01/Project Partners:	**SAbyNA**
1. LEITAT 2. IOM 3. CEA 4. TECNALIA 5. UKCEH 6. CNRS 7. RIVM 8. GAIKER 9. FIOH 10. ISTEC 11. THINKWORKS 12. ALLIOS 13. LATI 14. NOURYON 15. SYMLOG 16. DUKE UNIVERSITY	H2020-NMBP-15-2020 Simple, robust and cost-effective approaches to guide industry in the development of safer nanomaterials and nano-enabled products Start date of the project: 01/03/2020 Duration 48 months # WP5 D5.1 Map of available resources for strategies towards SbD nanoprocesses, including end-of-life processes, and specifications for improving their usability (M12)

WP	5	Towards SAFER nanoPROCESSES: Managing risks of nanoprocesses along the NF/NEP life cycle applying SbD strategies and other RMM			
Dissemination level[1]		PU		Due delivery date	28/02/2021
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Contributing beneficiaries				WP5 partners	

[1] Dissemination level: **PU** = Public, **PP** = Restricted to other programme participants (including the JU), **RE** = Restricted to a group specified by the consortium (including the JU), **CO** = Confidential, only for members of the consortium (including the JU)

[2] Nature of the deliverable: **R** = Report, **P** = Prototype, **D** = Demonstrator, **O** = Other

This document contributes a first draft for D5.1.

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1	22/12/20	Jesus Lopez de Ipiña	TEC	jesus.lopezdeipina@tecnalia.com	Creation
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3	27/02/21	Richard Seddon	TEC		Modifications
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4	10/02/21	William Brown	IOM		Modification
4	10/02/21	James Hanlon	IOM		Modification
4	10/02/21	Polly Cooper	IOM		Modification
4	11/02/21	Camila Delpivo	LEITAT	cdelpivo@leitat.org	Modification
5	11/02/21	Richard Seddon	TEC		Final version for evaluation

[3] Creation, modification, final version for evaluation, revised version following evaluation, final

This document contributes a first draft for D5.1.

Table of Content

This document contributes a first draft for D5.1.

Abbreviations

Abbreviation	Description
ASINA	H2020 project - Anticipating Safety Issues at the Design Stage of Nano Product Development https://www.asina-project.eu/
caLIBRAte	H2020 project - Nano risk governance http://www.nanocalibrate.eu/home
GUIDEnano	FP7 project - Web-based guidance tool for NEP users to design and apply most appropriate risk assessment & mitigation strategies. https://www.guidenano.eu/
IRSST	Regional Institute of Occupational Health and Safety (Community of Madrid)
MNM	Manufactured nanomaterial
NEP	Nano-enabled product
NM	Nano material
NanoReg2	H2020 project - SbD for validation of novel MNM http://www.nanoreg2.eu/
PPE	Personal Protection Equipment
P-SbD	Library of Safe-by-Design resources for Nanoprocesses
SbD	Safe-by-Design
SDS	Safety Data Sheet
SOP	Standard Operating Procedure
TDS	Technical Data Sheet
TNO	Netherlands Organisation for Applied Scientific Research
WHO	World Health Organisation

1. Scope

The first step in the SAbyNA project within WP5 is the compilation, analysis and mapping of existing resources (strategies, models, tools, frameworks, databases, as well as previous outcomes from EU funded projects e.g. NanoReg2, caLIBRAte and GUIDEnano) for the Safety by Design (SbD) of ***nanoprocesses***.

The work set out within Task 5.1 is aimed at the compilation, analysis and mapping of information and resources in the field of SbD of nanoprocesses, in order to identify and select the most appropriate resources, detect gaps and specify the necessary adaptations of these resources to be able to create a robust and user friendly resource that is suitable for a practical implementation in industry in the SAbyNA platform, hereinafter defined as the P-SbD (Library of Safe-by-Design resources for nanoprocesses).

This document is focused on defining the "Map of available resources for strategies towards SbD nanoprocesses, including end-of-life processes, and specifications for improving their usability". The document will be provided to the Scientific Committee along with the developed P-SbD Resource Library (.xls format).

2. General Considerations

In the scope of this document, a resource for the SbD of nanoprocesses (P-SbD) is understood as being ***any support means that can be used to develop a feasible safe design of a nanoprocess***.

The full design of a process/nanoprocess cannot be completed in just a single step – i.e. just from implementing the measures of Inherently Safe by Design (SbD) – which would otherwise leave the process design unfinished. Therefore, the compilation of resources (P-SbD Resource Library) will not only include resources associated with SbD but will also include other available resources that are needed to implement complementary strategies (i.e. protection, information, etc.) more associated to the user. This will be done at both the designer and user level with the final goal always being to **achieve a safe and feasible final nanoprocess design for the full life cycle of the process**.

Types of P-SbD resources include: Best practices, Databases, Frameworks, Guidelines, Libraries, Methods, Models, Regulations, Standards, Standard Operating Procedures, Tools / Software tools, Technical Data Sheets / Safety Data Sheets (TDS / SDS) and Use cases.

Topics of process design (nano) include: Explosion, Emissions of hazardous materials and substances, Fire, Materials and products, Safety-related parts of control systems, Risk assessment (RA), Emission verification (EV), Exposure verification (ExV), Inherently safe design (ISD) and SbD, Safeguarding and complementary protective measures (SCPM), Information for use (IU), Organization (O), PPEs, Designer strategies (D) and User strategies (U).

Sources of P-SbD resources include: Industry or industrial groups, Industrial associations, Government or government agencies, Research organizations, Research projects, Regulators, Standardization organizations**.**

P-SbD resources will be stored in the Excel library enabled for this purpose.

3. Harmonisation with ASINA project

The SAbyNA resource library format has been harmonised with a similar library being developed within the collaborative project ASINA "Anticipating Safety Issues at the Design Stage of NAno Product Development". Both projects aim to develop Safe-by-Design concepts (SbD) that incorporate safety of nano-enabled products (NEP) at the design stage of the production process. Both projects include activities to identify resources, detect existing gaps in the current field of Safe by Design of nanoprocesses, as well as to specify the necessary adaptations of these resources to be able to create a robust and user friendly resource that is suitable for a practical implementation in industry. The harmonised approach means that resources can be easily shared between the two projects, which means greater collaboration as well as a more cost-effective use of human resources.

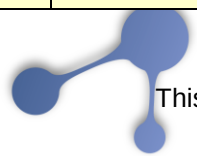
4. Identification of P-SbD resources

Resource identification means the codification of the P-SbD resource and the provision of a brief description of the scope, as well as information about the owner of the resource and the source on the web. The proposed entry fields for the resource identification are the following:

- **Code**: correlative numbering of the P-SbD resource ["RPSbD000"].
- **Name**: name of the resource (e.g. title of the document, of the tool, etc)
- **Scope**: brief description of the content of the resource.
- **Source**: web address to locate the resource.
- **Owner**: name of the organization/author who created the resource.
- **Organization type**. The proposed categories are: Industry or industrial group, Industrial association, Government or government agency, Research organization, Research project, Regulator, Standardization organization, Other.

Table 1 : Identification of resources – extract from P-SbD resource Excel database

1. RESOURCE IDENTIFICATION					
Code	**Name**	**Scope**	**Source**	**Owner**	**Organization type**
RPSbD001	EN 689:2018+AC:2019 Workplace exposure. Measurement of exposure by inhalation to chemical agents. Strategy for testing compliance with occupational exposure limit values.	This European Standard specifies a strategy to perform representative measurements of exposure by inhalation to chemical agents in order to demonstrate the compliance with occupational exposure limit values (OELVs). This European Standard is not applicable to OELVs with reference periods less than 15 min.	https://standards.cen.eu/dyn/www/f?p=204:110:0::::FSP_PROJECT,FSP_ORG_ID:67662,6119&cs=14AF6DBAB8597419DB537B242544A737F	European Committee for Standardization (CEN)	Standardization organization



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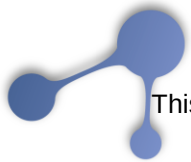
1. RESOURCE IDENTIFICATION					
Code	**Name**	**Scope**	**Source**	**Owner**	**Organization type**
RPSbD002	EN 1093-1:2008 Safety of machinery - Evaluation of the emission of airborne hazardous substances - Part 1: Selection of test methods	This European Standard specifies parameters which can be used for the assessment of the emission of pollutants from machines or the performance of the pollutant control systems integrated in machines. It gives guidance on the selection of appropriate test methods according to their various fields of application and types of machines including the effects of measures to reduce exposures to pollutants. The test methods are given in additional parts of this European Standard.	https://standards.cen.eu/dyn/www/f?p=204:110:0::::FSP_PROJECT,FSP_ORG_ID:27868,6096&cs=19D334F0E8895E9D0395F640737099B14	European Committee for Standardization (CEN)	Standardization organization
RPSbD003	EN 1093-11:2001+A1:2008 Safety of machinery - Evaluation of the emission of airborne hazardous substances - Part 11: Decontamination index	This standard describes a method for the measurement of the decontamination index of pollution control systems e. g. capture devices including local exhaust ventilation, water spray systems and, when appropriate, separation equipment installed on a machine. This method uses the real pollutant (EN 1093-1: 1998) and can be operated in room or field environments.	https://standards.cen.eu/dyn/www/f?p=204:110:0::::FSP_PROJECT,FSP_ORG_ID:31115,6096&cs=1E6A640EA68CB94627A18B800863AEBDC	European Committee for Standardization (CEN)	Standardization organization
RPSbD004	EN ISO 12100:2010 Safety of machinery - General principles for design - Risk assessment and risk reduction (ISO 12100:2010)	ISO 12100:2010 specifies basic terminology, principles and a methodology for achieving safety in the design of machinery. It specifies principles of risk assessment and risk reduction to help designers in achieving this objective. These principles are based on knowledge and experience of the design, use, incidents, accidents and risks associated with machinery. Procedures are described for identifying hazards and estimating and evaluating risks during relevant phases of the machine life cycle, and for the elimination of hazards or sufficient risk reduction. Guidance is given on the documentation and verification of the risk assessment and risk reduction process.	https://standards.cen.eu/dyn/www/f?p=204:110:0::::FSP_PROJECT,FSP_ORG_ID:32299,6096&cs=14C6B274520C60586598CB63FE4732782	European Committee for Standardization (CEN)	Standardization organization



5. Criteria for the classification of P-SbD resources

Resource classification means the organization of P-SbD resources by type of resource, design topic, design strategy and industrial sector. It is important to note that these are not always nano specific, but in many cases the resources are part of general best practices for process design within whose structure nanomaterials and nanoproducts can be considered. The proposed criteria are the following:

- **Type of resource.** The proposed categories are: Best practice, Database, Framework, Guideline, Library, Method, Model, Regulation, Standard, Tool/Software Tool, Technical Data Sheet /Safety Data Sheet (TDS/SDS), Use case, Other.
- **Design topic.** The proposed categories are **(according to Directive 2006/42/EC New Machinery Directive - Annex I "Essential health and safety requirements relating to the design and construction of machinery" (EHSRs/MD))**:
    - **Explosion**: this design topic refers to the risk of explosion posed by the machinery itself or by gases, liquids, dust, vapours or other substances, including nanomaterials and nanoproducts, produced or used by the machinery. In addition, by-products which may not be nano but produced using nanomaterials/nano-enabled products, will be considered.
    - **Emissions of hazardous materials and substances**: this design topic refers to the risk of contact of hazardous nanomaterials produced by the machine/process via inhalation, ingestion, contact with the skin, eyes and mucous membranes and/or penetration through the skin.
    - **Fire**: this design topic refers to the risk of fire or overheating posed by gases, liquids, dust, vapours or other substances produced or used by the machinery.
    - **Materials and products:** this design topic refers to the nanomaterials or nanoproducts used or created during its use that must not endanger persons' safety or health.
    - **Safety part of control systems**: this design topic refers to the control systems, in such a way as to prevent hazardous situations from arising [e.g. a fault in the machine control system (hardware, software) or a reasonably foreseeable human error during operation, can cause unforeseen accidental emissions/exposures to nanomaterials, with potential impact on the environment and safety and health at work of workers].
- **Design strategy**. The proposed categories are: Risk assessment, Emission verification, Exposure verification, Inherently safe design, Safeguarding and complementary protective measures, Information for use, Organization, PPEs, Designer strategies (D), User strategies (U), Other.
- **Industrial sector**. The proposed categories are: Cosmetics, Textiles, 3D printing, Paints, Other (sectors), All (general for all sectors).

