA Safety Standards Series No. SSG-11) was used to develop questions. The report was published in October 2012:
http://www-ns.iaea.org/tech-areas/communication-networks/orpnet/documents/wgir-survey-report-main-text.pdf

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Conclusions (1 of 3)

- Initial radiation protection training for radiographers is reasonably well established, but there is room for improvement especially with respect to refresher training and practical emergency response training
- The frequency of occurrence of incidents (accidents, near missed and deviations) is not trivial, and methods such as better incident reporting, analysis, feedback and sharing lessons learned need to be better utilized

Conclusions (2 of 3)

- Collimators and diaphragms are not being used as often as they should be
- Survey meters are not as widely available as they should be
- Individual monitoring, as reported, is well established, with passive and, usually, active dosimeters. The establishment and use of investigation levels needs to be improve
- Warning systems to prevent entry to the work area during site radiography were not always as effective as desired. Better communication at the site is indicated

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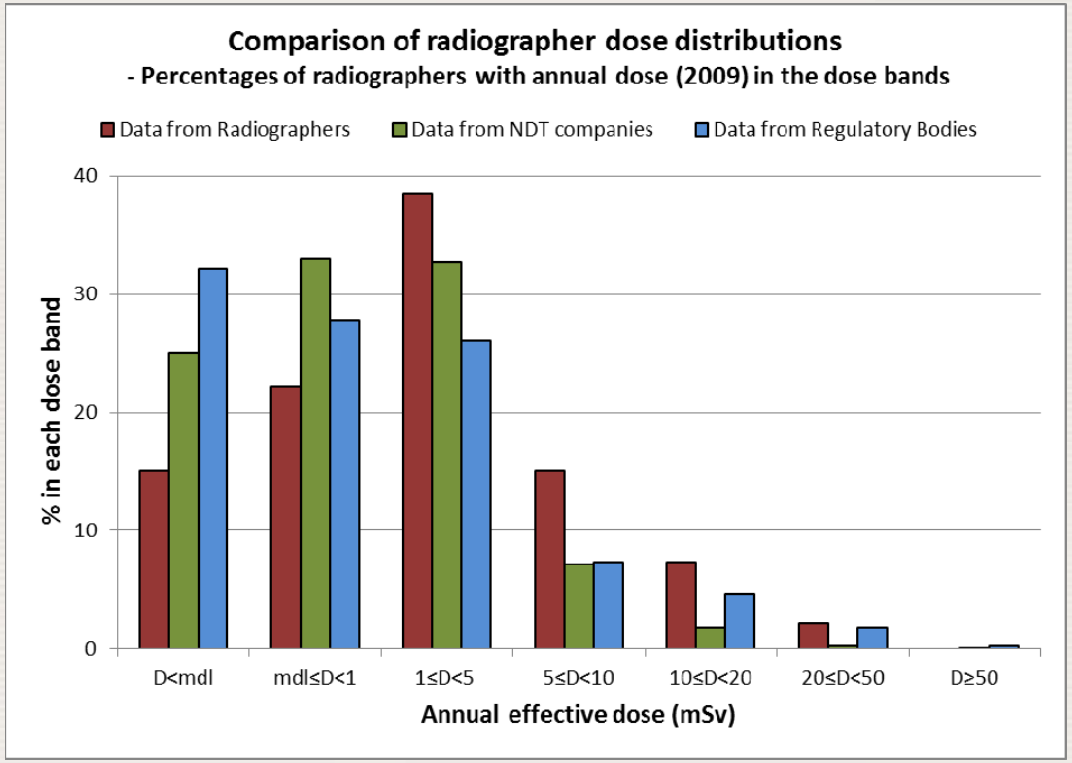
Conclusions (3 of 3)

- Emergency plans were widely prevalent, but there seemed to be some issues regarding specific training for radiographers with respect to emergencies
- Occupational doses received by radiographers varied considerably, with no correlation with radiographic workload

There is considerable scope for improvement in radiation protection

Dose distribution

- The radiographer data are for 234 radiographers, the NDT company data are for nearly 3500 radiographers, and the regulatory body data are for over 16,000 radiographers
- Average dose
  - Radiographer data: 3.4 mSv
  - RB data: 2.9 mSv



