How to measure status of PSM using the RBPS model

CCPS Workshop: Nice, September 29, 2015

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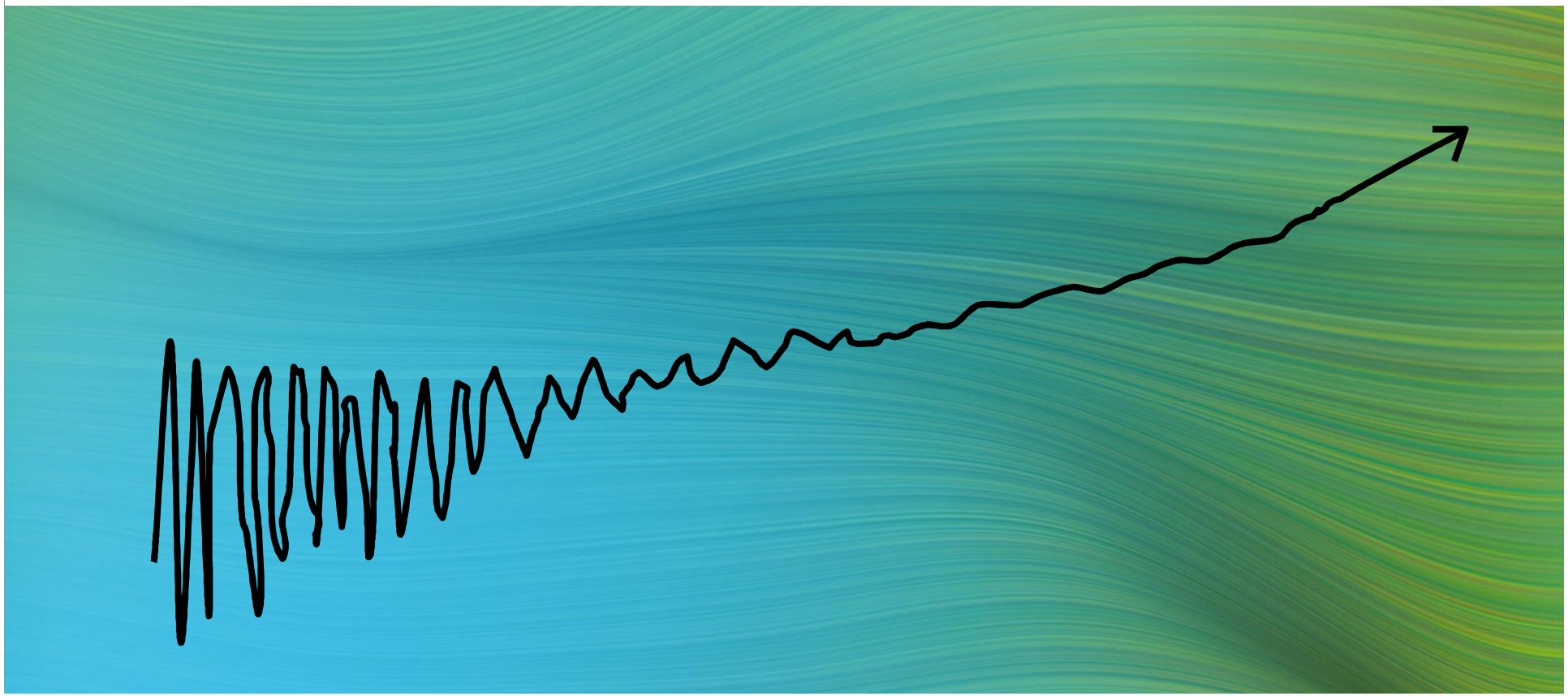
AkzoNobel



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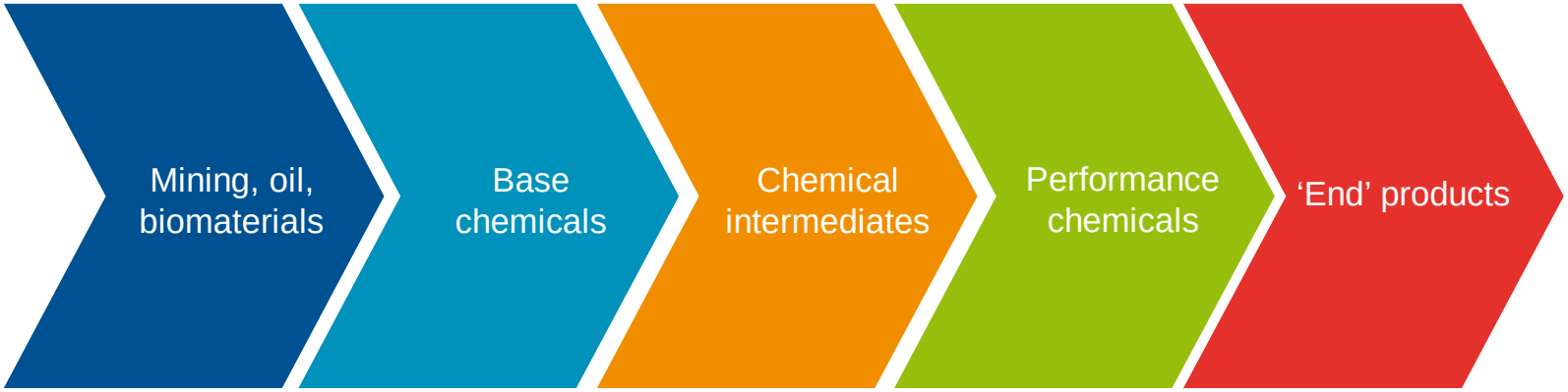
3. Initiative phase: defining the project
4. Base Lining phase: methods and results
5. Implementation phase: integrating with company program
6. Observations halfway down the Industrial Chemicals project

Industrial Chemicals in the value chain



Industrial Chemicals

- Salt
- Energy

- Chlorine
- Caustic lye
- Hydrogen

- Monochloro acetic acid
- Chloro-methanes
- Hydrochloric acid
- Sodium hypochlorite
- Iron Chloride

- Ecosel® additives
- Pharmaceutical Salt

- Jozo
- Nezo
- Broxo
- KNZ licks
- Suprasel
- Sanal

Industrial Chemicals

- Businesses : Industrial Salt, Salt Specialties, Chlor-Alkali, MonoChloro Acetic acid
- 13 plants at 8 production sites (The Netherlands, Germany, Denmark, China)
- Research centre and staff offices in The Netherlands
- Approximately 1700 employees

Process Safety project
within Industrial Chemicals

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HSE, Inspection, Maintenance, Process Safety, Projects and QA

Phase 0: Initiative

Pilots at plants (2011-12)

- à ***In-house project team (4 FTEs): mix of expertise***
- à ***Selected an overall reference grid (industry standard)***
- à ***Defined set of achievement level criteria (proprietary)***

Phase 1: Base Lining

Project activity (2013-14)

- à ***Determined starting position for each plant***
- à ***Improvement options and recommendable practices***
- à ***Identification of issues that merit a joint approach***

Phase 2: Implementation

Project activity (2014-16)

- à ***Addressing gaps revealed during Base Lining***
- à ***Guidance, standardization, sharing best practices***
- à ***Embedding PSM in the plants governance structure***

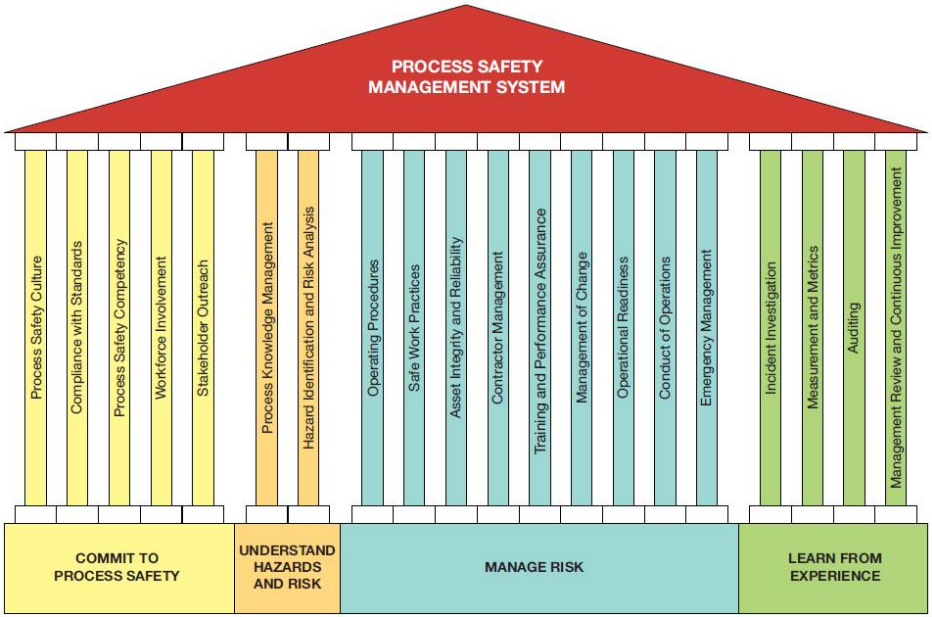
Phase 3: Assurance

Ongoing activity (≥ 2016)

- à ***Verifying and ensuring that Process Safety remains sustainably embedded in the organization***
- à ***Harmonization with other HSE and audit programs***

Phase 0 – Initiative

Management system reference grid



Risk Based Process Safety model

(as per Centre for Chemical Process Safety)

A reference grid of 20 elements in 4 groups

A. Commit to Process Safety (5)

words, actions, demonstration, support

B. Understand Hazard and Risk (2)

what could go wrong, how badly, how often?