Table 2 : Classification of resources – example from P-SbD resource Excel database

2. RESOURCE CLASSIFICATION				
Code	**Resource type**	**Design topic**	**Design strategy**	**Industrial sector**
RPSbD001	Standard	Emissions of hazardous materials and substances	Exposure verification	All sectors
RPSbD002	Standard	Emissions of hazardous materials and substances	Emission verification	All sectors
RPSbD003	Standard	Emissions of hazardous materials and substances	Emission verification	All sectors
RPSbD004	Standard	All design topics	Risk assessment	All sectors

In addition it is important to note that the Machinery Directive covers principles of safety integration, which states that "machinery must be designed and constructed so that it is fitted for its function, and can be operated, adjusted and maintained without putting persons at risk when these operations are carried out under the conditions foreseen but also taking into account any reasonably foreseeable misuse thereof. The aim of measures taken must be to eliminate any risk throughout the foreseeable lifetime of the machinery including the phases of transport, assembly, dismantling, disabling and scrapping." Therefore, components of this guideline can be used to guide the design for the full life cycle of the machine/process.

6. Criteria for the analysis of P-SbD resources

Resource analysis means the extraction of knowledge from the P-SbD resource about its usability (in terms of Relevance, User-friendless and Nano-specificity), information on the applicability of the resource for nanoprocess design and, perhaps most importantly, the gaps in information that are not covered by the resource, as well as recommendations for use.

The proposed categories to identify the usability of a resource are noted below and characterised as "High", "Medium" or "Low".:

- **Relevance (R)**. This parameter represents the degree of relevance of the resource in the field of nanosafety, ***according to the prestige/credibility of the organization/author developing the resource***.
- **User-friendliness (UF)**. This parameter represents the degree of ease of use of the resource by the designer, to solve a specific nanosafety requirement with effectiveness, efficiency and satisfaction.
- **Nano-specificity (nS)**. This parameter represents the degree of specificity of the resource to cover the nano-requirement concerned categories

Table 3 lists the three usability categories and defines the guidelines to determine at which of the three levels (high, medium or low) each resource should be ranked.

Table 3 : Resource usability - provisional criteria for assigning levels to the usability parameters of the P-SbD resource.

P-SbD resource indicator	Level		
	High (Green)	Medium (Orange)	Low (Red)
Relevance (R)	Resource developed by an organization/ agent with recognized prestige, with a broad consensus and transparency; or a regulatory body.	Resource developed by an organization / agent with recognized prestige, but with limited consensus and/or transparency.	Resource developed by other organizations/agents different from the previous ones.
User-friendliness (UF)	Resource easily understandable and usable by the designer, with little need for additional training.	Resource moderately difficult to understand and use by the designer, requiring some specific training.	Resource difficult to understand and use by the designer, requiring important specific training
Nano-specificity (nS)	Specific nanosafety resource, to directly address the design topic.	Non-specific nanosafety resource, to address the design topic.	Non-nanosafety resource; general resource for design. Applicability conditioned by the expertise of the designer.

In addition to the classification of the usability of each resource, several further categories have been proposed to analyse each resource, including:

- **Applicability for P-SbD**: advice on the application limitations of the resource for the design topic considered.
- **Gaps**: issues not covered by the resource to solve the design topic considered. This category will be essential to identify key focus points for the work in Task 5.2.
- **Recommendations for use**: advice on the use of the resource, alone or in combination with other resources, to solve the design topic considered.
- **Notes**: additional relevant comments related to the resource that the partner(s) identify as being important.
- **Partner**: name of SAbyNA partner responsible for the identification and classification of the resource.

Table 4 : Analysis of resources - example from P-SbD resource Excel database

3. RESOURCE ANALYSIS								
Code	**R**	**UF**	**nS**	**Applicability for PSbD**	**Gaps**	**Recommend for use**	**Notes**	**Partner (Responsible for Resource)**
RPSbD001	H	M	L	Indirect verification of airborne emissions of machinery/processes, by measuring occupational exposure (OELVs).				Tecnalia
RPSbD002	H	H	L					Tecnalia
RPSbD003	H	M	L	Assessment of the effectiveness of pollution control systems installed in machinery/processes (enclosures, LEVs, etc).		Measurement of the decontamination index of pollution control system can serve for the: 1) evaluation of the performance of a pollution control system of a machine; 2) evaluation of the improvement of a pollution control system; comparison of pollution control systems for machines of similar design; 3) ranking of pollution control systems according to their decontamination efficiency; 4) determination of the air flow rate in the case of an exhaust system to achieve a given level; 5) determination of the state of the art of pollution control systems for machines with respect to the decontamination efficiency.		Tecnalia
RPSbD004	H	H	L	General procedure to conduct the SbD and risk assessment of machinery/processes				Tecnalia

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7. Working procedure for the inclusion of a new P-SbD resource

The three steps to include a P-SbD resource in the database are:

- **Step 1. RESOURCE IDENTIFICATION.** Identify the resource, entering the code, name, a brief description of its scope, the owner of the resource and the source of its location on the web in the corresponding columns. Finally, to identify the type of organization, using the labels listed in Table 1.
- **Step 2. RESOURCE CLASIFICATION.** Classify the resource by type, by design topic, by design strategy and by industrial sector, using the corresponding labels listed in Table 5.
- **Step 3. RESOURCES ANALYSIS.** First, score the indicators of Relevance (R), User-Friendliness (UF) and Nano-specificity (nS) of the resource, according to the experience of the evaluator, labelling the corresponding cell with an "H", "M" or "L" and highlighting the cell in green, orange or red depending on the scored value (see Table 3). Then, briefly describe the applicability, gaps and recommendations for the use of the resource for the design/redesign of SAbyNA nano-processes.

In support of the identification, classification and analysis of the resources, the following table (Table 5) provides a list of labels for each of the categories in the database: Organization type, Resource type, Design topic, Design strategy and Industrial sector.

The labels in Table 5 are a guideline and wherever a partner determines that a new label should be added, the new label title can be added to the corresponding table within the Excel database (sheet "Table 1. Tags"). Partners are encouraged to use these titles to help simplify the statistical analysis of the identified resources.

Table 5 : Guide to labelling of P-SbD resources

Table. Tags for labelling P-SbD resources in the database				
1. Organization type	**2. Resource type**	**Design topic**	**4. Design strategy**	**5. Industrial sector**
Industry or industrial group	Best practice	Explosion	Risk assessment	Cosmetics
Industrial association	Database	Emissions of hazardous materials and substances	Emission verification	Textiles
Government or government agency	Framework	Fire	Exposure verification	3D printing
Research organization	Guideline	Materials and products	Inherently safe design	Paints
Research project	Library	Safety-related parts of control systems	Safeguarding and complementary protective measures	ASINA sectors
Regulator	Method	All design topics	Information for use	SAbyNA sectors
Standardization organization	Model	Other design topic	Organization	All sectors
Other source	Regulation		PPEs	Other sector
	Standard		Designer strategies (D)	
	Tool/Software tool		User strategies (U)	
	TDS/SDS		All strategies	
	Use case		Other strategy	
	Other resource			

8. Statistical analysis of identified resources

This section analyses and statistically summarises the resources identified within the database according to a number of key factors:

- Analysis of applicability of identified resources for PSbD.
  - Ranking of resource suitability (based on a traffic light scheme)
- Statistical analysis according to resource owner, organisation type, resource type, design topic, design strategy and industrial sector
- Grouping of collaborative resources
- Identification and analysis of gaps within current resources
- Recommendations for future work

As of February 2021, the SAbyNA P-SbD Resource Library contained 51 resources that have been identified, evaluated and documented by the WP5 partners. The resources come from a range of sources but most predominantly to date (90%), are resources based on Guidelines, Standards and Articles. Figure 1 shows the different types of resources under consideration and identifies the number of each type of resource that have been identified.

It is important to note that this library will continue to expand throughout the project lifetime, as more resources are identified, analysed and added.

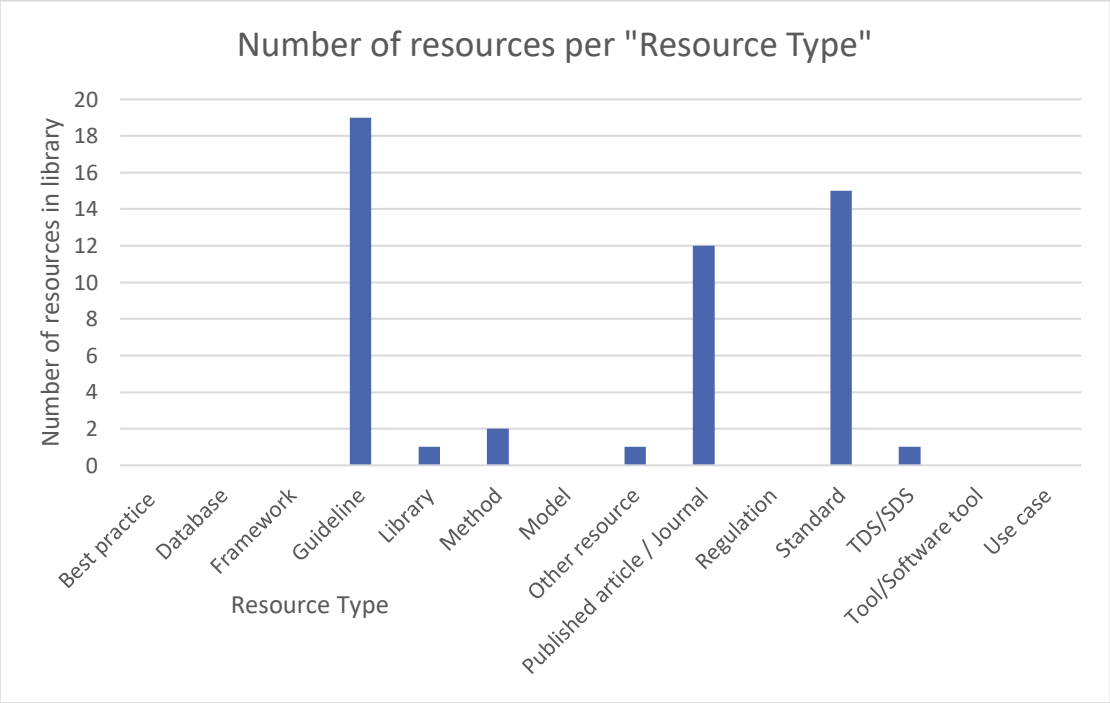


Figure 1: Type of resources identified in WP5 library

Figure 2 shows the types of organisations responsible for the identified resources. Nearly 2/3rds of the resources are from either Standardisation organisations or Government agencies. The remaining resources come from Research organisations, Research projects, Industrial groups, or “Other” sources.

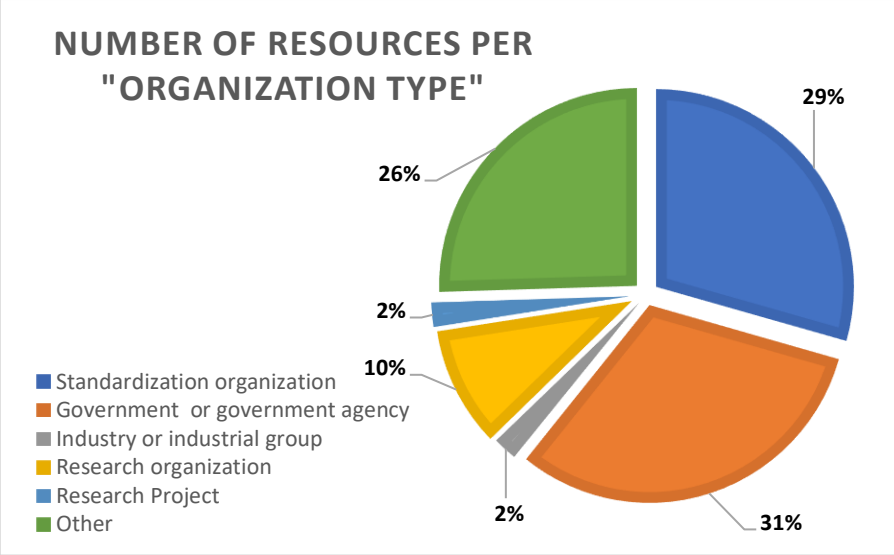


Figure 2: Types of organisations responsible for identified resources.

Figure 3 shows the individual resource owners in greater detail and identifies those owners that have contributed the highest number of resources to the library. The four highest contributors (25 of 51 resources [49%]) are the European Committee for Standardisation (CEN) [22%], National Institute for Health and Safety (NIOSH) [12%], CDC/NIOSH [8%] and International Organisation for Standardisation (ISO) [8%]. A single resource has been identified for sixteen of the 25 resource owners, including WHO, Health and Safety Executive, Nanocyl, TNO and IRSST.