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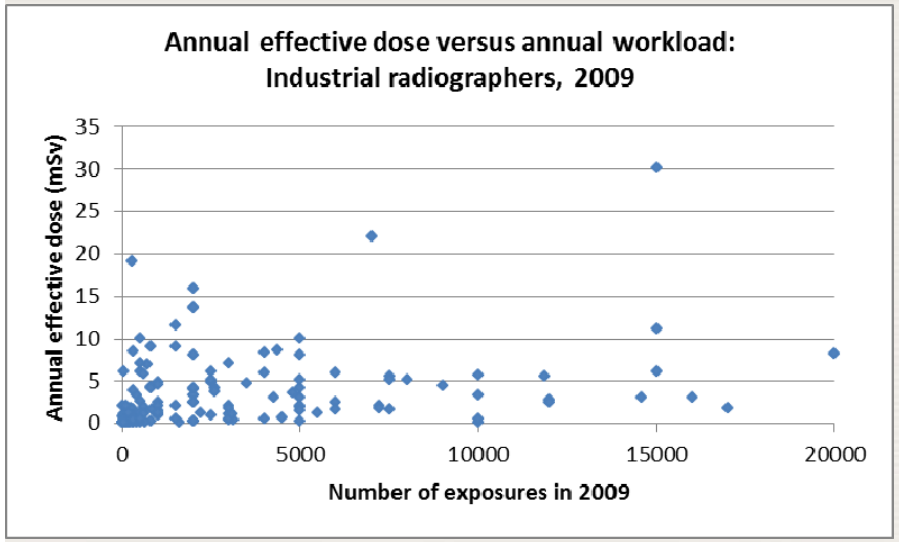
Dose versus workload



- No correlation found
  - Radiation protection in industrial radiography is not being effectively optimized
- Mean occupational dose per radiographic exposure
  - 4.8 ± 2.3 µSv for all operators
  - 2.9 ± 1.2 µSv for operators with workload > 100 exposures
  - No effect on dose per exposure found with:
    - level of NDT training
    - type of sources being used,
    - activity of sources,
    - use of collimation, or
    - incidence of events
  - But limited data numbers

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Rationale for an International Database (iDB)

- The worldwide survey of the WGIR showed
  - significant occupational doses do occur,
  - accidents do happen, and
  - the variation in occupational dose per radiographic exposure is considerable
- This in turn shows that there is a need for
  - considerable improvement in occupational radiation protection
  - implementation of optimization of protection

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ISEMIR – an international database

- Purpose
  - Tool for optimization of Occupational RP
    - Primarily for the end-user
  - Not for assessing compliance with dose limits
- Based around individual facilities
    - NDT companies, for industrial radiography
    - Individual personnel in each facility

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What is implemented?
Industrial Radiography (IR)

Characterizing the circumstances of occupational exposure arising from Industrial Radiography.

NDT Company's attributes:

- Preventive maintenance
- Inspection
- Investigation levels
- Source activities

Individual's attributes:

- Professional training
- Role
- Radiation sources used
- Types of work site
- Radiation protection training
- Radiation protection habits
- Radiation incidents

(Not functional yet)

Individual's metric: Dose per radiographic exposure

- Workload
- Doses

(Not functional yet)