C. Manage Risk (9)

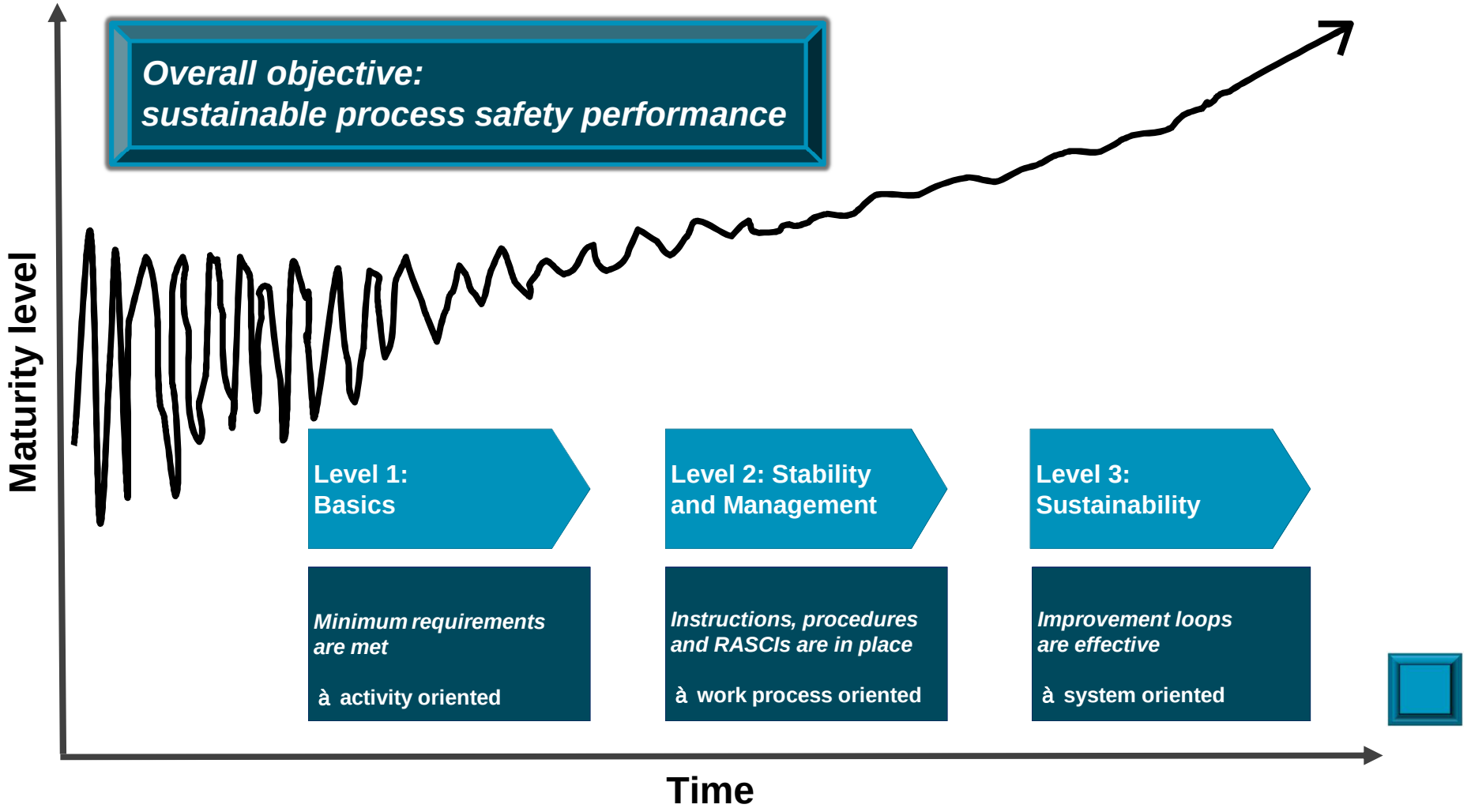
measures and resources to control the risks

D. Learn From Experience (4)

capture and apply lessons learned

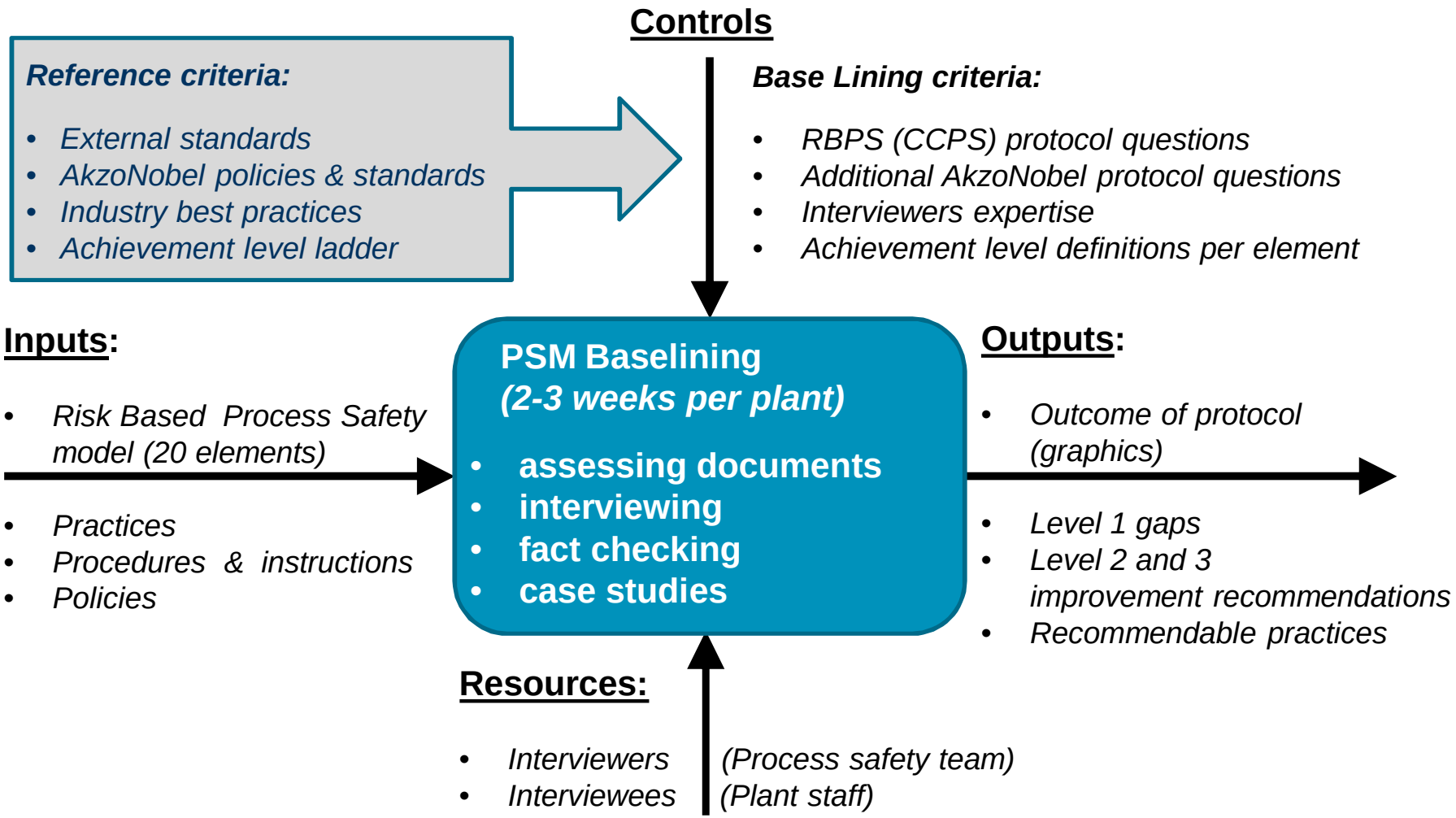
Phase 0 – Initiative

Achievement level definition



Phase 1 - Base Lining (*completed*) :

Assessing each plant's starting position



Example of result for a plant/site:

Spider format: levels achieved

Note: fictive score

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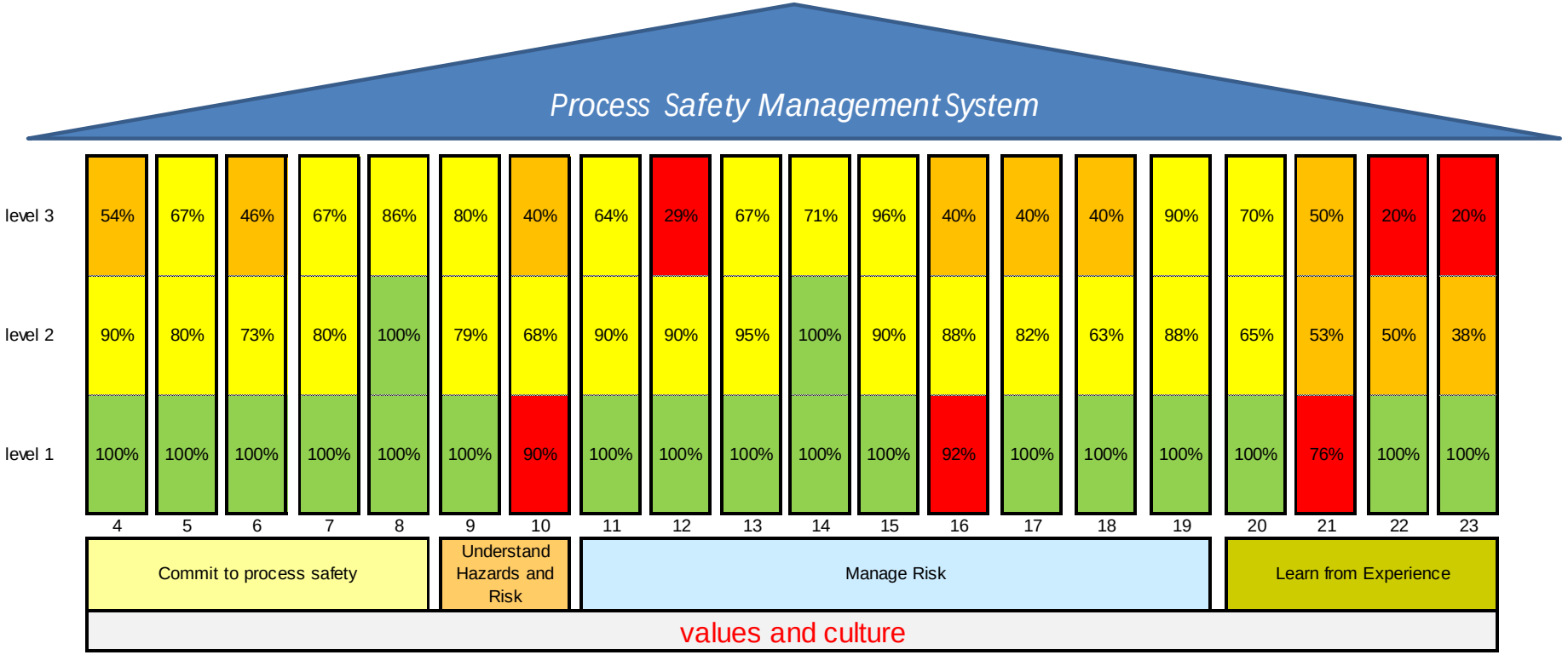
Example of result for a plant/site:

Temple format: score per level



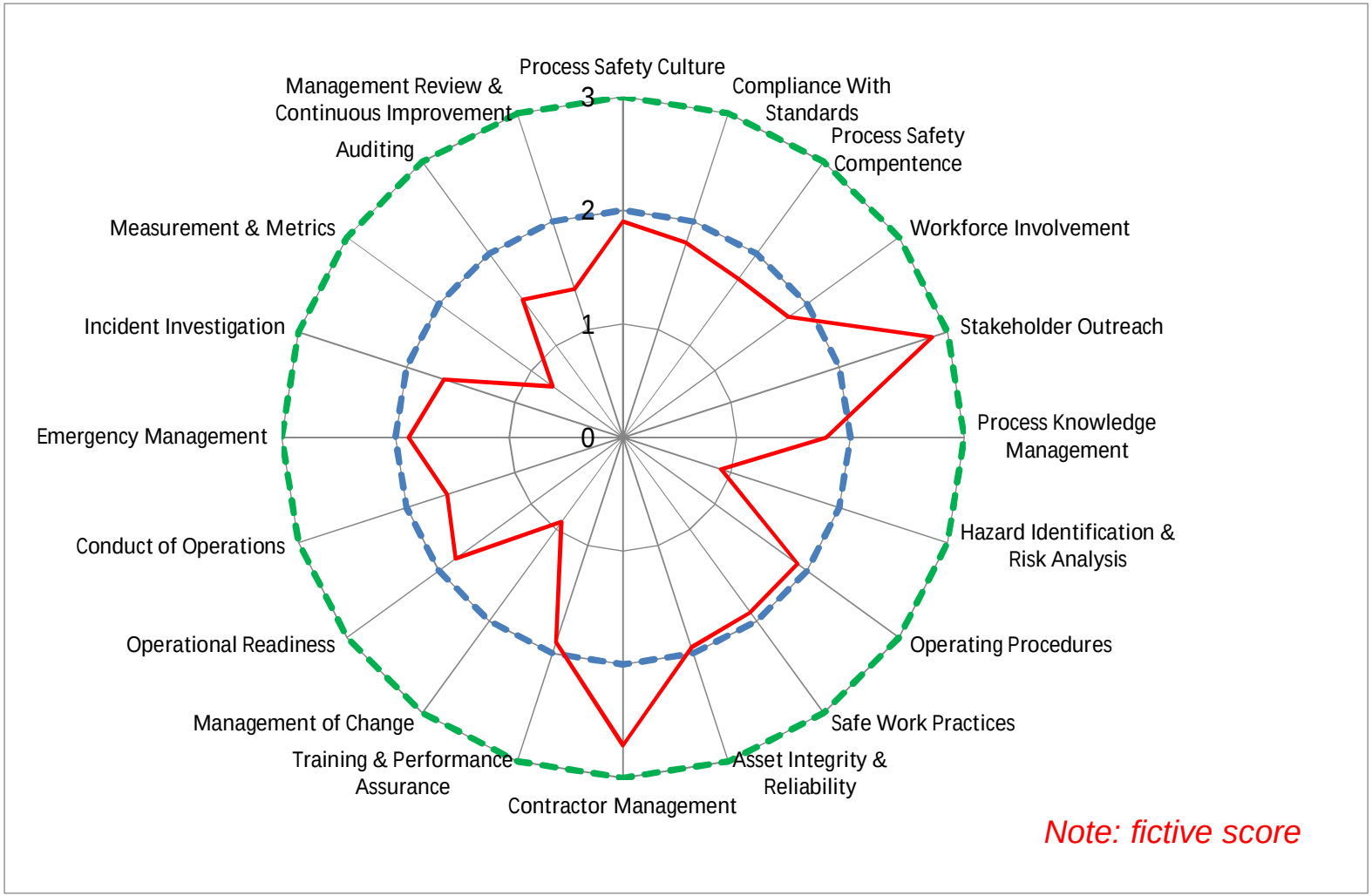
4	Process Safety Culture	9	Process Knowledge Management	14	Contractor Management	19	Emergency Management
5	Compliance With Standards	10	Hazard Identification & Risk Analysis	15	Training & Performance Assurance	20	Incident Investigation
6	Process Safety Compentence	11	Operating Procedures	16	Management of Change	21	Measurement & Metrics
7	Workforce Involvement	12	Safe Work Practices	17	Operational Readiness	22	Auditing
8	Stakeholder Outreach	13	Asset Integrity & Reliability	18	Conduct of Operations	23	Mngt Review & Cont. Improvement

<34% (Level 1 <100%) <60% <100% = 100%

Note: fictive score

Example of result for a plant/site:

Spider format: levels achieved



Note: fictive score

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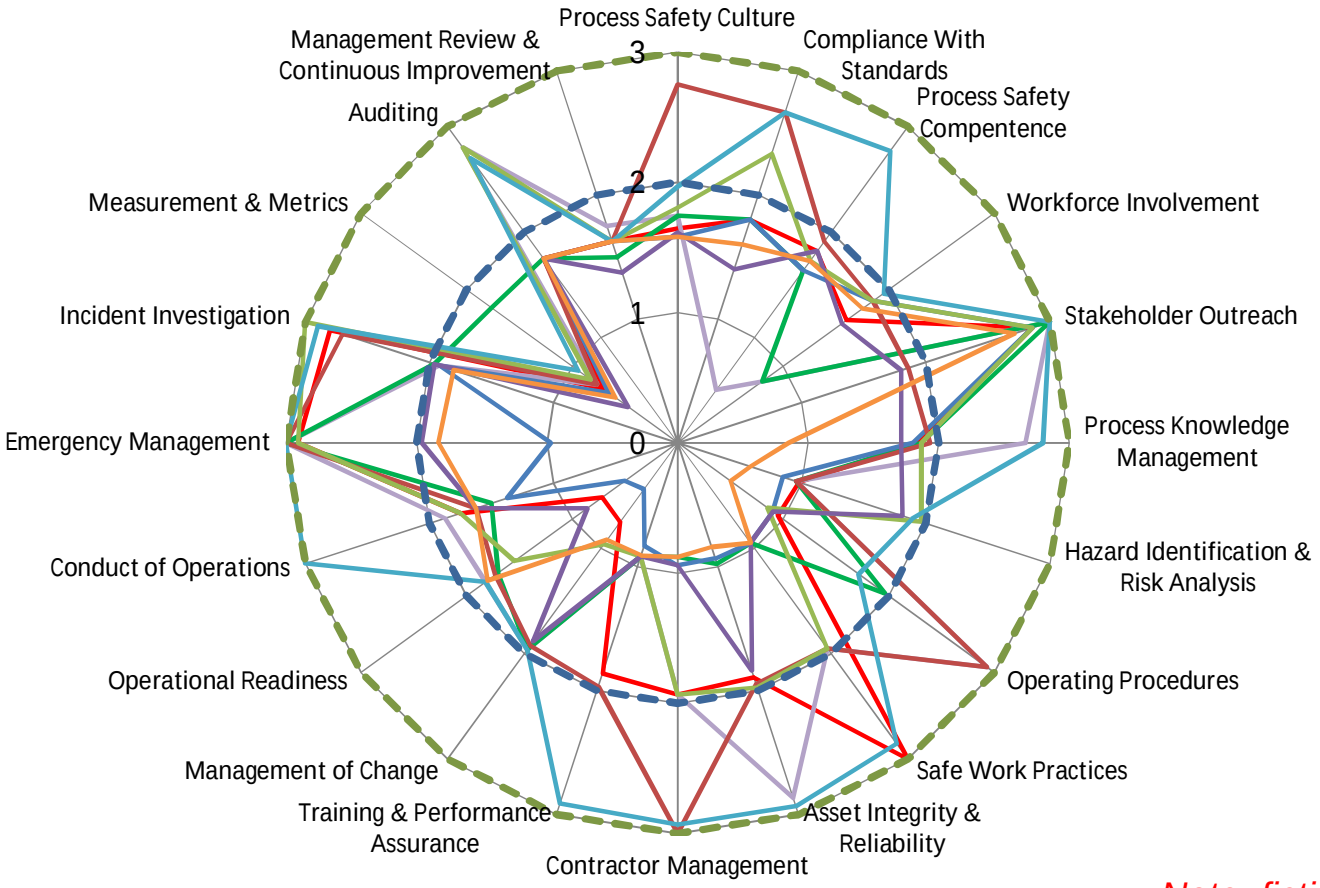
Result overview for several plants:

How to define the path forward ……?



Note: fictive scores

Phase 2 - Implementation

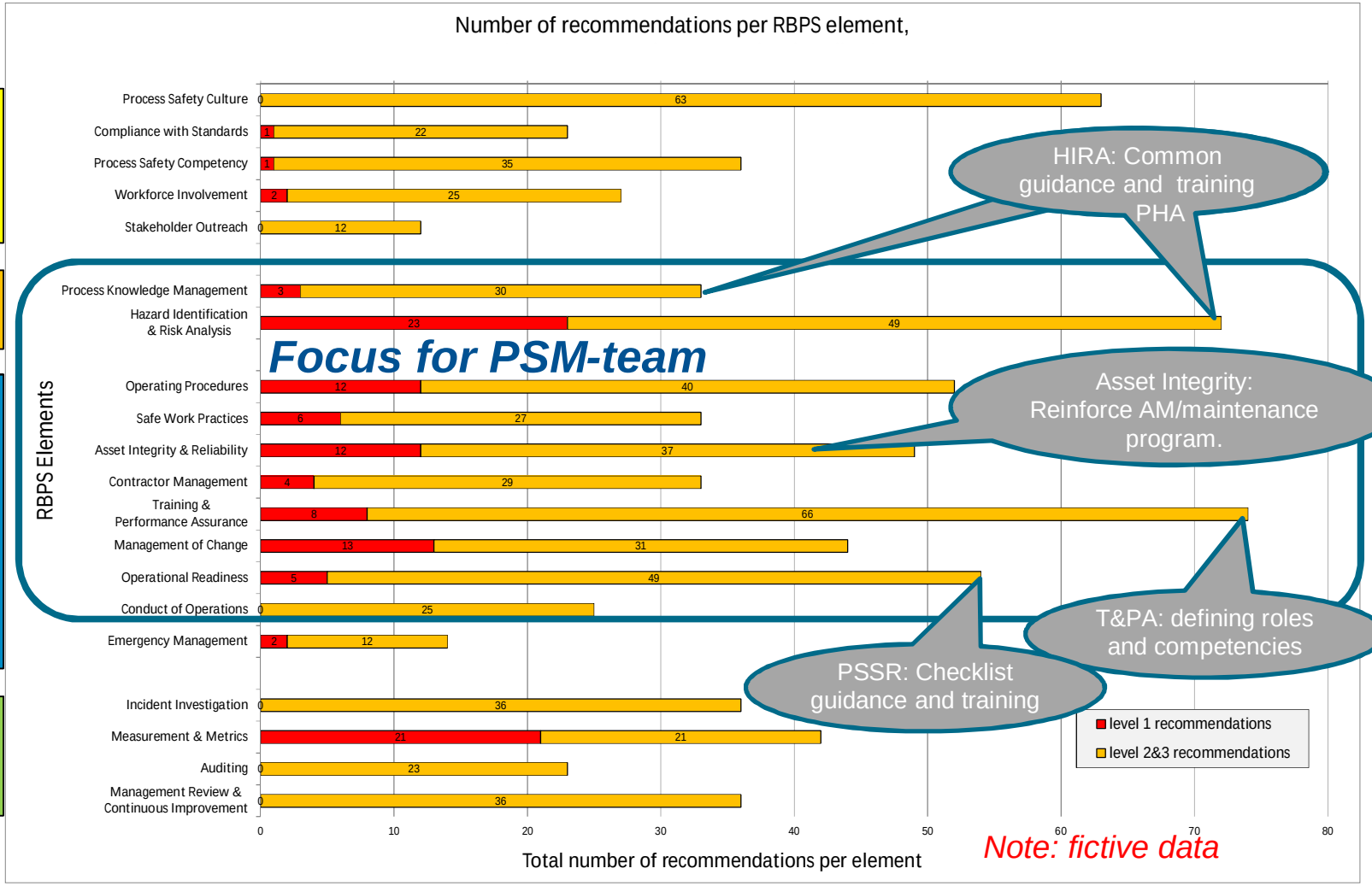
Aggregated results - all plants: which elements require focus