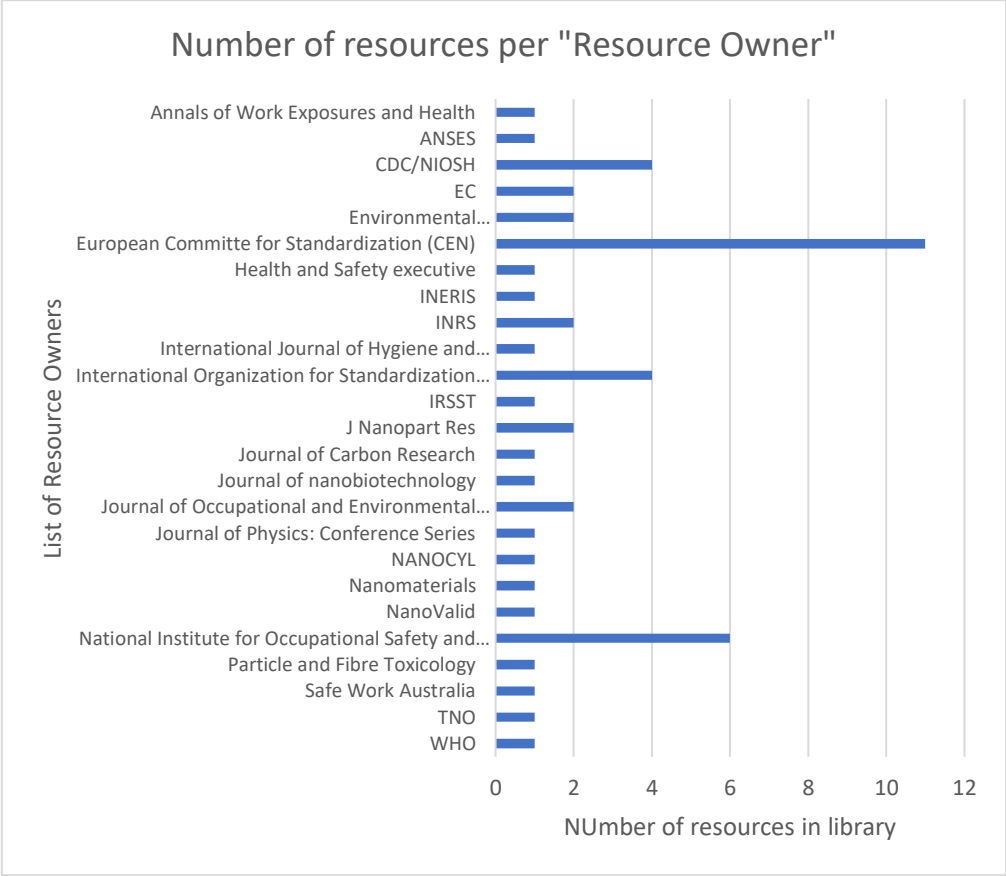


Figure 3: List of resource owners and number of resources identified per owner

Figure 4 describes the percentage of resources for each of the identified design topics. Half of the resources cover details of the emissions of hazardous materials and substances. Nearly a third describe safety-related parts of control systems. The remaining 18% of resources cover materials and products (6%), “all design topics” (6%), regulatory aspects (2%), fire (2%) and explosion (2%).

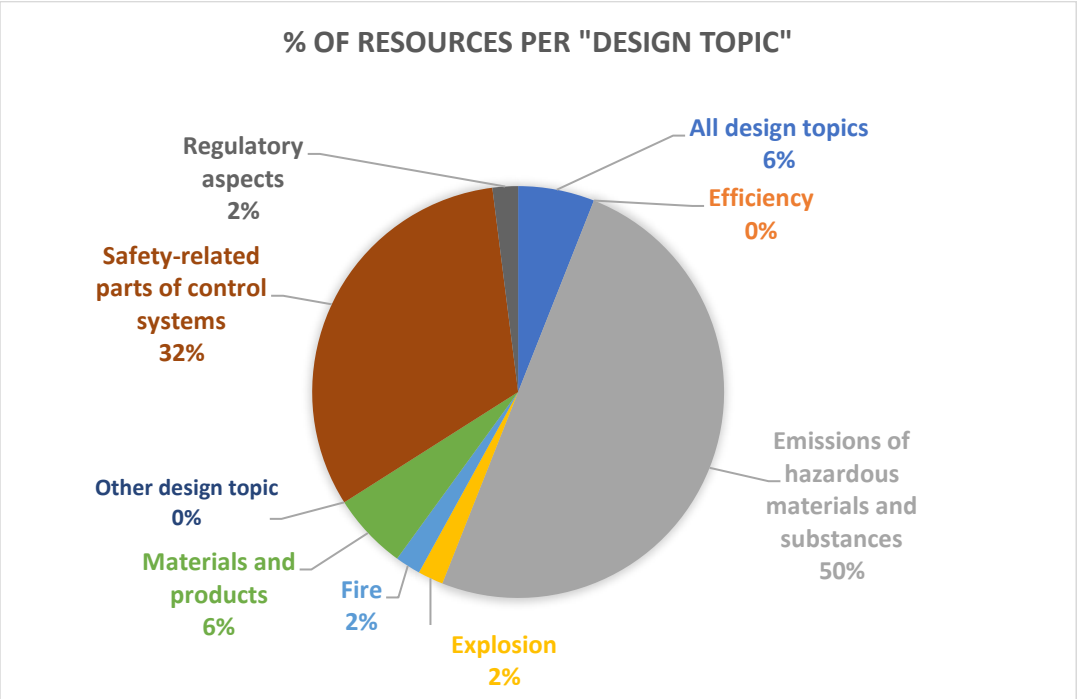


Figure 4: Percentage of total resources for each of the identified design topics

Figure 5 lists the different resources according to design strategy. User strategies (11), risk assessment (10) and exposure mitigation measures (10) are the three predominant design strategies covered by nearly 2/3rds of the resources.

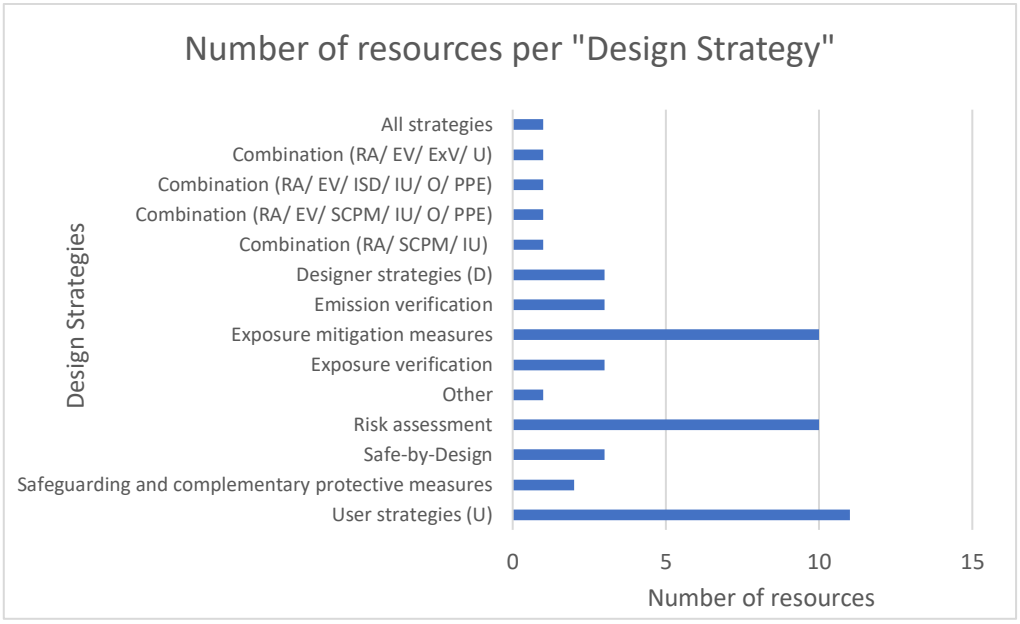


Figure 5: Number of identified resources based on “Design Strategy”

A number of the resources in the library have been assessed to cover combinations of several design strategies, for example, one resource [RPSbD D033 “WHO Guidelines on Protecting Workers from Potential Risks of Manufactured Nanomaterials”] combines risk assessment, emission verification, exposure verification and user strategies.

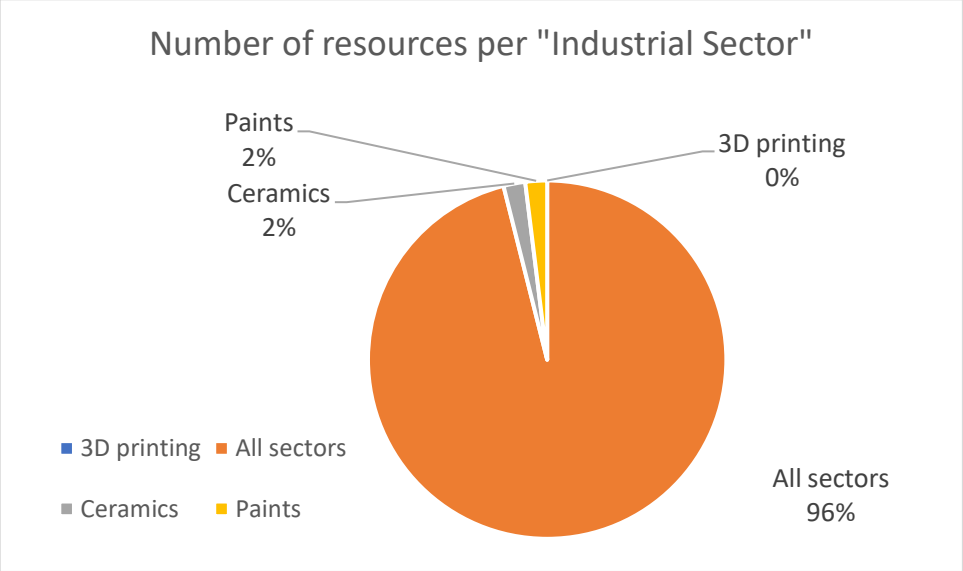


Figure 6: Number of identified resources per Industrial Sector.

Figure 6 shows the industrial sectors covered by the resources. The majority of the resources are general to all industrial sectors with only one resource identified as specific to the Paint sector [RPSbD 041: Effectiveness of nanoparticle exposure mitigation measures in industrial settings] and another to the Ceramics sector [RPSbD 050: SERENADE: safer and eco-design research and education applied to nanomaterial development, the new generation of materials safer by design]. To date a number of resources specific to the 3D printing sector have been identified by partners but have yet to be added to the resource library. Ideally future research will identify more sector specific resources, especially those related to the Paint and 3D Print industries.

Table 6: Resource evaluation – level of relevance (R), User-friendliness (UF) and Nano-specificity (nS)

Relevance	User-friendliness	Nano-specificity	Number of resources
H	H	H	21
H	H	L	7
H	M	H	6
H	H	M	5
H	M	L	3
M	H	M	3
H	M	M	2
M	M	H	2
H	L	H	1
M	H	H	1

Table 6 shows the analysis of the resources according to the traffic light scheme, in accordance with the guidelines described in Table 3. Of all the resources identified to date, 21 were evaluated with 3 green lights, that is to say that they were assessed to be resources developed by an organization/ agent

or regulatory body with recognized prestige; easily understandable and usable by the designer, and to be specific nanosafety resources, able to directly address the design topic. It is expected that many resources receive a "top ranking" as the WP5 partners are screening the resources during their assessments. In general, lower ranked resources are not included in the library, unless certain aspects are deemed to be critical for designers.

- Relevance
  - In general the resources identified to date are resources developed by an organization/ agent or regulatory body with recognized prestige, with only 6 of all resources being classed as coming from an organisation "with limited consensus and/or transparency" [RPSbD011, RPSbD012, RPSbD022, PSbD048, RPSbD049, RPSbD051]
- User-friendly
  - Nearly 75% of the resources have been classified as being highly user friendly i.e., the resources are easily understandable and usable by the designer, with little need for additional training. 25% of all resources have been assessed to be moderately user-friendly – i.e. moderately difficult to understand and use by the designer, requiring some specific training. Only one resource [RPSbD009 EN 16966:2018 Workplace exposure - Measurement of exposure by inhalation of nano-objects and their aggregates and agglomerates] been assessed to be "difficult to understand and use by the designer, requiring important specific training".
- Nano-specific
  - 60% of all resources have been assessed to be "highly specific nanosafety resources, which directly address the design topic." 20% of resources have been classified as moderate "non-specific nanosafety resources" and a further 20% are low "non-nanosafety; general resources for design whose applicability are conditioned by the expertise of the designer."

Table 7 clearly shows that nearly 40% of all resources have a medium or low rating when the "Nano-specificity" of the resource is assessed.