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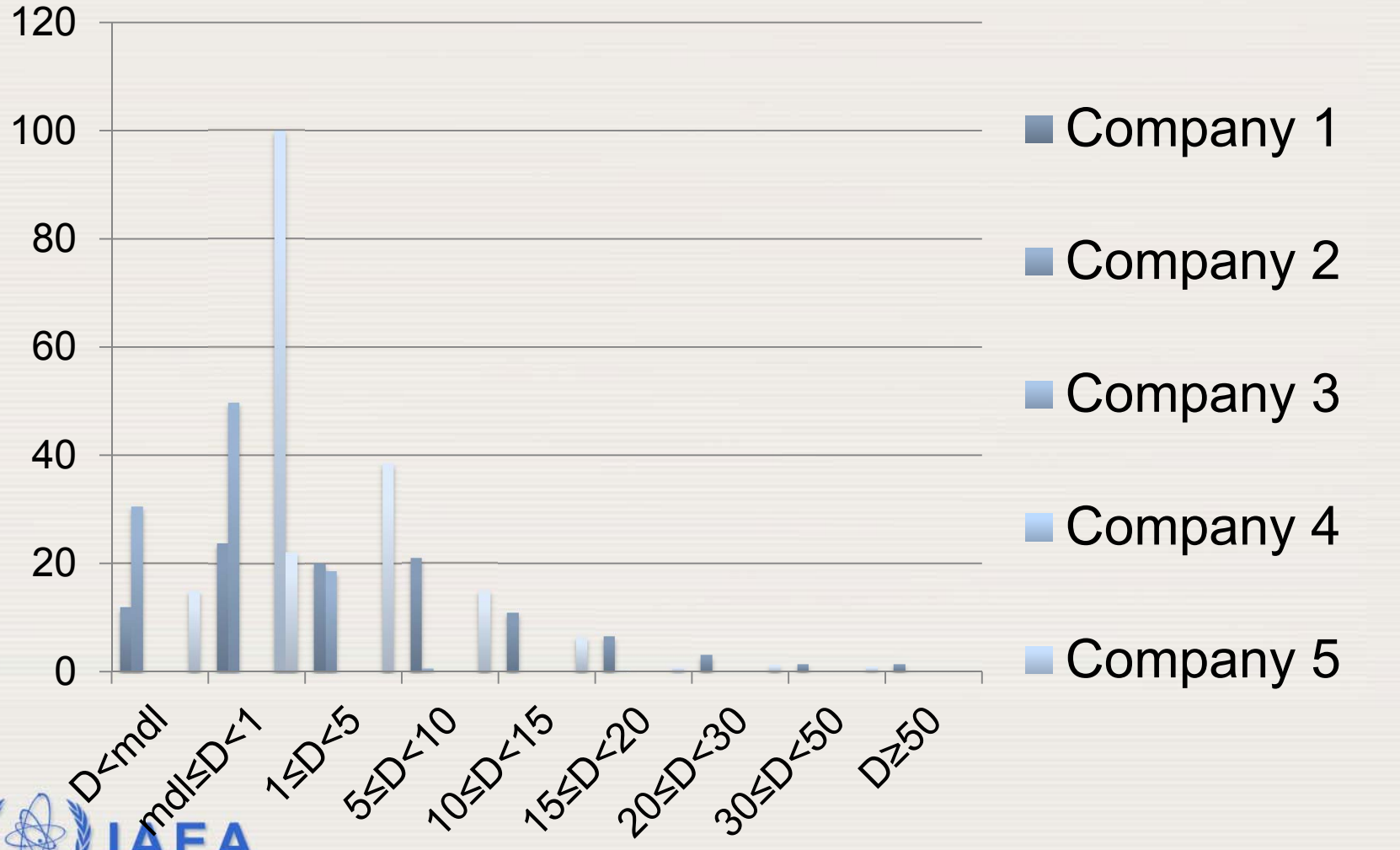
Current situation:
June 2015 - January 2016

ISEMIR - IR	
20 users applied (2015)	
18 NDT companies worldwide applied (2015)	
18 Annual Collections in the system (for years 2012-2015)	
Country	**Region**
Slovenia	Eastern Europe Western Europe
Austria	
Denmark	
France	
Netherlands	
Canada	North America
USA	
Bangladesh (4 companies – 9 annual collections)	Middle East and South Asia
Israel	

Example of the data analysis:
Percentages of industrial radiographers whose reported effective doses in 2015 were in each dose band



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Road Map idea

- Self assessment tool for companies
- Same questions asked as in Company questionnaire
- Where applicable, third quartile of responses to Company questionnaire is used as benchmark
- Weighting of question based on relative importance for radiation protection

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Road Map structure

Similar to the Company questionnaire the Road Map is divided into four sections:

1. Qualifications & training of industrial radiographers in radiation protection;
2. Learning from incidents (deviations from normal, near misses and accidents);
3. Systems and procedures in place for safe operation;
4. Emergency Preparedness and Response.

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Example of input to the “road map”

Sample questions on the topic of systems and procedures in place for individual monitoring with illustrative responses from a hypothetical NDT company:

Question	NDT company answer	Score	Good practice answer	Relative weighting
With regard to individual monitoring, does your Company provide its radiographers with active individual dosimeters?	Yes	3.0	Yes	3
With regard to individual monitoring, does your Company provide its radiographers with Passive individual dosimeters?	Yes	2.0	Yes	2
Are the active individual dosimeters equipped with Visual alarms?	Yes	1.0	Yes	1
Are the active individual dosimeters equipped with Audible alarms?	Yes	1.0	Yes	1
Are the active individual dosimeters equipped with Vibrating alarms?	No	0.0	Yes	1