Commit to Process Safety

Understand Hazards and Risk

Manage Risk

Learn from Experience



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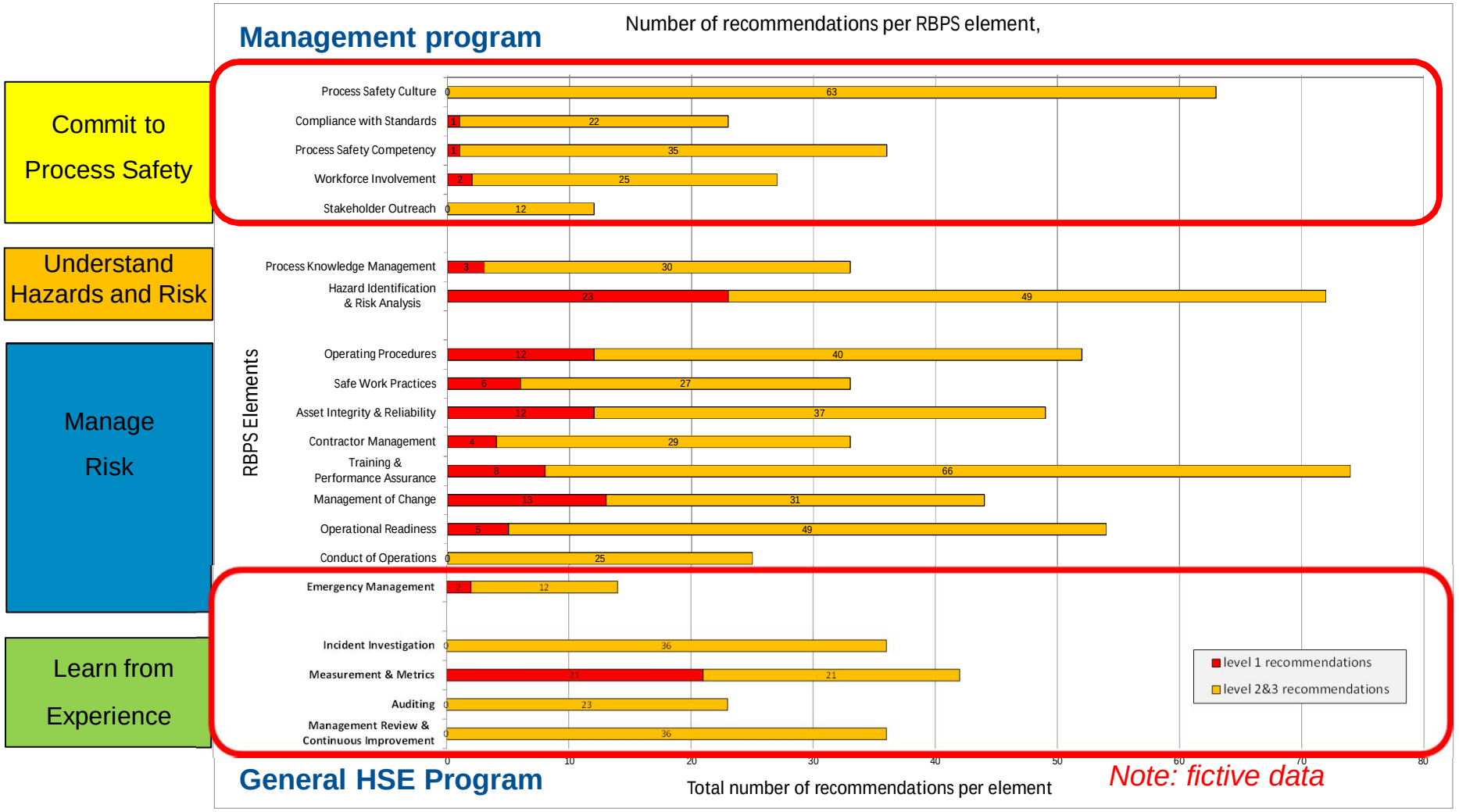
Aggregated results - all plants:
elements covered in other (HSE) programs



HSE common platform

transition from PSM project to PSM program

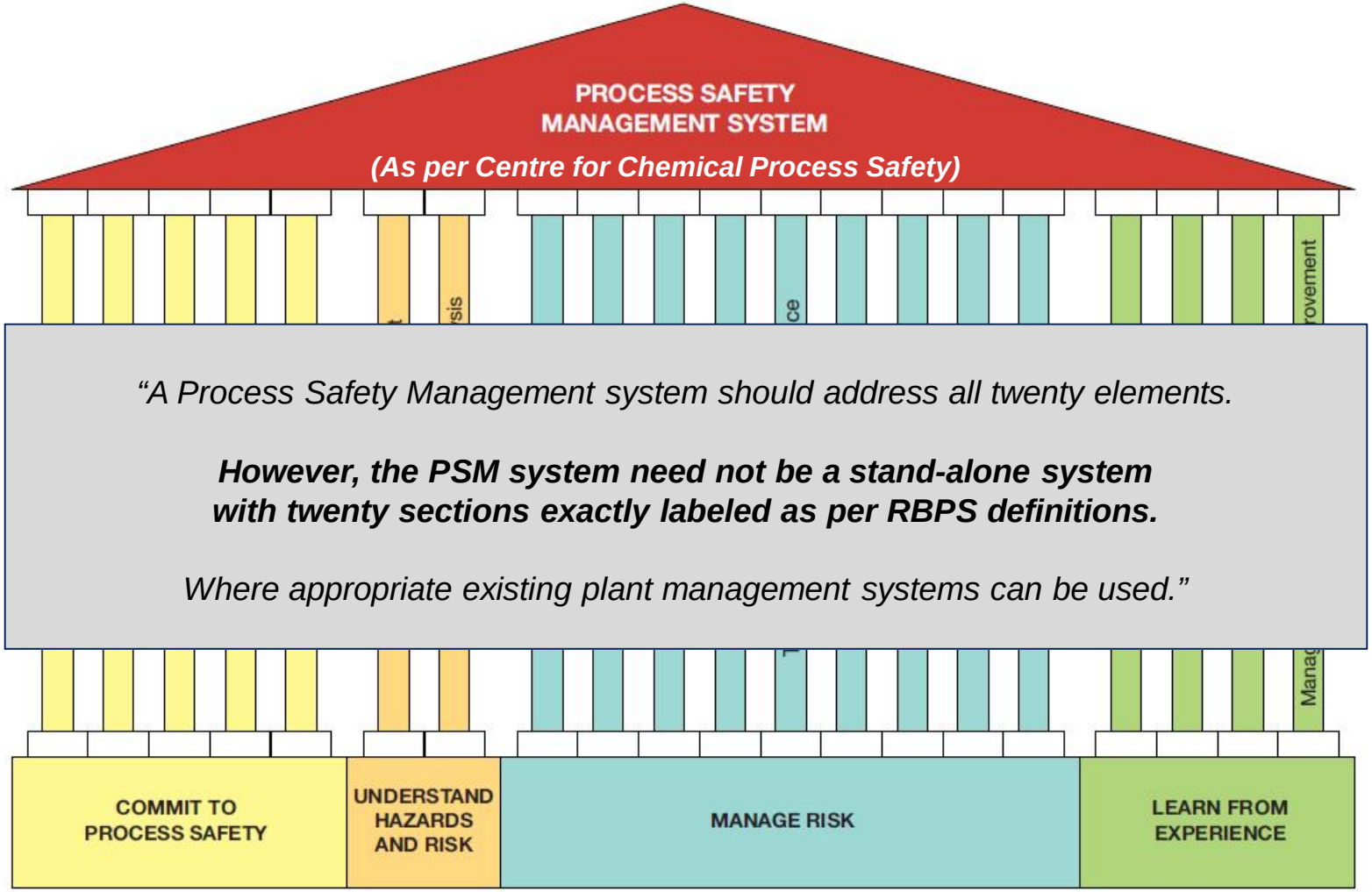
General context

- Industrial incidents have resulted in increased focus on process safety, by companies and industry associations as well as by regulators
- Although Process Safety Management does help manufacturing sites in meeting legal requirements, it has also gained the status of an essential operational excellence tool

AkzoNobel context

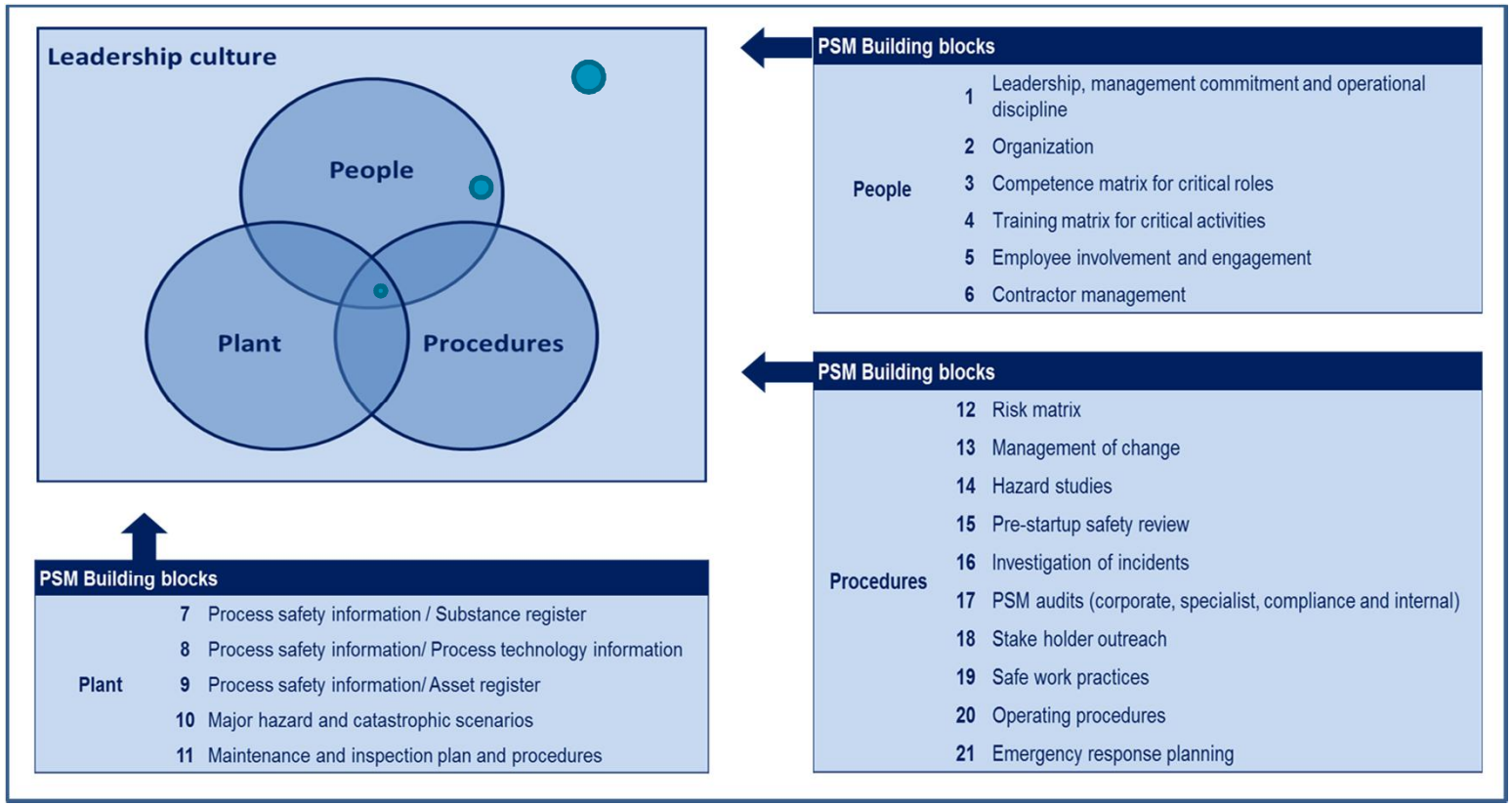
- AkzoNobel has defined 3 core HSE programs: People, Process and Product Safety
- The overall Process Safety program *(approved by Executive Committee early 2014)* :
  - Ø provides a common framework for all manufacturing operations (Chemicals as well as Coatings), compatible with major Process Safety legislation
  - Ø foresees phased implementation at individual sites, based on process hazard rating
- Industrial Chemicals, with its potentially hazardous bulk operations, has taken the lead in in shaping a practical approach to Process Safety Management *(initiative started in 2010)*