Table 7: Resource evaluation – % of resources with (H)igh, (M)edium and (L)ow rankings according based on resource provider relevance (R), User-friendliness (UF) and Nano-specificity (nS)

Rank	Relevance	User-friendliness	Nano-specificity
H	88%	73%	60.8%
M	12%	25%	19.6%
L	0%	2%	19.6%

Table 8 shows the type of resources that received a green traffic light (High rating) for each of the three parameters. Of these 21 resources, 14 are guidelines, 4 are articles and the remainder include a standard, method and one library.

Table 8: Resource evaluation – level of relevance (R), User-friendliness (UF) and Nano-specificity (nS)

Resource Type	Number
Standard	1
Guideline	14
Method	1
Library	1
Published article / Journal	4

9. Summary of work and recommendations for Task 5.2

The WP5 partners have developed a resource library, in collaboration with the ASINA project, for the identification and analysis of resources related to nano processes. This library will continue to be developed throughout the SABYNA project and will be used as to support and provide critical inputs to the platform under development in WP6.

To date 51 resources have been identified and catalogued according to several fields:

- Resource ID – ID code, Resource name, scope, source, resource owner and organization type
- Resource Classification - Resource type, design topic, design strategy, Industrial sector
- Resource Analysis – Level of resource provider relevance, User-friendliness, Nano-specificity, Applicability of the resource for the SABYNA resource library, Critical gaps not covered by resource, Recommendations for use

The library acts as an input for the activities in Task 5.2, and a critical input relates to the gaps identified by the partners during the analysis of the PSbD resources. Issues that have been highlighted include the following:

- Practical resource advice is only related to a specific work situation (and not necessarily applicable to other work situations).
- Resource documents that do not deal with incidental release of nanomaterials.
- Resource documents that are specific to just one form of nanomaterial (e.g. CNTs)
- Resources with specific information on engineering controls for different applications but which do not include detailed information on where or how to implement these.
- Resources which do not supply background information for the respective recommendations, nor information on how to implement these successfully (i.e. verification of controls/maintenance of control measures)
- Resources that lack specific answers or end points, which could be used as guidance documents in conjunction with more specific guidance.
- Resources that do not provide direct reference/advice to specific measures such as ventilation and other design factors.
- Resources without detailed information on the control measures that can be used - aimed more at workers and not process designers.
- Resources with a narrow focus on very specific case studies.
- Not state of the art
- Overall conceptual methodology which does not focus on nano processes.
- Resource focused on graphene related products and processes (not considering generalization)
- No quantitative/qualitative data and more nano material focused, rather than nano process.

In addition to the gaps identified by individual partners, the work in WP5 now also needs to focus on the gaps in the resource library, particularly with respect to the five design topics identified from the requirements of the machinery directive. For each of the five categories, the following resources have been identified (based on identified topic keywords]. As can be seen from the following section, there are currently a limited number of resources related to explosion (4 resources) and fire (3 resources). Further effort is required to identify additional resources in these two topics to enable a more detailed analysis.

Explosion [“explosion”, “explosive”]

RPSbD005	EN 1127-1:2019 Explosive atmospheres - Explosion prevention and protection - Part 1: Basic concepts and methodology
RPSbD007	EN ISO 14123-1:2015 Safety of machinery — Reduction of risks to health resulting from hazardous substances emitted by machinery — Part 1: Principles and specifications for machinery manufacturers
RPSbD028	Approaches to Safe Nanotechnology: Managing the Health and Safety Concerns Associated with Engineered Nanomaterials
RPSbD029	Building a Safety Program to Protect the Nanotechnology Workforce: A Guide for Small to Medium Enterprises

Emissions of hazardous materials and substances [“emissions”,

RPSbD001	EN 689:2018+AC:2019 Workplace exposure. Measurement of exposure by inhalation to chemical agents. Strategy for testing compliance with occupational exposure limit values.
RPSbD002	EN 1093-1:2008 Safety of machinery - Evaluation of the emission of airborne hazardous substances - Part 1: Selection of test methods
RPSbD003	EN 1093-11:2001+A1:2008 Safety of machinery - Evaluation of the emission of airborne hazardous substances - Part 11: Decontamination index
RPSbD007	EN ISO 14123-1:2015 Safety of machinery — Reduction of risks to health resulting from hazardous substances emitted by machinery — Part 1: Principles and specifications for machinery manufacturers
RPSbD008	EN ISO 14123-2:2015 Safety of machinery - Reduction of risks to health resulting from hazardous substances emitted by machinery - Part 2: Methodology leading to verification procedures (ISO 14123-2:2015)
RPSbD009	EN 16966:2018 Workplace exposure - Measurement of exposure by inhalation of nano-objects and their aggregates and agglomerates - Metrics to be used such as number concentration, surface area concentration and mass concentration
RPSbD010	EN 17058:2018 Workplace exposure - Assessment of exposure by inhalation of nano-objects and their aggregates and agglomerates
RPSbD011	ISO/TR 12885:2018 Nanotechnologies — Health and safety practices in occupational settings
RPSbD012	ISO/TS 12901-2:2014 Nanotechnologies — Occupational risk management applied to engineered nanomaterials — Part 2: Use of the control banding approach
RPSbD014	ISO/TR 18637:2016 Nanotechnologies — Overview of available frameworks for the development of occupational exposure limits and bands for nano-objects and their aggregates and agglomerates (NOAAs)
RPSbD016	Current Strategies for Engineering Controls in Nanomaterial Production and Downstream Handling Processes
RPSbD017	Workplace Design Solutions: Protecting Workers during Nanomaterial Reactor Operations
RPSbD018	Workplace Design Solutions: Protecting Workers during the Handling of Nanomaterials
RPSbD019	Workplace Design Solutions: Protecting Workers during Intermediate and Downstream Processing of Nanomaterials
RPSbD020	Current Intelligence Bulletin 65. Occupational Exposure to Carbon Nanotubes and Nanofibers
RPSbD021	Current Intelligence Bulletin 63: Occupational Exposure to Titanium Dioxide
RPSbD023	Best practices guidance for nanomaterial risk management in workplace
RPSbD027	Safe handling and use of carbon nanotubes
RPSbD028	Approaches to Safe Nanotechnology: Managing the Health and Safety Concerns Associated with Engineered Nanomaterials
RPSbD029	Building a Safety Program to Protect the Nanotechnology Workforce: A Guide for Small to Medium Enterprises
RPSbD030	Controlling Health Hazards when Working with Nanomaterials: Questions to Ask Before You Start?
RPSbD031	General Safe Practices for Working with Engineered Nanomaterials in Research Laboratories
RPSbD032	Safe handling of nanomaterials and other advanced materials at workplaces
RPSbD033	WHO Guidelines on Protecting Workers from Potential Risks of Manufactured Nanomaterials
RPSbD039	The Exposure Control Efficacy Library (ECEL v3.0)
RPSbD050	SERENADE: safer and ecodesign research and education applied to nanomaterial development, the new generation of materials safer by design

Fire (3 resources)

RPSbD015	"EN ISO 19353:2019 Safety of machinery - Fire prevention and fire protection (ISO 19353:2019)
RPSbD028	Approaches to Safe Nanotechnology: Managing the Health and Safety Concerns Associated with Engineered Nanomaterials
RPSbD029	Building a Safety Program to Protect the Nanotechnology Workforce: A Guide for Small to Medium Enterprises

Materials and products ["materials", "products"]

This topic is covered by almost all of the library resources.

Safety part of control systems ["control system"]

RPSbD002	EN 1093-1:2008 Safety of machinery - Evaluation of the emission of airborne hazardous substances - Part 1: Selection of test methods
RPSbD003	EN 1093-11:2001+A1:2008 Safety of machinery - Evaluation of the emission of airborne hazardous substances - Part 11: Decontamination index
RPSbD006	EN ISO 13849-1:2015 Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design (ISO 13849-1:2015)
RPSbD024	Using Nanomaterials at work including CNT and other bio persistent HARNs
RPSbD026	Nanomatériaux: Ventilation et filtration de l'air dans les lieux de travail nanomaterials: Ventilation & filtering in workstation
RPSbD036	Développemnent d'un outil de gestion graduée des risques spécifique au cas des nanomatériaux = Development of a graduated risk management tool specific to the case of nanomaterials
RPSbD037	Engineered nanomaterials: Toward effective safety management in research laboratories
RPSbD038	Benchmark européen des guides de bonnes pratiques et référentiels sur la Securité liée à la mise en oeuvre de NM = European Benchmark of good practice guides and benchmarks on safety related to the implementation of NMs
RPSbD039	The Exposure Control Efficacy Library (ECEL v3.0)
RPSbD040	A Review of Workplace Risk Management Measures for Nanomaterials to Mitigate Inhalation and Dermal Exposure
RPSbD041	Effectiveness of nanoparticle exposure mitigation measures in industrial settings
RPSbD042	Exposure Controls for Nanomaterials at Three Manufacturing Sites
RPSbD043	Occupational safety and health in nanotechnology and Organisation for Economic Cooperation and Development
RPSbD044	Evaluation of Existing Control Measures in Reducing Health and Safety Risks of Engineered Nanomaterials
RPSbD045	Occupational Risk Management of Engineered Nanoparticles
RPSbD046	Overview of Risk Management for Engineered Nanomaterials
RPSbD047	Handling and Risk Mitigation of Nanoscale Graphene and Related Materials: Some Considerations and Recommendations
RPSbD049	Implementation of Safe-by-Design for Nanomaterial Development and Safe Innovation: WhyWe Need a Comprehensive Approach

The PSbD library can now be used to identify key resources and what they offer to process designers. More importantly critical combinations of resources need to be identified, i.e. combinations of complimentary resources that can be used to identify / solve critical design issues related to the use of nano materials in existing/new processes.

The work in Task 5.2 will need to assess the resources in the PSbD library to identify where these complimentary resources exist, where there continue to be gaps and to identify the type of resource(s) needed to fill these critical gaps.

10. ANNEX I – Terms and Definitions

A1.1 Typology of SbD resources

Best practice (sin. good practice): level representing best available real performance (ISO 21678:2020). ***Good practice***: method that has been proven to work well and produce good results and is therefore recommended as a model (ISO 14055-1:2017).

Database: collection of data organized according to a conceptual structure describing the characteristics of these data and the relationships among their corresponding entities, supporting one or more application areas (ISO/IEC 2382:2015). A database is a set of almost any digital objects, which can be text, picture, sound, video, etc. (ISO/TR 23845:2020). Database collection of electronically stored descriptive records or content units (including facts, full texts, pictures, and sound) with a common user interface and software for the retrieval and manipulation of the data (ISO/TR 17185-3:2015).

Framework: particular set of beliefs and ideas referred to in order to describe a scenario or solve a problem (ISO/TS 15638-4:2020); structure expressed in diagrams, text, and formal rules which relates the components of a conceptual entity to each other (ISO 19439:2006).

Guideline: consensual document that originates from any one of a number of different professional organizations and provides technical information about safe practices and procedures (ISO/TR 15916:2015). An official recommendation or advice that indicates policies, standards, or procedures for how something should be accomplished [A Guide to the Project Management Body of Knowledge (PMBOK® Guide) — Fifth Edition].

Library: place containing collections of work products (programs, set of data, etc) and useful information items for people to read, borrow or refer to, and for machines to access and retrieve data from (ISO/IEC/IEEE 42020:2019).

Methodology: set of means or procedures used for a specific purpose (ISO 14050:2020). collection of standards, procedures and supporting methods that define the complete approach to the development of a product or system (ISO/IEC 21827:2008).

Model: physical, mathematical, or otherwise logical representation of a system, entity, phenomenon, or process (ISO/IEC 18023-1:2006, 3.1.11).

Mathematical model: sets of equations that describe the behaviour of a physical system (ISO 16730-1:2015).

Paper: scientific article in a scientific journal (ISO 5127:2017).

Regulation: document providing binding legislative rules, that is adopted by an authority (ISO/IEC Guide 2:2004). A technical regulation provides technical requirements, either directly or by referring to or incorporating the content of a standard, technical specification or code of practice (ISO/IEC Guide 2:2004). In ASINA, this term includes international, European and national regulations.

Standard: documented agreement containing technical specifications or other precise criteria to be used consistently as rules, guidelines, or definitions of characteristics, to ensure that materials, products, processes and services are fit for their purpose. (ISO/IEC Guide 2:2004). Standards are developed by recognised international, European or national standardization organizations such as e.g. ISO, CEN, DIN, UNE. Standards are based on the consolidated results of science, technology and experience. Standards are voluntary and some standards are made mandatory by regulation.

Tool (Software tool): something tangible, such as a template or software program, used in performing an activity to produce a product or result. Also, tool is used as a short form for software tool (ISO/IEC/IEEE 24765:2017).