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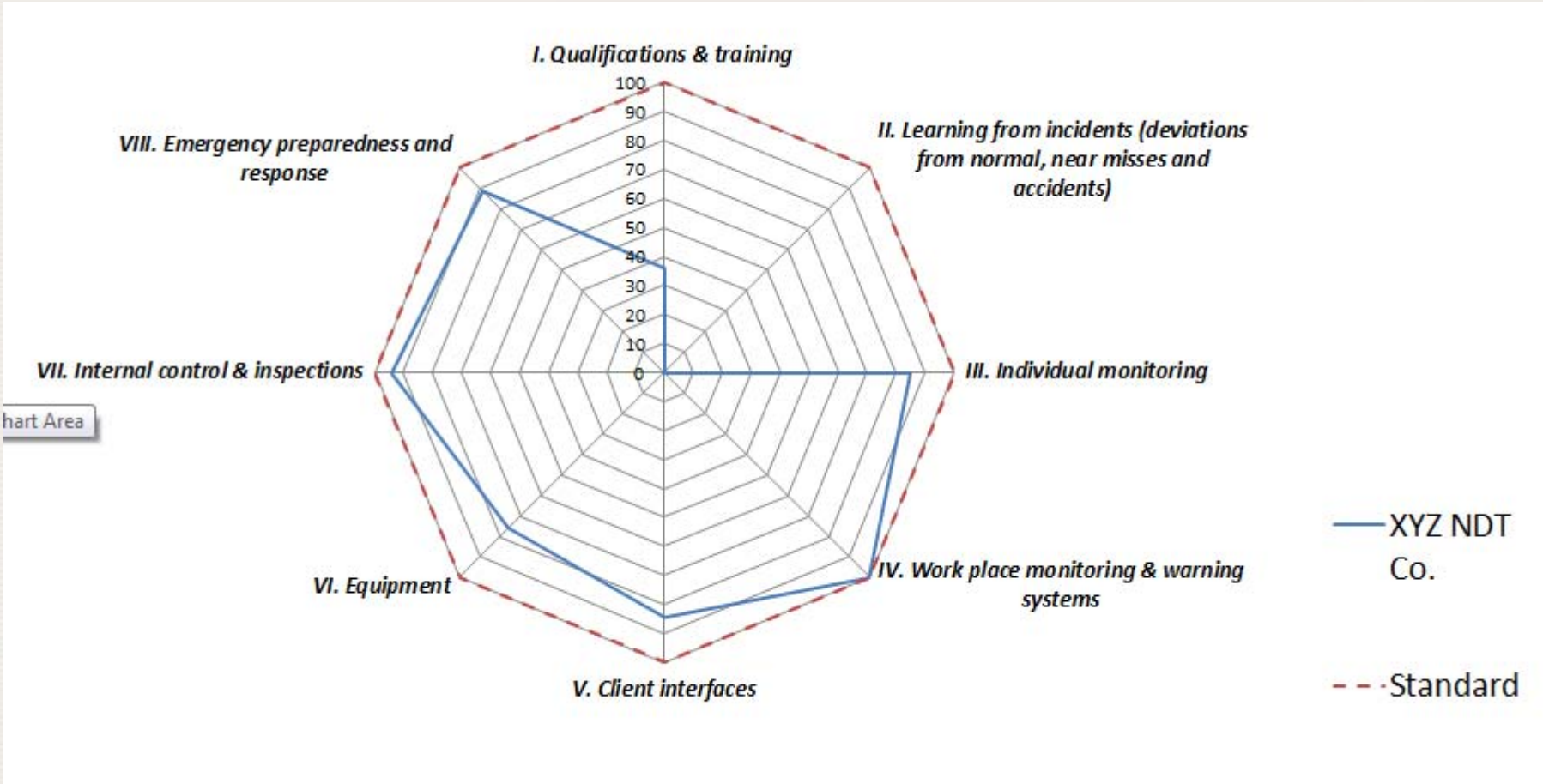
Example of output from the “road map”

Output for a hypothetical company that is deficient in qualifications and training of radiographers and in emergency preparedness and response:



Next steps

- Development of the individual attributes and analytical tools
- What can you access now?

  ✓ ISEMIR IR Database
  https://nucleus.iaea.org/isemir/

  ✓ Road map published at ORPNET
  http://www-ns.iaea.org/tech-areas/communication-networks/orpnet/isemir-roadmap-tool.asp

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Thank you!