Shaping a PSM model to match with existing policies, systems and practices



Shaping a PSM model to match with existing policies, systems and practices

Objective: enhanced alignment of Process Safety program with the AkzoNobel Safety Common Platform



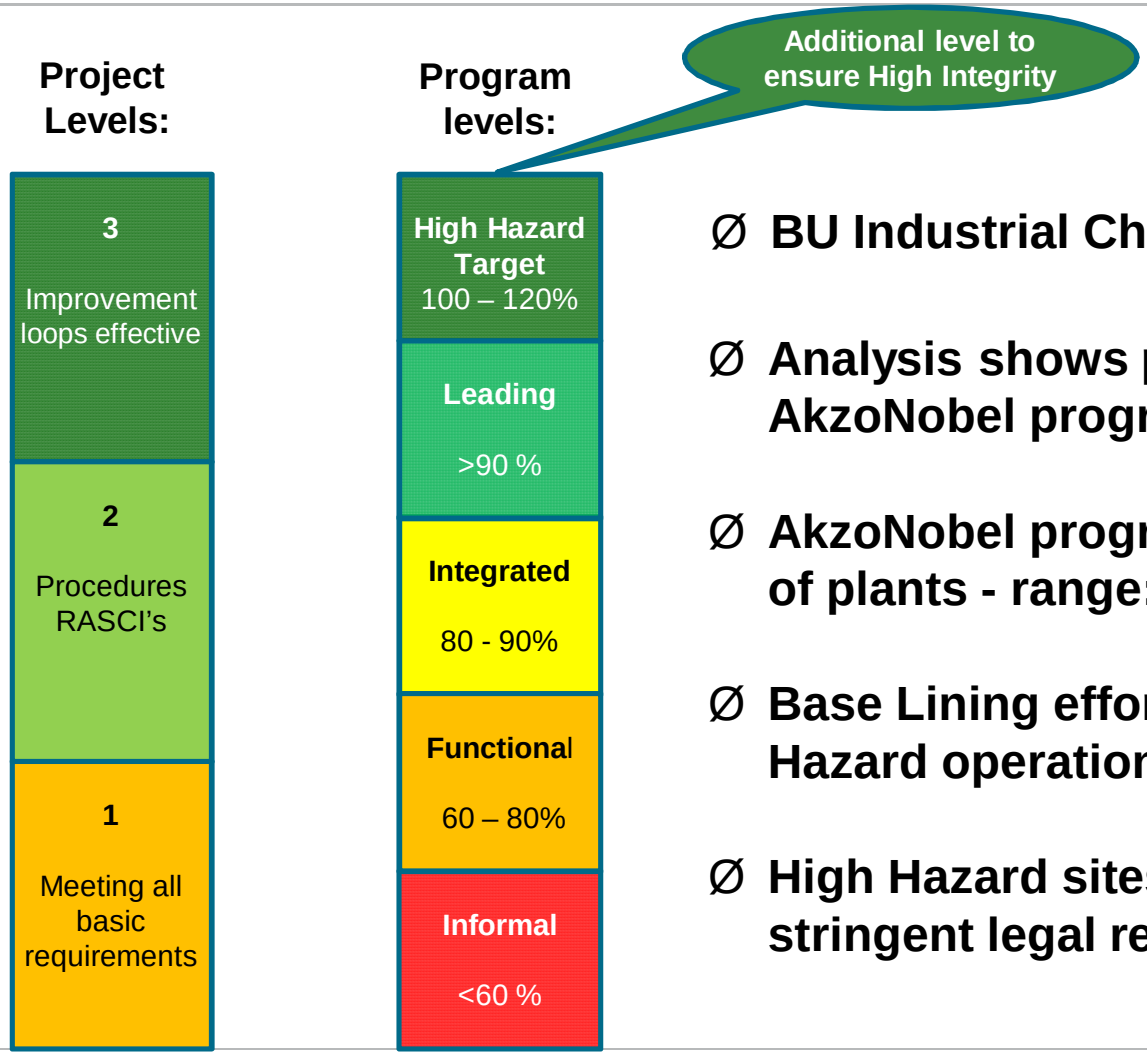
PSM Building blocks		
People	1	Leadership, management commitment and operational discipline
	2	Organization
	3	Competence matrix for critical roles
	4	Training matrix for critical activities
	5	Employee involvement and engagement
	6	Contractor management

PSM Building blocks		
Plant	7	Process safety information / Substance register
	8	Process safety information/ Process technology information
	9	Process safety information/ Asset register
	10	Major hazard and catastrophic scenarios
	11	Maintenance and inspection plan and procedures

PSM Building blocks		
Procedures	12	Risk matrix
	13	Management of change
	14	Hazard studies
	15	Pre-startup safety review
	16	Investigation of incidents
	17	PSM audits (corporate, specialist, compliance and internal)
	18	Stake holder outreach
	19	Safe work practices
	20	Operating procedures
	21	Emergency response planning

Switch to AN management systems

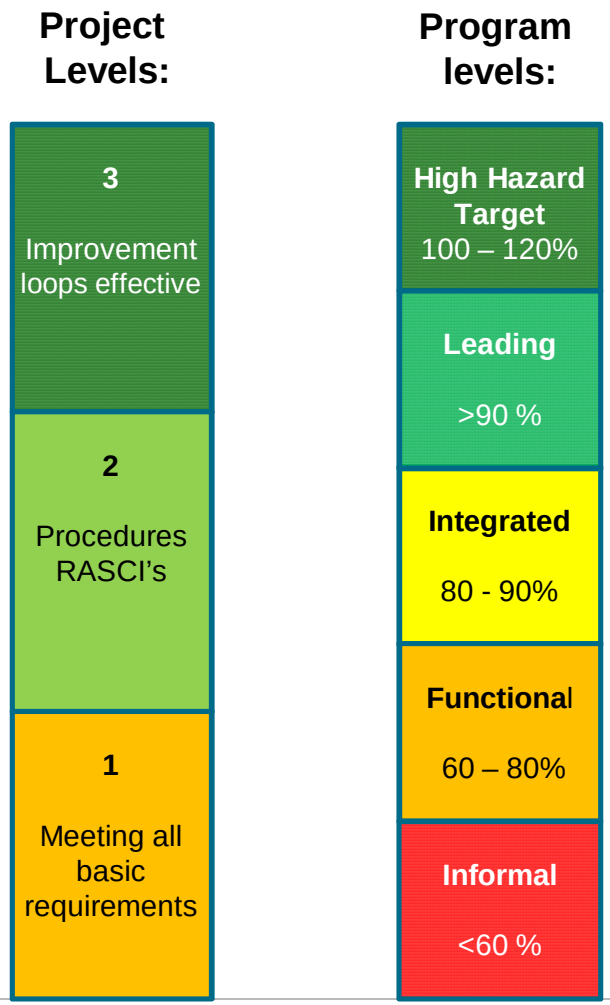
Integration in HSE building



- Ø **BU Industrial Chemicals 'Add On'**
- Ø **Analysis shows project going beyond AkzoNobel program scope**
- Ø **AkzoNobel program covers a broad range of plants - range: Low Hazard/High Hazard**
- Ø **Base Lining effort not suitable for Low Hazard operations (1800 questions)**
- Ø **High Hazard sites are subject to more stringent legal requirements**