Use case: specification of a sequence of actions, including variants, that a system (or other entity) can perform, interacting with actors of the system (ISO/IEC 23643:2020).

A1.2 Machinery and process

Adequate risk reduction: risk reduction that is at least in accordance with legal requirements, taking into consideration the current state of the art. The objective of risk reduction can be achieved by the elimination of hazards, or by separately or simultaneously reducing each of the two elements that determine the associated risk: 1) severity of harm from the hazard under consideration; b) probability of occurrence of that harm (EN ISO 12100: 2010).

Comparative emission data: set of emission values of similar machines collected for the purpose of comparison (EN ISO 12100: 2010).

Emission value: numerical value quantifying an emission generated by a machine (for example, noise, vibration, **hazardous substances**, radiation).

NOTE 1: emission values are part of the information on the properties of a machine and are used as a basis for risk assessment; NOTE 2: **the term "emission value" ought not to be confused with "exposure value"**, which quantifies the exposure of persons to emissions when the machine is in use. Exposure values can be estimated using the emission values; NOTE 3: emission values are preferably measured and their associated uncertainties determined by means of standardized methods (for example, to allow comparison between similar machines).

Information for use: protective measure consisting of communication links (for example, text, words, signs, signals, symbols, diagrams, instruction handbook) used separately or in combination, to convey information to the user (EN ISO 12100: 2010).

Inherently safe design measure: protective measure which either eliminates hazards or reduces the risks associated with hazards by changing the design or operating characteristics of the machine without the use of guards or protective devices. Inherently safe design measures are achieved by avoiding hazards or reducing risks by a suitable choice of design features for the machine itself and/or interaction between the exposed persons and the machine [e.g. limiting the emissions by acting on the characteristics of the source using measures for reducing the emission of hazardous substances, including the use of less hazardous substances or dust-reducing processes (granules instead of powders, milling instead of grinding)] (EN ISO 12100: 2010).

Machinery/machine: assembly, fitted with or intended to be fitted with a drive system consisting of linked parts or components, at least one of which moves, and which are joined together for a specific application.

NOTE 1 The term "machinery" also covers an **assembly of machines** which, in order to achieve the same end, are arranged and controlled so that they function as an integral whole (EN ISO 12100: 2010).

Nanomanufacturing: intentional synthesis, generation or control of nanomaterials, or fabrication steps in the nanoscale, for commercial purposes (ISO/TS 80004-1:2015)-

Nanomanufacturing process: ensemble of activities to intentionally synthesize, generate or control nanomaterials, or fabrication steps in the nanoscale, for commercial purpose (ISO/TS 80004-1:2015)

Process: set of interrelated or interacting activities that use inputs to deliver an intended result (EN ISO 9000:2015)

NOTE 1 to entry: Whether the "intended result" of a process is called output, product or service depends on the context of the reference; NOTE 2 to entry: Inputs to a process are generally the outputs of other processes and outputs of a process are generally the inputs to other processes; NOTE 3 to entry: Two or more interrelated and interacting processes in series can also be referred to as a process; NOTE 4 to entry: Processes in an organization (3.2.1) are generally planned and carried out under controlled conditions to add value; NOTE 5 to entry: A process where the conformity of the resulting output cannot be readily or economically validated is frequently referred to as a "special process"; NOTE 6 to entry: This constitutes one of the common terms and core definitions for ISO management system standards given in Annex SL of the Consolidated ISO Supplement to the ISO/IEC Directives, Part 1.

The original definition has been modified to prevent circularity between process and output and Notes 1 to 5 to entry have been added.

Protective measure: measure intended to achieve risk reduction, implemented 1) by the designer (inherently safe design, safeguarding and complementary protective measures, information for use) and/or 2) by the user (organization: safe working procedures, supervision, permit-to-work systems; provision and use of additional safeguards; use of personal protective equipment; training) (EN ISO 12100: 2010).

Residual risk: risk remaining after protective measures have been implemented. ISO 12100 distinguishes: 1) the residual risk after protective measures have been implemented by the designer, 2) the residual risk remaining after all protective measures have been implemented (EN ISO 12100: 2010).

Risk: combination of the probability of occurrence of harm and the severity of that harm (EN ISO 12100: 2010).

Risk analysis: combination of the specification of the limits of the machine, hazard identification and risk estimation. Risk analysis provides information required for the risk evaluation, which in turn allows judgments to be made about whether or not risk reduction is required (EN ISO 12100: 2010).

Risk assessment: overall process comprising a risk analysis and a risk evaluation (EN ISO 12100: 2010).

Risk estimation: defining likely severity of harm and probability of its occurrence (EN ISO 12100: 2010).

Risk evaluation: judgment, on the basis of risk analysis, of whether the risk reduction objectives have been achieved. After risk estimation has been completed, risk evaluation shall be carried out to determine if risk reduction is required. If so, then appropriate protective measures shall be selected and applied (EN ISO 12100: 2010).

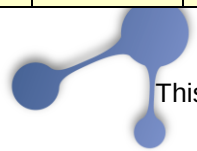
Safeguarding: protective measure using safeguards to protect persons from the hazards which cannot reasonably be eliminated or risks which cannot be sufficiently reduced by inherently safe design measures (EN ISO 12100: 2010).

Three-step method: hierarchical sequence - in three steps - for the application of protective measures intended for reaching the objective of risk reduction (see Figure).

11. ANNEX II – P-SbD Resource Library

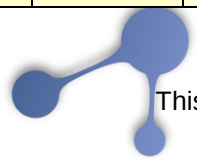
A full copy of the resources Excel database will be added here.

1. RESOURCE IDENTIFICATION						2. RESOURCE CLASSIFICATION				3. RESOURCE ANALYSIS							
Code	Name	Scope	Source	Owner	Organization type	Resource type	Design topic	Design strategy	Industrial sector	R	UF	S	Applicability for PSbD	Gaps	Recommend for use	Notes	Partner (Responsible for Resource)
RPSbD001	EN 689:2018+AC:2019 Workplace exposure. Measurement of exposure by inhalation to chemical agents. Strategy for testing compliance with occupational exposure limit values.	This European Standard specifies a strategy to perform representative measurements of exposure by inhalation to chemical agents in order to demonstrate the compliance with occupational exposure limit values (OELVs). This European Standard is not applicable to OELVs with reference periods less than 15 min.	https://standards.cen.eu/dyn/www/f?p=204:110:0::::FSP_PROJECT,FSP_ORG_ID:67662,6119&cs=14AF6DBAB8597419DB537B242544A737F	European Committe for Standardization (CEN)	Standardization organization	Standard	Emissions of hazardous materials and substances	Exposure verification	All sectors	H	M	L	Indirect verification of airborne emissions of machinery/processes, by measuring occupational exposure (OELVs).				Tecnalia
RPSbD002	EN 1093-1:2008 Safety of machinery - Evaluation of the emission of airborne hazardous substances - Part 1: Selection of test methods	This European Standard specifies parameters which can be used for the assessment of the emission of pollutants from machines or the performance of the pollutant control systems integrated in machines. It gives guidance on the selection of appropriate test methods according to their various fields of application and types of machines including the effects of measures to reduce exposures to pollutants. The test methods are given in additional parts of this European Standard.	https://standards.cen.eu/dyn/www/f?p=204:110:0::::FSP_PROJECT,FSP_ORG_ID:27868,6096&cs=19D334F0E8895E9D0395F640737099B14	European Committe for Standardization (CEN)	Standardization organization	Standard	Emissions of hazardous materials and substances	Emission verification	All sectors	H	H	L					Tecnalia
RPSbD003	EN 1093-11:2001+A1:2008 Safety of machinery - Evaluation of the emission of airborne hazardous substances - Part 11: Decontamination index	This standard describes a method for the measurement of the decontamination index of pollution control systems e. g. capture devices including local exhaust ventilation, water spray systems and, when appropriate, separation equipment installed on a machine. This method uses the real pollutant (EN 1093-1: 1998) and can be operated in room or field environments.	https://standards.cen.eu/dyn/www/f?p=204:110:0::::FSP_PROJECT,FSP_ORG_ID:31115,6096&cs=1E6A640EA68CB94627A18B800863AEBDC	European Committe for Standardization (CEN)	Standardization organization	Standard	Emissions of hazardous materials and substances	Emission verification	All sectors	H	M	L	Assessment of the effectiveness of pollution control systems installed in machinery/processes (enclosures, LEVs, etc).		Measurement of the decontamination index of pollution control system can serve for the: 1) evaluation of the performance of a pollution control system of a machine; 2) evaluation of the improvement of a pollution control system; comparison of pollution control systems for machines of similar design; 3) ranking of pollution control systems according to their decontamination efficiency; 4) determination of the air flow rate in the case of an exhaust system to		Tecnalia



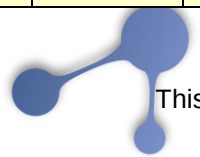
This document contributes a first draft for D5.1.

														achieve a given level; 5) determination of the state of the art of pollution control systems for machines with respect to the decontamination efficiency.		
RPSbD004	EN ISO 12100:2010 Safety of machinery - General principles for design - Risk assessment and risk reduction (ISO 12100:2010)	ISO 12100:2010 specifies basic terminology, principles and a methodology for achieving safety in the design of machinery. It specifies principles of risk assessment and risk reduction to help designers in achieving this objective. These principles are based on knowledge and experience of the design, use, incidents, accidents and risks associated with machinery. Procedures are described for identifying hazards and estimating and evaluating risks during relevant phases of the machine life cycle, and for the elimination of hazards or sufficient risk reduction. Guidance is given on the documentation and verification of the risk assessment and risk reduction process.	https://standards.cen.eu/dyn/www/f?p=204:110:0::::FSP_PROJECT,FSP_ORG_ID:32299,6096&cs=14C6B274520C60586598CB63FE4732782	European Committe for Standardization (CEN)	Standardization organization	Standard	All design topics	Risk assessment	All sectors	H	H	L	General procedure to conduct the SbD and risk assessment of machinery/processes				Tecnalia
RPSbD005	EN 1127-1:2019 Explosive atmospheres - Explosion prevention and protection - Part 1: Basic concepts and methodology	This document specifies methods for the identification and assessment of hazardous situations leading to explosion and the design and construction measures appropriate for the required safety. This is achieved by: - risk assessment; - risk reduction. This document specifies general design and construction methods to help designers and manufacturers in achieving explosion safety in the design of equipment, protective systems and components.	https://standards.cen.eu/dyn/www/f?p=204:110:0::::FSP_PROJECT,FSP_ORG_ID:59696,6286&cs=17A2DAA1A5EEAC5AFB7A07C7EE0016222	European Committe for Standardization (CEN)	Standardization organization	Standard	Explosion	Designer strategies (D)	All sectors	H	H	L	This document is applicable to any equipment, protective systems and components intended to be used in potentially explosive atmospheres, under atmospheric conditions. These atmospheres can arise from flammable/combustible substances processed, used or released by the equipment, protective systems and components or from materials in the vicinity of the equipment, protective systems and components and/or from the materials of construction of the equipment, protective systems and components. This document is applicable to equipment, protective systems and components at all stages of its use.				Tecnalia



This document contributes a first draft for D5.1.