Switch to AN management systems

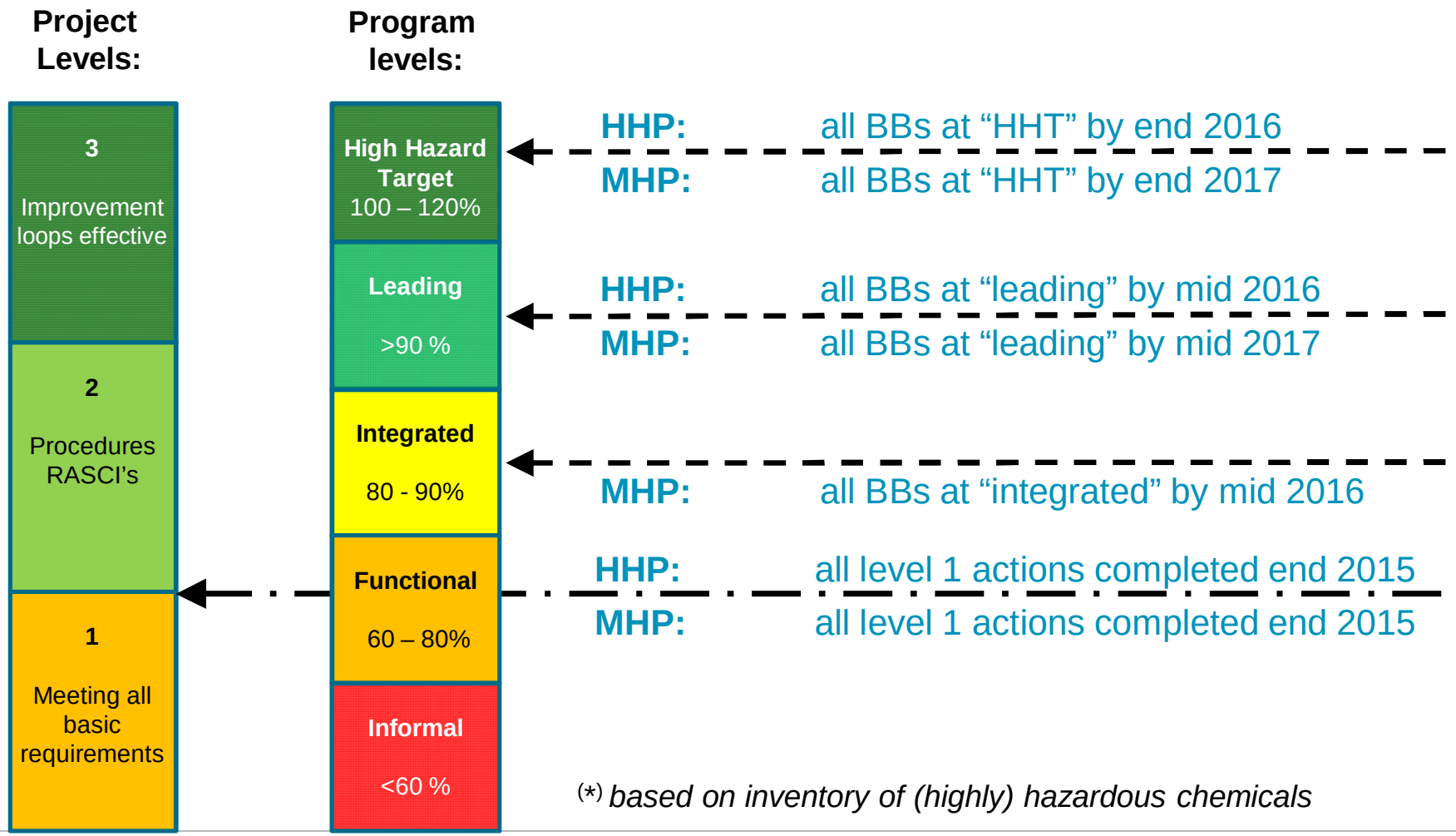
Integration in HSE building



- Ø **AkzoNobel PSM Program based on CCPS RBPS Elements**
- Ø **Base Lining results have been translated to AkzoNobel Program Requirements**
- Ø **PSM Program scan results serve to monitor project progress**
- Ø **Improvement reported quarterly**

Targets for High Hazard(*) and Medium Hazard plants

A proposed timing



(*) *based on inventory of (highly) hazardous chemicals*

Observations halfway down the PSM project at Industrial Chemicals

- **Process Safety is where Production, Asset Management and HSE meet:**
  - This process safety project has allowed project team as well as plants to get to grips with the complexity of Process Safety Management within an ongoing business
  - Risk of overloading plants with simultaneous programs by above stakeholder groups:
    à *alignment of the various programs is essential to maintain focus*

- **Essential elements for the Base Lining phase have been:**
  - In-house expert team
  - The use of a management system model that can easily be understood
  - “Plant friendly” interviewing methods: discussing rather than auditing
  - Scoring per achievement level in order to enable prioritization

- **Essential elements for the implementation phase are:**
  - Assign local champions for the various process safety management elements
  - Providing central guidance documents and tools for issues that affect several plants
  - Promoting cross fertilization between plants: networking and sharing best practices

Much more could be said on managing Process Safety

Some guidance documents are listed below

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- Introduction/overview:
  Article "Understanding Process Safety Management"
  (Compiled by Adrian Sepeda for AIChE, 2010)

- More detailed overview:
  Brochure "Risked Based Process Safety Overview"
  A summary of the risk based process safety (RBPS) management approach as detailed in "Guidelines for Risk Based Process Safety" : CCPS 2014

- Comprehensive reference:
  "Guidelines for Risk Based Process Safety" : *CCPS 2007*
  "Guidelines for Auditing Process Safety Management Systems" *CCPS 2011*

- For managers' awareness:
  Book "Catastrophic Incident Warning Signs" : *CCPS 2012*

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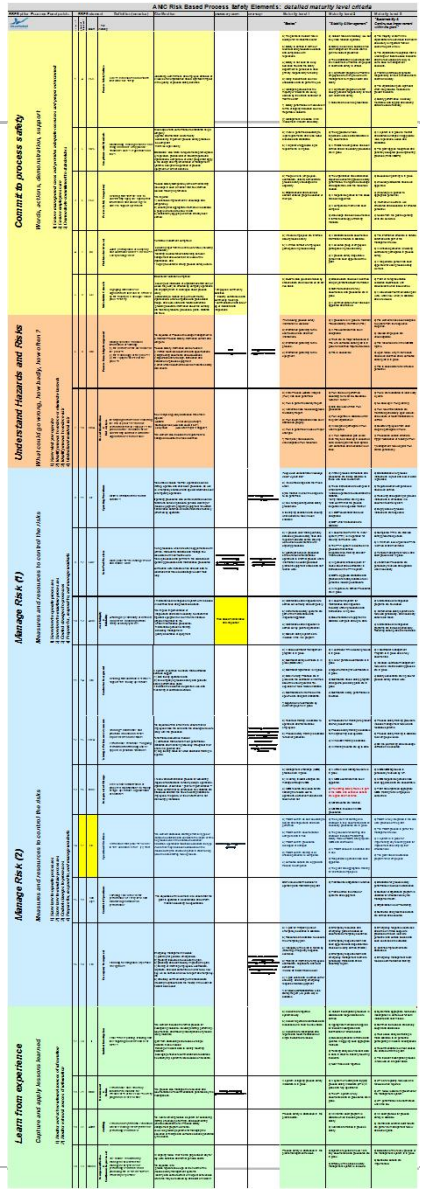
Back-up slides