RPSbD006	EN ISO 13849-1:2015 Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design (ISO 13849-1:2015)	This document provides safety requirements and guidance on the principles for the design and integration of safety-related parts of control systems (SRP/CS), including the design of software. For these parts of SRP/CS, it specifies characteristics that include the performance level required for carrying out safety functions.	https://standards.cen.eu/dyn/www/f?p=204:110:0::::FSP_PROJECT,FSP_ORG_ID:39285,6096&cs=1269268F03116BF7319D76D5A120E771A	European Committe for Standardization (CEN)	Standardization organization	Standard	Safety-related parts of control systems	Risk assessment	All sectors	H	M	L	It applies to SRP/CS for high demand and continuous mode, regardless of the type of technology and energy used (electrical, hydraulic, pneumatic, mechanical, etc.), for all kinds of machinery. It does not specify the safety functions or performance levels that are to be used in a particular case.				Tecnalia
RPSbD007	EN ISO 14123-1:2015 Safety of machinery — Reduction of risks to health resulting from hazardous substances emitted by machinery — Part 1: Principles and specifications for machinery manufacturers	This part of ISO 14123 establishes principles for the control of risks to health resulting from hazardous substances emitted by machinery.	https://standards.cen.eu/dyn/www/f?p=204:110:0::::FSP_PROJECT,FSP_ORG_ID:59210,6096&cs=1D68899E03A3DA9C3315822EBCBCA8ADB	European Committe for Standardization (CEN)	Standardization organization	Standard	Emissions of hazardous materials and substances	Designer strategies (D)	All sectors	H	H	L	ISO 14123-1:2015 is not applicable to substances that are a hazard to health solely because of their explosive, flammable or radioactive properties or their behaviour at extremes of temperature or pressure.	Non-specific standard for nano-pollutant emissions	Apply in combination with …		Tecnalia
RPSbD008	EN ISO 14123-2:2015 Safety of machinery - Reduction of risks to health resulting from hazardous substances emitted by machinery - Part 2: Methodology leading to verification procedures (ISO 14123-2:2015)	ISO 14123-2:2015 establishes a methodology that leads to the selection of critical factors relating to emissions of hazardous substances for the purpose of specifying suitable verification procedures. ISO 14123-2:2015 is intended to be used in conjunction with ISO 14123-1.	https://standards.cen.eu/dyn/www/f?p=204:110:0::::FSP_PROJECT,FSP_ORG_ID:59209,6096&cs=10DCA6333E1138F9EFDA4EDD50279BEBB	European Committe for Standardization (CEN)	Standardization organization	Standard	Emissions of hazardous materials and substances	Emission verification	All sectors	H	H	L	Identification of emission sources and verification procedures. In combination with EN ISO 14123-1.				Tecnalia
RPSbD009	EN 16966:2018 Workplace exposure - Measurement of exposure by inhalation of nano-objects and their aggregates and agglomerates - Metrics to be used such as number concentration, surface area concentration and mass concentration	This European Standard specifies the use of different metrics for the measurement of exposure by inhalation of NOAA during a basic assessment and a comprehensive assessment, respectively, as described in EN 17058. This document is intended for those responsible for selecting measurement methods for occupational exposure to airborne NOAA.	https://standards.cen.eu/dyn/www/f?p=204:110:0::::FSP_PROJECT,FSP_ORG_ID:40120,6119&cs=1D1AB202F7D3D4B8F73C514B0E7E65C69	European Committe for Standardization (CEN)	Standardization organization	Standard	Emissions of hazardous materials and substances	Exposure verification	All sectors	H	L	H	Specific information is mainly given for the following metrics/measurement techniques: - Number/Condensation Particle Counters by optical detection; - Number size distribution/differential mobility analysing systems by electrical mobility; - Surface area/electrical charge on available particle surface; - Mass/chemical analyses (e.g.		This document demonstrates the implications of choice of particle metric to express the exposure by inhalation to airborne NOAA, e.g. released from nanomaterials and present the principles of operation, advantages and disadvantages of various techniques that measure the different aerosol metrics.		Tecnalia



This document contributes a first draft for D5.1.

													Inductively Coupled Plasma atomic Mass Spectrometry (ICP-MS), X-Ray Fluorescence (XRF)) on size-selective samples (e.g. by impaction or diffusion). Potential problems and limitations are described and need to be addressed when occupational exposure limit values might be adopted in the future and compliance measurements will be carried out.				
RPSbD010	EN 17058:2018 Workplace exposure - Assessment of exposure by inhalation of nano-objects and their aggregates and agglomerates	This European Standard provides guidelines to assess workplace exposure by inhalation of nano-objects and their aggregates and agglomerates (NOAA). It contains guidance on the sampling and measurement strategies to adopt and methods for data evaluation. It is linked to the OECD Harmonized tiered approach (2015).	https://standards.cen.eu/dyn/www/f?p=204:110:0::::FSP_PROJECT,FSP_ORG_ID:37668,6119&cs=15F75671B7475A592782A3200FDD096F5	European Committe for Standardization (CEN)	Standardization organization	Standard	Emissions of hazardous materials and substances	Exposure verification	All sectors	H	H	H	Indirect verification of airborne emissions of PPLs, by measuring occupational exposure (NOAAs).		While the focus of this document is on the assessment of nano-objects, the approach is also applicable for exposure to the associated aggregates and agglomerates, i.e. NOAA, and particles released from nanocomposites and nano-enabled products.		Tecnalia
RPSbD011	ISO/TR 12885:2018 Nanotechnologies — Health and safety practices in occupational settings	This document describes health and safety practices in occupational settings relevant to nanotechnologies.	https://www.iso.org/standard/67446.html	International Organization for Standardization (ISO)	Standardization organization	Standard	Emissions of hazardous materials and substances	User strategies (U)	All sectors	M	M	H	This document focuses on the occupational manufacture and use of manufactured nano-objects, and their aggregates and agglomerates greater than 100 nm (NOAAs). It does not address health and safety issues or practices associated with NOAAs generated by natural processes, hot processes and other standard operations which unintentionally generate NOAAs, or potential consumer exposures or uses, though some of the information in this document can be				Tecnalia

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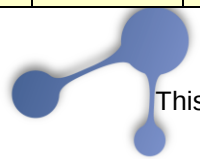
													relevant to those areas.			
RPSbD012	ISO/TS 12901-2:2014 Nanotechnologies — Occupational risk management applied to engineered nanomaterials — Part 2: Use of the control banding approach	ISO/TS 12901-2:2014 describes the use of a control banding approach for controlling the risks associated with occupational exposures to nano-objects, and their aggregates and agglomerates greater than 100 nm (NOAA), even if knowledge regarding their toxicity and quantitative exposure estimations is limited or lacking.	https://www.iso.org/standard/53375.html	International Organization for Standardization (ISO)	Standardization organization	Standard	Emissions of hazardous materials and substances	Risk assessment	All sectors	M	H	H	ISO/TS 12901-2:2014 is focused on intentionally produced nano-objects such as nanoparticles, nanopowders, nanofibres, nanotubes, nanowires, as well as of aggregates and agglomerates of the same. As used in ISO/TS 12901-2:2014, the term ""NOAA"" applies to such components, whether in their original form or incorporated in materials or preparations from which they could be released during their lifecycle. ISO/TS 12901-2:2014 is intended to help businesses and others, including research organizations engaged in the manufacturing, processing or handling of NOAA, by providing an easy-to-understand, pragmatic approach for the control of occupational exposures."		The ultimate purpose of control banding is to control exposure in order to prevent any possible adverse effects on workers' health. The control banding tool described here is specifically designed for inhalation control. Some guidance for skin and eye protection is given in ISO/TS 12901-1.		Tecnalia
RPSbD013	ISO/TR 14121-2:2012 Safety of machinery — Risk assessment — Part 2: Practical guidance and examples of methods	ISO/TR 14121-2:2012 gives practical guidance on conducting risk assessment for machinery in accordance with ISO 12100 and describes various methods and tools for each step in the process.	https://www.iso.org/standard/57180.html	International Organization for Standardization (ISO)	Standardization organization	Standard	All design topics	Risk assessment	All sectors	H	H	L	It gives examples of different measures that can be used to reduce risk and is intended to be used for risk assessment on a wide variety of machinery in terms of complexity and potential for harm.				Tecnalia



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													Its intended users are those involved in the design, installation or modification of machinery (for example, designers, technicians or safety specialists).				
RPSbD014	ISO/TR 18637:2016 Nanotechnologies — Overview of available frameworks for the development of occupational exposure limits and bands for nano-objects and their aggregates and agglomerates (NOAAs)	ISO/TR 16837:2016 provides an overview of available methods and procedures for the development of occupational exposure limits (OELs) and occupational exposure bands (OEBs) for manufactured nano-objects and their aggregates and agglomerates (NOAAs) for use in occupational health risk management decision-making.	https://www.iso.org/standard/63096.html	International Organization for Standardization (ISO)	Standardization organization	Standard	Emissions of hazardous materials and substances	User strategies (U)	All sectors	H	M	H	Selection of OELs and OEBs for the assessment of occupational exposure and apply control banding.				Tecnalia
RPSbD015	EN ISO 19353:2019 Safety of machinery - Fire prevention and fire protection (ISO 19353:2019)	This document specifies methods for identifying fire hazards resulting from machinery and for performing a risk assessment. It gives the basic concepts and methodology of protective measures for fire prevention and protection to be taken during the design and construction of machinery.	https://standards.cen.eu/dyn/www/f?p=204:110:0::::FSP_PROJECT,FSP_ORG_ID:64580,6096&cs=1D66140515 7B82946A7E37A895A7E9F39	European Committe for Standardization (CEN)	Standardization organization	Standard	Fire	Designer strategies (D)	All sectors	H	H	L	The measures consider the intended use and reasonably foreseeable misuse of the machine. It provides guidelines for consideration in reducing the risk of machinery fires to acceptable levels through machine design, risk assessment and operator instructions.				Tecnalia
RPSbD016	Current Strategies for Engineering Controls in Nanomaterial Production and Downstream Handling Processes	This document identifies and describes strategies for the engineering control of worker exposure during the production or use of engineered nanomaterials (manufacturing, use, and handling processes).	https://www.cdc.gov/niosh/docs/2014-102/default.html	National Institute for Occupational Safety and Health (NIOSH)	Government or government agency	Guideline	Emissions of hazardous materials and substances	User strategies (U)	All sectors	H	M	H					Tecnalia
RPSbD017	Workplace Design Solutions: Protecting Workers during Nanomaterial Reactor Operations	This document provides practical guidance on exposure control approaches for protecting workers during nanomaterial reactor operations.	https://www.cdc.gov/niosh/topics/nanotech/pubs.html	National Institute for Occupational Safety and Health (NIOSH)	Government or government agency	Guideline	Emissions of hazardous materials and substances	User strategies (U)	All sectors	H	H	H	The controls described in this document include enclosures for large and small reactors during harvesting as well as an approach for controlling exposures during reactor cleaning				Tecnalia

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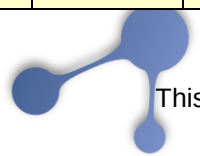
RPSbD018	Workplace Design Solutions: Protecting Workers during the Handling of Nanomaterials	This document provides practical guidance on exposure control approaches for protecting workers during the Handling of Nanomaterials	https://www.cdc.gov/niosh/topics/nanotech/pubs.html	National Institute for Occupational Safety and Health (NIOSH)	Government or government agency	Guideline	Emissions of hazardous materials and substances	User strategies (U)	All sectors	H	H	H	The controls described in this document include chemical fume hoods, nanomaterial handling enclosures, biological safety cabinets, and glove boxes.				Tecnalia
RPSbD019	Workplace Design Solutions: Protecting Workers during Intermediate and Downstream Processing of Nanomaterials	This document provides practical guidance on exposure control approaches for protecting workers during Intermediate and Downstream Processing of Nanomaterials	https://www.cdc.gov/niosh/topics/nanotech/pubs.html	National Institute for Occupational Safety and Health (NIOSH)	Government or government agency	Guideline	Emissions of hazardous materials and substances	User strategies (U)	All sectors	H	H	H	The controls described in this document include local exhaust ventilation (LEV) such as annular exhaust hoods, enclosures around the emission points, and down flow booths for larger scale processes.				Tecnalia
RPSbD020	Current Intelligence Bulletin 65. Occupational Exposure to Carbon Nanotubes and Nanofibers	This document provides guidance to prevent the development of adverse respiratory health effects in workers exposed to carbon nanotubes (CNT) and carbon nanofibers (CNT). It provides information and recommendations about these nanomaterials, the assessment of the health risk and recommended Exposure Limit and the exposure measurement and controls.	https://www.cdc.gov/niosh/topics/nanotech/pubs.html	National Institute for Occupational Safety and Health (NIOSH)	Government or government agency	Guideline	Emissions of hazardous materials and substances	User strategies (U)	All sectors	H	M	H					Tecnalia
RPSbD021	Current Intelligence Bulletin 63:Occupational Exposure to Titanium Dioxide	This document provides guidance to prevent the development of adverse respiratory health effects in workers exposed to Titanium dioxide (TiO2) and carbon nanofibers (CNT). It provides information and recommendations about these nanomaterials, the assessment of the health risk and recommended Exposure Limit and the exposure measurement and controls.	https://www.cdc.gov/niosh/topics/nanotech/pubs.html	National Institute for Occupational Safety and Health (NIOSH)	Government or government agency	Guideline	Emissions of hazardous materials and substances	User strategies (U)	All sectors	H	M	H					Tecnalia
RPSbD022	Technical and safety data sheets of carbon nantubes and CNT-based nanoproducts	Technical and safety data sheets of carbon nantubes and CNT-based nanoproducts	https://www.nanocyl.com/product/	NANOCYL	Industry or industrial group	TDS/SDS	Materials and products	All strategies	All sectors	M	M	H					Tecnalia
RPSbD023	Best practices guidance for nanomaterial risk management in workplace	This guide describes and suggests an approach , prevention advices and practical solutions for the safe handling of nanomaterials produced and used in work environment. The following topics are covered: variety of nanomaterials, nanomaterial synthesis, nanomaterial behaviour and hazard identification, exposure characterization, risk assessment, laws, prevention and risk management.	http://www.irsst.qc.ca/media/documents/PubIRSST/R-899.pdf	IRSST	Research organization	Guideline	Emissions of hazardous materials and substances	Combination (RA/ EV/ ISD/ IU/ O/ PPE)	All sectors	H	H	H	This guide presents and settles a complete framework for nano risk management. Practical guides needs to be used simultaneously.	Practical advices related to specific work situation	This guide is recommended for beginners in nanosafety who wants to build an organised nano risk management. For beginners the document could be used alone. For advanced, specific guidelines could be used simultaneously		CEA