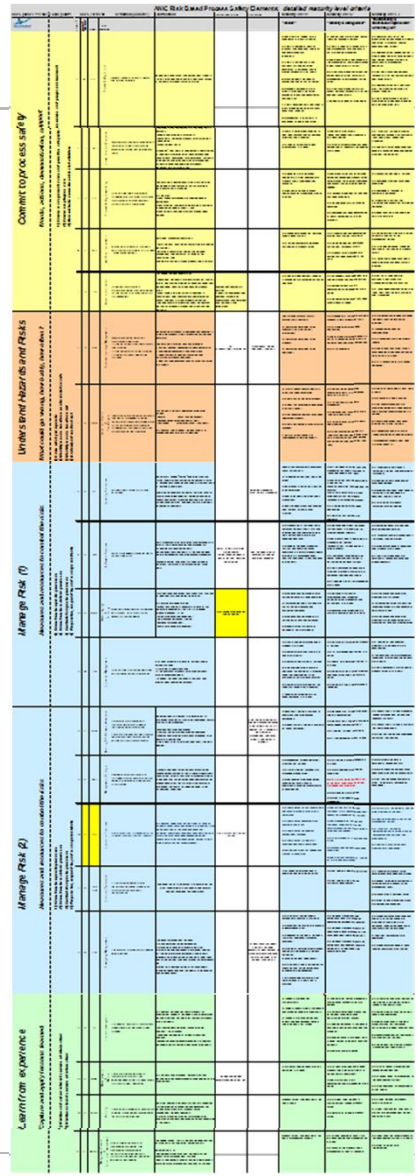
Maturity Levels
General overview

AkzoNobel Tomorrow's Answers Today	ANIC Risk Based Process Safety maturity levels		
	Maturity level 1 ***" Basics"***	***Maturity level 2*** ***" Stability & Management"***	***Maturity level 3*** ***"Sustainability & Continuous Improvement ~~within the plant~~"***
Descriptive summary	**~~Effectively~~ Performing the required basic activities for process safety**	**Documenting how the required basic activities for process safety are to be carried out, and ~~reporting~~ documenting the results**	**Evaluating the plants process safety performance and applying and verifying improvements to the local processes and systems**
Criteria to achieve level	*The minimum ~~requirements~~ activities to assure process safety, as imposed by both legal authorities and Akzo Nobel corporate and BU, are ~~met~~ executed by the plant.*	*In compliance with previous level, on top of which:* - The implementation of process safety is demonstrated by programs , tools and documents. - A stable process safety performance is demonstrated.	*In compliance with previous level, on top of which:* - Sustainable embedding of activities for process safety that lie within the plants ~~direct~~ span of control is demonstrated. - Continuous improvement of the PSM system ~~in leading process safety indicators in the plant~~ is demonstrated.
Orientation / Focus	**Operating activities**	**Documented work processes**	**Systems and Controls**
Indicators / Criteria (for auditing use)	- outcome of interviews with staff and - observations of plant ~~staff~~ operations - verification of records	plant operational documents (procedures and instructions) - external audit documents	- plant policies - internal review documents - internal improvement plans - action tracking system
Process Safety Management system characteristics	~~Consistent~~ Coherent practices, knowledge and competences throughout the plant or site	A basic (i.e. largely descriptive) PSM system exists at the plant or site, that covers ~~most~~ all of the 201 ~~RBPS~~ AN building blocks ~~elements~~: - RASCIs are in place - KPIs in place - ownership of procedures is clearly defined and known	<u>Applicable to all 20 RBPS elements:</u> - control loops have been defined - KPIs are managed actively - improvement actions are allocated to persons - follow-up of actions is monitored - management review and site auditing process are in place.
Process Safety leadership	Process safety expertise ~~needs to~~ typically ~~be~~ solicited outside the ~~plant~~ local organization on an ad hoc basis	Process safety expertise is available within the plant organization	All plant staff has been trained in Process Safety and is aware of requirements
Implementation degree	Practices in line with standards and regulations~~are present at plant level~~	Written procedures and documentation are ~~available at plant level~~ appropriate for the standing organization	Sustainable management systems at plant level



Maturity Levels
Requirements per level

6	9	KM	Process Knowledge Management	**Making available technical information describing:** **(1) the hazards of the chemicals in the process** **(2) the technology of the process** **(3) the equipment used in the process**	The objective of Process Knowledge management is to maintain Process Safety Information current and complete. Process Safety Information can be found in: a) Written technical documents and specifications b) Engineering documents and calculations c) Specifications for design, fabrication and installation of process equipment d) other written documents such as materials safety data sheets	PSI Process safety Information	Non process related equipment, functions	*The following process safety information is available:* a) information pertaining to the chemicals on site and their interactions, b) information pertaining to the process, c) information pertaining to the equipment.	a) A procedure is in place to maintain Process Safety Information (PSI). b) A PSI coordinator has been designated. c) There are no major deficiencies in PSI, or a corrective action plan is in place for identified major deficiencies. d) PSI is accessible	a) PSI elements have been assigned to owners from the respective diciplines. b) Involved employees are knowledgeable. c) PSI resources are in the MOOC regime. d) Upon review, only minor issues have been identified and a corrective action plan is in place. e) PSI is accessible for all affected personnel.
7	10	HIRA	Hazard Identification & Risk Analysis	**Identifying hazards and evaluating the risk of processes to make certain that risks to employees, the public and the environment are consistently controlled within the organization's risk tolerance**	Risk Analysis typically addresses three main aspects: - Hazard (What can go wrong?), - Consequences (How bad could it be?), - Likelyhood (How often might it happen?). This element also includes the requirement to manage and control the risks identified.			a) Initial Process Hazard Analysis (PHA) has been performed. b) PHA is part of the Safety Report. c) Authorities have received/approved the Safety Report. d) PHA recommendations have been addressed properly. e) PHA is performed in case of major changes. f) Plant (site) has access to knowledgeable PHA resources.	a) PHA has be en performed according to AN St 8 & Guidance Note 23.1 to 23.11 . b) Site has local written PHA procedures. c) PHA expertise is available within the plant organisation d) All diciplines participate in PHA when required. e) A PHA revalidation plan exists; there may be a backlog in execution, but a closure plan has been agreed with authorities and realisation is on track.	a) PHAs are revalidated at least every 5 years. b) No backlog in PHA planning. c) PHA recommendations are monitored periodically upon closure, and closure of recommandations is verified. d) Several employees from each dicipline participate in PHAs. e) Procedures contain criteria to trigger revalidation or redoing of PHA. f) Management reviews plant PHA status periodically.



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A. Commit to Process Safety (5)

Cluster A: Commit to Process Safety:

words, actions, demonstration, support

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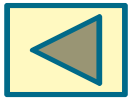
1. **Process Safety Culture**
   Beliefs, behaviors, and customs that influence safety
2. **Compliance with Standards**
   Maintaining and using an archive of applicable standards, codes, regulations and laws
3. **Process Safety Competency**
   Ensuring that staff are able to consistently apply the appropriate information and knowledge for safe operations
4. **Workforce Involvement**
   Active participation of company and contractor workers in Process Safety Management
5. **Stakeholder Outreach**
   Engaging individuals or organizations that can be affected by the facility in a dialogue about process safety



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B. Understand Hazard and Risk (2)

Cluster B: Understand Hazard and Risk

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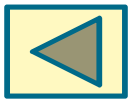
what could go wrong, how badly, how often ?

5. **Process Knowledge Management**

Making available technical information describing:
(1) the hazards of the chemicals in the process
(2) the technology of the process
(3) the equipment used in the process

6. **Hazard Identification and Risk Analysis**

Identifying hazards and evaluating the risk of processes to make certain that risks to employees, the public, or the environment are consistently controlled within the organization's risk tolerance



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C. Manage Risk (9)

Cluster C: Manage Risk (1)

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measures and resources to control risks

8. **Operating Procedures**
   Written instructions for routine activities

9. **Safe Work Practices**
   Work processes to manage risk of non-routine work

10. **Asset Integrity and Reliability**
    Assuring dependability of installed equipment, including critical safety or utility systems

11. **Contractor Management**
    Ensuring that contracted services support safe facility operations

12. **Training and Performance Assurance**
    Training = informative and practical education in tasks' requirements and methods

    Performance assurance = ongoing verification that training can be applied in practical situations

Cluster C: Manage Risk (2)

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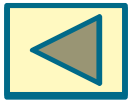
13. **Management of Change**
    Review and authorization of proposed modifications
    to facility design, operations, organization or activities

14. **Operational Readiness**
    Verification that
    processes will be in safe condition before (re-)start

15. **Conduct of Operations**
    Pursue excellence in the performance of every task
    and minimize variations in performance

16. **Emergency Management**
    Planning for mitigation of possible emergencies



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D. Learn From Experience (4)

Cluster D: Learn From Experience

capture and apply lessons learned

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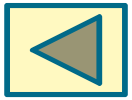
17. **Incident Investigation**
    Process for reporting, tracking, and investigating incidents and near misses

18. **Measurement and Metrics**
    Performance and efficiency indicators to monitor the effectiveness of the Process Safety program in near-real-time

19. **Auditing**
    Periodic systematic evaluation whether management systems are performing as intended

20. **Management Review and Continuous Improvement**
    Ongoing "due diligence" review by management that fills the gap between day-to-day work activities and formal periodic audits



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Assurance reviews:

System based audit or topic based verification?

	Process Safety Culture	Compliance With Standards	Process Safety Competence	Workforce Involvement	Stakeholder Outreach	Process Knowledge Management	Hazard Identification & Risk Analysis	Operating Procedures	Safe Working Practices	Asset Integrity & Reliability	Contractor Management	Training & Performance Assurance	Management of Change	Operational Readiness	Conduct of Operations	Emergency Management	Incident Investigation	Measurement & Metrics	Auditing	Management Review & Cont. Improvement
ATEX		X	X			X			X			X	X							
Pressure Relief Systems		X				X	X			X			X		X					
Safety Instrumented Systems (IPF)		X				X	X			X			X		X			X		
Integrity Operating Window	X					X		X		X			X		X			X		
Life Saving Rules									X											