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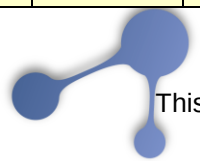
RPSbD024	Using Nanomaterials at work including CNT and other bio persistent HARNs	This guidance describes how to control occupational exposure to manufactured nanomaterials in the workplace. The control principles describes can be applied to all nanomaterials used in the workplace. Any differences between control of CNT and other high aspect ratio nanomaterials to any other type of nanomaterials are highlighted in this document.	https://www.hse.gov.uk/pubns/books/hsg272.pdf	Health and Safety executive	Research organization	Guideline	Safety-related parts of control systems	Combination (RA/ SCPM/ IU)	All sectors	H	H	H	A higher level of control is warranted for CNT an HARNs. Charts, table and checklist are developed in this document in order to facilitate its use.	The document does not deal with incidental release of NM	For company where decisions about controlling hazardous substances are complex, a professional advices could be used in addition (a specific section is dedicated in the document)		CEA
RPSbD025	Nanomatériaux : Prévention des risques dans les laboratoires Nanomaterials: Risk management in laboratories	This French document aims to inform and give practical advices for the safe handling of manufactured NM in laboratories. The following topics are presented: scope of use, hazard for both health and safety, occupational exposure, risk assessment, French legislation and risk prevention.	https://www.inrs.fr/media.html?refINRS=ED%206115	INRS	Research organization	Guideline	All design topics	Combination (RA/ EV/ SCPM/ IU/ O/ PPE)	All sectors	H	H	H	Only for laboratories	The document does not deal with incidental release of NM Only in French	Could be completed by "nanomaterials: Ventilation & filtering in workstation"		CEA
RPSbD026	Nanomatériaux: Ventilation et filtration de l'air dans les lieux de travail nanomaterials: Ventilation & filtering in workstation	This French document aims to give practical advise for the workplace ventilation and air filtering of NM.	https://www.inrs.fr/media.html?refINRS=ED%206181	INRS	Research organization	Guideline	Safety-related parts of control systems	Safeguarding and complementary protective measures	All sectors	H	H	H	Focuses on ventilation and filtering	Only in French	Should be used after "Nanomaterials: Risk management in laboratories" for laboratories		CEA
RPSbD027	Safe handling and use of carbon nanotubes	This document includes two approaches to manage the risks for exposure to carbon nanotubes. These are risk management with a detailed hazard analysis and exposure assessment (Part A of the document) and risk management by control banding (Part B of the document). It can also be used for other carbon nanofibres.	http://www.safeworkaustralia.gov.au/doc/safe-handling-and-use-carbon-nanotubes	Safe Work Australia	Government or government agency	Guideline	Emissions of hazardous materials and substances	Risk assessment	All sectors	H	H	H	Provides details of control measures (such as engineering controls) that could be used for CNTs. Provides information on specific controls for specific tasks. Provides a guide on developing a risk management approach by control banding and developing exposure potentials	The document is only specific for CNTs	This resource is specific for handling of CNTs. Detailed, easy to follow guide and would be useful for those users with less experience.		IOM
RPSbD028	Approaches to Safe Nanotechnology: Managing the Health and Safety Concerns Associated with Engineered Nanomaterials	This document aims to raise awareness of occupational safety and health issues present in the field of nanotechnology and make recommendations on occupational safety and health practices in the production and use of nanomaterials. These recommendations address key components of occupational safety and health, including exposure monitoring, engineering controls, personal protective equipment and administrative controls. This document also aims to identify information gaps where few or no data exist and where research is needed.	https://www.cdc.gov/niosh/docs/2009-125/pdfs/2009-125.pdf	CDC/NIOSH	Government or government agency	Guideline	Emissions of hazardous materials and substances	User strategies (U)	All sectors	H	M	M	Provides details of how to establish a risk management program. Controls discussed within this include engineering controls, work practices, PPE/RPE and cleaning procedures. Document also covers dust collection efficiency of filters, occupational health	Specific information on engineering controls for different applications. There is reference to different control measures but not detailed information on where or how to implement these.	This document goes into a lot of detail into why different measures must be implemented to protect the safety and health of workers, therefore it would be more suited to users who have some knowledge of the field already. The document is very long but would be very useful for those who are at the initial stages of working with nanomaterials to gain a thorough background knowledge of		IOM



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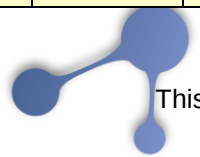
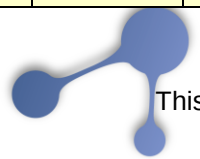
													surveillance, exposure assessment and characterisation and also other potential safety hazards including fire and explosion risks.		the hazards associated to nanomaterials.		
RPSbD029	Building a Safety Program to Protect the Nanotechnology Workforce: A Guide for Small to Medium Enterprises	This document aims to provide entrepreneurial business owners the tools necessary to develop and implement a written health and safety program, to protect workers. The aim is to help business owners recognise and control potential hazards and risks from their nanomaterial processes that may adversely impact the health, safety, and well-being of employees.	https://www.cdc.gov/niosh/docs/2016-102/pdfs/2016-102.pdf	CDC/NIOSH	Government or government agency	Guideline	Emissions of hazardous materials and substances	Risk assessment	All sectors	H	H	H	Discusses 'prevention through design PtD' and the advantages of integrating PtD early in the design of the facility. The document then describes the hierarchy of controls and each strategy individually (i.e. elimination and substitution, engineering controls (with examples), administrative controls, PPE), then follows this with a section on verification of controls. Additional sections include medical screening/surveillance, emergency preparedness, fire and explosion, product stewardship, federal regulatory compliance (useful only for US-based companies), and building and sustaining a successful program.		This document makes reference to other NIOSH guidance reports such as Current Strategies for Engineering Controls in Nanomaterial Production and Downstream Handling Processes (www.cdc.gov/niosh/docs/2014-102) and General Safe Practices for Working with Engineered Nanomaterials in Research Laboratories (www.cdc.gov/niosh/docs/2012-147/) for choosing engineering controls. This document is good for companies looking to create successful risk management programs.		IOM
RPSbD030	Controlling Health Hazards when Working with Nanomaterials: Questions to Ask Before You Start?	This poster prompts users with questions you should ask yourself before starting work with nanomaterials and gives some options you can use to reduce exposures to nanomaterials in the workplace	https://www.cdc.gov/niosh/docs/2018-103/pdfs/Nano_MP1_2018-103_508.pdf	CDC/NIOSH	Government or government agency	Other resource	Emissions of hazardous materials and substances	Risk assessment	All sectors	H	H	M	The advice is basic but to the point and is easy to follow visually. Prompts the user to think about how their process could create exposure scenarios. Questions relate to the physical form (NMs in dry powder, liquid suspension and physically	Background information is not supplied for the respective recommendations, nor is there information on how to implement these successfully (i.e. verification of controls/maintenance of control measures)	This resource is very basic but is useful for showing the differences in control measures required for different NM forms.		IOM

													bound/encapsulated) and activity performed and the recommended controls given are within engineering controls, administrative controls and PPE.				
RPSbD031	General Safe Practices for Working with Engineered Nanomaterials in Research Laboratories	This document provides guidance to those working with ENMs in research/pilot scale laboratories on risk management, hazard identification and exposure control.	https://www.cdc.gov/niosh/docs/2012-147/pdfs/2012-147.pdf?id=10.26616/NIOSHPUB2012147	CDC/NIOSH	Government or government agency	Guideline	Emissions of hazardous materials and substances	User strategies (U)	All sectors	H	H	H	Development of a health and safety program by guiding the reader through hazard identification, exposure assessment and exposure control. Document contains useful information such as a table of employee activities and recommended minimum (engineering) controls, the advice given in this table also considers the state of the nanomaterial. Document also contains good advice on how to use control measures properly.		This document is very detailed and would be useful for users who are in the pilot stage of a process utilising NMs. Very useful advice on the use of containment controls (i.e. chemical hoods, safety cabinets etc) and good practice with PPE.		IOM
RPSbD032	Safe handling of nanomaterials and other advanced materials at workplaces	Guidance document outlining the STOP principle: substitution, technical measures, organisational measures and personal protection measures. Outlines guidance across several applications and covers exposure and risk determination too.	http://www.nanovalid.eu/nanoToGo/Brochure/Safe%20handling%20of%20nanomaterials%20and%20other%20advanced%20materials%20at%20workplaces_v1-0.pdf	NanoValid	Research Project	Guideline	Emissions of hazardous materials and substances	User strategies (U)	All sectors	H	H	H	The guidance is set out in a way that is easily followed through the chapters and a nice mixture of specific and generic guidance. Could be useful to set the scene for those looking develop new nano applications to understand the likely challenges from these in the form they may be handling in a generic sense.	a lack of specific answers or end points, very much a guidance document that's principles could be used in conjunction with more specific guidance regarding PSbD as focus is on the materials hazards and exposures.	This resource is useful for showing the differences in control measures required for different NM forms but probably not specific enough for all users. That said outlines good starting considerations and approaches.		IOM
RPSbD033	WHO Guidelines on Protecting Workers from Potential Risks of Manufactured Nanomaterials	This document provides a comprehensive outline to assessing and controlling exposure and risk from the production and use of nano manufactured materials. A set wise outline presented within the chapters outlining all the steps from production through to control and ongoing monitoring.	http://apps.who.int/iris/bitstream/handle/10665/259671/9789241550048-eng.pdf;jsessionid=CBC7E114DAF887E3CE4F91C70DC85E5C?sequence=1	WHO	Government or government agency	Guideline	Emissions of hazardous materials and substances	Combination (RA/ EV/ ExV/ U)	All sectors	H	H	H	Outlines the process for conducting monitoring of a nano material during its development, works through the stages to ensure issues from	no direct reference/advice to specific measures such as ventilation and other design factors, very much a guidance document to outline and direct.	very good document to outline the considerations and potential hazard and exposure issues with recommendation for both physical and management controls.		IOM



This document contributes a first draft for D5.1.

													hazards, exposure through to management controls are considered in the decision making processes. information in the annex about OELs and where available OECD exposure limits for different materials. Also in annex information about findings from different scenarios relating to form, hazard and exposure so useful for SbD. Document well set out and flows with an intuitive process to follow with strong reference and authorship.				
RPSbD034	Working Safely with Manufactured Nanomaterials Guidance for Workers	This document provides guidance for general use of manufactured nanomaterials in occupational settings for workers. The document includes a description of what nanomaterials and nano-enabled products are, basis for current concerns, treating manufactured nanomaterials, exposure and safe working actions.	https://op.europa.eu/en/publication-detail/-/publication/4d51f5b2-545d-11ea-aece-01aa75ed71a1/language-en/format-PDF/source-184942294	EC	Government or government agency	Guideline	Materials and products	Other	All sectors	H	H	H	Discusses control measures that can be put in place for the safe working with manufactured nanomaterials and nano-enabled products.	No detailed information on the control measures that can be used. General document aimed at workers and not designers.	This resource is very basic but is a useful starting point for workers to understand what can be done to work safely with nanomaterials and nano-enabled products.		IOM
RPSbD035	Guidance on the protection of the health and safety of workers from the potential risks related to nanomaterials at work - Guidance for employers and health and safety practitioners	This document provides guidance for the use of manufactured nanomaterials for employers and health and safety practitioners to fulfil regulatory requirements (i.e. Framework Directive 89/391/EEC and Chemicals Agents Directive 98/24/EEC (CAD)). The document offers guidance on risk assessment and risk management.	https://op.europa.eu/en/publication-detail/-/publication/85064a82-56b6-11ea-aece-01aa75ed71a1/language-en/format-PDF/source-184945749	EC	Government or government agency	Guideline	Materials and products	Risk assessment	All sectors	H	H	H	Suggested in the guidance that some of the risk management measures could also contribute for incident nanomaterials. Outlines the processes involved in preparaing a risk assessment including concern categories (including dustiness and flammability), activities, exposure levels (high, medium high, medium low, and low) and risk (control) banding. Discussion of control measures required under 89/391/EEC and CAD and also	The document does not deal with incidential nanomaterials specifically although it is suggested that some of the risk management measures suggested in the document could be used.	The document is good for discussing regulatory requirements and for outlining the process for risk assessment.		IOM



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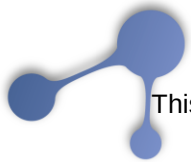
													measures needed on the risk level (risk levels 1-4)..				
RPSbD036	Développemnent d'un outil de gestion graduée des risques spécifique au cas des nanomatériaux = Development of a graduated risk management tool specific to the case of nanomaterials	Control banding is a method combining risk assessment and risk management. It was originally developed in industry. This tool is proposed in particular to guide risk management whenever there is uncertainty concerning the input data needed for risk assessment (uncertainty about the hazards of nanomaterials and about exposure levels). It takes into account existing information, the available technical and scientific data, and is based on a number of assumptions.	https://www.anses.fr/fr/system/files/AP2008sa0407Ra.pdf	ANSES	Government or government agency	Method	Safety-related parts of control systems	Risk assessment	All sectors	H	H	H	This document offers five levels of means of control depending on both the hazard and the exposure levels.	Only in French	This guide is recommended for beginners in nanosafety who wants to firstly estimate the nanorisk. Could be completed by "nanomaterials: Ventilation & filtering in workstation"		
RPSbD037	Engineered nanomaterials: Toward effective safety management in research laboratories	To deal with the rapid evolution of research, including the fast turnover of collaborators, a user-friendly and easy-to-apply risk assessment tool offering adequate preventive and protective measures is provided.	https://www.scopus.com/record/display.uri?eid=2-s2.0-84960926573&origin=resultslist&sort=plf-f&src=s&st1=&st2=&sid=7ebd16238b07c9428f4814d6c5db5d35&sot=b&sdt=b&sl=19&s=AUTHOR-NAME+%28qroso%29&relpos=5&citeCnt=13&searchTerm=	Journal of nanobiotechnology	Other	Method	Safety-related parts of control systems	Risk assessment	All sectors	H	M	H	This document offers three levels of means of control following a flowchart based on the hazard and the potential exposure	Only for laboratories The method is developed but test and tool are missing	Laboratory managers have a reliable tool to obtain an overview of the operations involving nanomaterials in their laboratories; this is essential, as they are responsible for the employee safety, but are sometimes unaware of the works performed. Bringing this risk to a three-band scale (like other types of risks such as biological, radiation, chemical, etc.) facilitates the management for occupational health and safety specialists. Institutes and school managers can obtain the necessary information to implement an adequate safety management system.		
RPSbD038	Benchmark européen des guides de bonnes pratiques et référentiels sur la Securité liée à la mise en oeuvre de NM = European Benchmark of good practice guides and benchmarks on safety related to the implementation of NMs	This document reviews approaches and recommendations available for industrial compagnies for the main steps of nano risk management: hazard characterisation, risk assessment, exposure mitigation, accident control and measurement of the effectiveness of this control.	https://www.ineris.fr/sites/ineris.fr/files/contribution/Documents/125500-dra-95-op%C3%A9-3-procedes-nano-1422373147.pdf	INERIS	Government or government agency	Guideline	Safety-related parts of control systems	Safeguarding and complementary protective measures	All sectors	H	M	H	This document presents 6 good practices guides and their recommendations for safely handling NM	Only in French and not updated since 2013	This document should be used knowing that other guides have been published since.		

This document contributes a first draft for D5.1.

RPSbD039	The Exposure Control Efficacy Library (ECEL v3.0)	ECEL provides information on the effectiveness of occupational and environmental Risk Management Measures (RMM).	https://diamonds.tno.nl/ecel/risk-managements	TNO	Research Organization	Library	Safety-related parts of control systems	Exposure mitigation measures	All sectors	H	H	H	It offers a database structure to search for different types of RMM and exposure or emission scenarios and to compare their effectiveness. This information is required in the context of the European Chemicals policy (REACH - Registration, Evaluation and Authorization of Chemicals) and other European regulations to demonstrate and document safe use of substances based on quantitative exposures and exposure reduction by Risk Management Measures (RMM).	Needs constant update for new techologies and specific case studies	Very usuful library to calculate potential impact of specific control measures (e.g. engineering controls)		LEITAT
RPSbD040	A Review of Workplace Risk Management Measures for Nanomaterials to Mitigate Inhalation and Dermal Exposure	Focus on workplace RMM and specifically on EC, respiratory protective equipment (RPE) and skin protective equipment (SPE): gloves and clothing. The aim of this study was to determine (i) whether there are any differences in the effectiveness of control measures for nanomaterials versus conventional materials, and (ii) whether currently used effectiveness values of RMM relevant for conventional substances should be replaced, refined, or extrapolated based on evidence from nanomaterial-specific data.	DOI: 10.1093/annweh/wxy032	Annals of Work Exposures and Health	other	Published article / Journal	Safety-related parts of control systems	Exposure mitigation measures	All sectors	H	H	H	This review describes an evaluation of the effectiveness of Risk Management Measures (RMM) for nanomaterials in the workplace.	More specific to on Engineering Controls, respiratory protective equipment and skin protective equipment: gloves and clothing	Exhaustive and up-to-date quantitative values on NPs mitigation measures efficiency		LEITAT
RPSbD041	Effectiveness of nanoparticle exposure mitigation measures in industrial settings	Quantified effectiveness of mitigation strategies implemented during real world industrial processes	https://doi.org/10.1016/j.ijheh.2019.06.009	International Journal of Hygiene and Environmental Health	other	Published article / Journal	Safety-related parts of control systems	Exposure mitigation measures	Ceramics	H	H	M	Quantitative efficancy data of Risk Managment Measures are necessary as input for exposure modelling and risk assessment tools and potentially SbD for nanoprocesses.	Specified to the ceramic sector processes	Real-world and quantitative data on the efficiency of applied mitigation strategies at an industrial scale		LEITAT



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RPSbD042	Exposure Controls for Nanomaterials at Three Manufacturing Sites	Information about the effectiveness of control measures including process changes, a downflow room, a ventilated enclosure, and an enclosed reactor that were conducted at three different field studies.	http://dx.doi.org/10.1080/15459624.2014.930559	Journal of Occupational and Environmental Hygiene	other	Published article / Journal	Safety-related parts of control systems	Exposure mitigation measures	All sectors	H	M	M	Control measures are best implemented as a component of an occupational safety and health management system. During the initial process design, the techniques of safety systems engineering, such as preliminary or initial hazard analysis, could be used to identify hazards appropriate control measures early in the design process.	Narow focus on very specific case studies			LEITAT
RPSbD043	Occupational safety and health in nanotechnology and Organisation for Economic Cooperation and Development	This article describes OECD activities around occupational safety and health of nanotechnology and provides state-of the science overview resulting from an OECD workshop on exposure assessment and mitigation for nanotechnology workplace.	DOI: 10.1007/s11051-009-9637-7	J Nanopart Res	other	Published article / Journal	Safety-related parts of control systems	Exposure mitigation measures	All sectors	H	H	M	This OECD workshop was an important first step by OECD WPMN in bringing together all stakeholders on a global scale to initiate dialog aimed at building consensus and promoting globally harmonized approaches to proactively mitigate potential risks of nanomaterials in the workplace.				LEITAT
RPSbD044	Evaluation of Existing Control Measures in Reducing Health and Safety Risks of Engineered Nanomaterials	Provide evidence on the adequacy of traditional controls to minimize potential health and environmental risks resulting from exposure to ENMs.	DOI: 10.1039/C6EN00122J	Environmental Science Nano	other	Published article / Journal	Safety-related parts of control systems	Exposure mitigation measures	All sectors	H	H	H	The aim here was to advance our understanding of the risk management approaches relevant for ENMs, and ultimately to support the selection of the most suitable RMMs when handling ENMs.				LEITAT
RPSbD045	Occupational Risk Management of Engineered Nanoparticles	This review has described the range of controls that can be used in risk management of engineered nanoparticles.	http://dx.doi.org/10.1080/15459620801907840	Journal of Occupational and Environmental Hygiene	other	Published article / Journal	Safety-related parts of control systems	Exposure mitigation measures	All sectors	H	H	H	A conceptual framework for occupational risk management as applied to engineered nanomaterials and describes an associated approach for controlling exposures in the	Not state of the art	Conseptual model and a guide for mitigation		LEITAT

													presence of uncertainty.				
RPSbD046	Overview of Risk Management for Engineered Nanomaterials	A naturalistic view of Risk Managment for ENMs	doi:10.1088/1742-6596/429/1/012062	Journal of Physics: Conference Series	other	Published artide / Journal	Safety-related parts of control systems	Exposure mitigation measures	All sectors	H	H	M	Critical for effective management of risks of nanomaterials is the need for a naturalistic view—one that sees where science and society are in the development of the technology.	Overal conceptual methodology, not focused on processess	managing the risks to the workforce through the hierarchy of controls, and then confirming the effectiveness of those management efforts		LEITAT
RPSbD047	Handling and Risk Mitigation of Nanoscale Graphene and Related Materials: Some Considerations and Recommendations	To put forward some considerations and recommendations while handling nanomaterials, especially graphene and its derivatives	doi:10.3390/c5030036	Journal of Carbon Research	other	Published artide / Journal	Safety-related parts of control systems	Exposure mitigation measures	All sectors	H	H	M	All possible precautions should be made available, and extensive risk assessment/mitigation protocols should be developed and used. A generalised approach for a different state, such as powder, dispersion, suspension or in polymer blends cannot be maintained; thus, knowledge of handling different states of nanomaterials is required. Research facilities/laboratories should have pragmatic mitigation procedures to control the exposure and airborne contamination of nanomaterials, as well as for specific activities involving nanomaterials.	Focused on graphene related products and processes (not considering generalization)	For carbon related and sheet-shaped nanomaterials/nanoprocesses		LEITAT

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RPSbD048	Towards a more effective and efficient governance and regulation of nanomaterials	Study on the ambiguity regarding the risks of most of the nanomaterials and nano-enabled products in the context of the current regulations.	DOI 10.1186/s12989-017-0235-z	Particle and Fibre Toxicology	other	Published article / Journal	Regulatory aspects	Exposure mitigation measures	All sectors	M	H	M	Following regulatory aspect and REACH guidlines	No quantitative/qualitative data and more (nano)material focused	The recommended measures proposed for data quality and data management will create a more solid information basis for risk assessment of nanomaterials.		LEITAT
RPSbD049	Implementation of Safe-by-Design for Nanomaterial Development and Safe Innovation: WhyWe Need a Comprehensive Approach	opinion on the current, synergistic, and comprehensive approach for implementation of Safe-by-Design (SbD) into the development of Manufactured Nanomaterials (MNMs) and nano-enabled products.	doi:10.3390/nano8040239	Nanomaterials	other	Published article / Journal	Safety-related parts of control systems	Safe-by-Design	All sectors	M	H	M	The whole SbD concept as proposed in this opinion paper is directly linked to the concept of "responsible (research and) innovation", and it goes beyond designing less hazardous materials	Non-quantitative data	Starting from the (scientific) relationships between the MNMs characteristics and their properties which can be studied at the design stage, the challenge is to implement this knowledge into industrial processes, focusing on applications and uses in a regulatory framework. It is necessary to focus on three aspects of the translation to industry: functionality; safety; and communication.		LEITAT
RPSbD050	SERENADE: safer and ecodesign research and education applied to nanomaterial development, the new generation of materials safer by design	tutorial review presents the conceptual approach to "Safer by Design" and provides several examples of case studies primarily for TiO2 (anatase) present in paints and cements to demonstrate how the approach can inform design decisions	DOI: 10.1039/c6en00282j	Environmental Science Nano	other	Published article / Journal	Emissions of hazardous materials and substances	Safe-by-Design	Paints	H	H	H	Provides a roadmap for designing materials with maximum benefits and minimal risks		Similar sector with SABYNA (paints) is studied and the outcomes may help bulit up SbD strategies		
RPSbD051	Perspectives on the design of safer nanomaterials and manufacturing processes	introduce to Prevention through Design (PtD) principles and discuss their applicability to design of safer nano-enabled products; approached from the molecule side and from the facility, tool, and task side; and how the outcomes of a prevention approach will support an environmental, health, and safety management system approach.	DOI 10.1007/s11051-015-3152-9	J Nanopart Res	other	Published article / Journal		Safe-by-Design	All sectors	M	H	M	Support and enhance existing safety management systems.		Prevention through design (PtD) takes many of the longstanding principles of "safety-by-design" and expands the effort by adding research and education elements so that practices can be anticipatory for a given technology. PtD is applicable to nanotechnology at both the molecular and process levels.		LEITAT

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