AMANAC

Advanced Material and Nanotechnology Cluster

D2.6 Database on nanosafety aspects

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Executive summary

This deliverable contains the **'Information and guidance report on nano-safety aspects in construction materials'**. The deliverable explains the change in format of the deliverable from the **'Database on nanosafety aspects'** to the **'Information and guidance report on nano-safety aspects in construction materials'** presented here, and gives an overview of the development of the report. The deliverable also explains the change in dissemination level of the deliverable from CO to PU. The report can be found in the public website of the AMANAC project within the AMANAC wiki (http://amanac.eu/wiki/amanac-wiki/), and is available to the general public, the scientific community and industry.

The AMANAC CSA aims to support understanding in subjects of common interest and importance to all AMANAC projects and to increase the visibility of AMANAC initiatives and project outcomes with key stakeholders in the building and construction industry sector in Europe.

This information and guidance report provides support and information to AMANAC projects and to the building and construction industry in order to create increased understanding of nano-safety issues, and give guidance on addressing the hurdles which may arise when introducing new materials. This contributes towards the AMANAC-CSAs aim of promoting a unified and harmonised understanding of the challenges and opportunities in introducing new materials to Europe's building industry.

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1. Introduction

1.1. Objectives of WP2

The objective of WP2 is to establish effective collaboration channels between all projects in order to:

i) ensure the achievement of their respective technical and non-technical goals;
ii) maximize the impact of such developments during and beyond the project life-time; and,
iii) identify hurdles that delay application of results in full scale.

This will allow the planning of future actions and international cooperation, and support the elaboration of policies in the Energy Efficient area.

WP2 aims to support understanding in subjects of common interest and importance which may become hurdles to application and adoption. This may be accomplished through the organisation of common interest workshops, the compilation of material databases for LCA, LCC, or through the provision of information and guidance reports. These information and guidance reports can provide support and information to AMANAC projects and to the building and construction industry sector to create increased awareness of issues which may prevent or delay adoption and application.

1.2. Objectives of Task 2.5

The objective of Task 2.5 is to create an information resource which will increase understanding of nano-safety issues in building materials, and give guidance on addressing the hurdles which may arise when introducing new materials. Due to their unique properties and the associated uncertainties which exist, designing and working with nano-based materials needs close cooperation between all projects and partners and also with external bodies like the Nanosafety Cluster.

The main objective of this task is to prepare an information resource that will include the relevant nanosafety aspects of the nanomaterials or nano-based components/systems addressed in the Cluster projects. This information resource will be uploaded to the project's Wiki.

1.3. Agreed modifications to dissemination level and format of deliverable

The original deliverable defined in the Description of Action specified the creation of a database:

prepare a database that will include all relevant nanosafety aspects (manufacturing, application, end-use) of the nanomaterials or nano-based components/systems addressed in the Cluster projects

However, it was agreed by the Project Officer, Dr Monique Levy, at the AMANAC-CSA mid-term review meeting held on the 5/11/15 that a more usable information resource would be a concise document regarding nanosafety issues. This document would be user-oriented, with links to direct the user to further resources which already provide useful reference material to provide support in

this area. The agreement to modify the format of the deliverable is documented in the minutes of the Mid-term Review Meeting.
In addition, it was agreed by the Project Officer, Dr Monique Levy, at the third Steering Committee meeting held on the 20/5/16 in Athens, Greece that the dissemination level of the information and guidance report within deliverable D2.6 should be changed from CO (Confidential, only for members of the consortium (including the Commission Services) to PU (Public). This agreement is documented in the minutes of the Steering Committee meeting.
The minutes of the Mid-term Review Meeting and the third Steering Committee meeting are available in the private area of the AMANAC website.

2. Approach and Methodology

2.1. Definition of output required

The most relevant format of the Deliverable 2.6 was discussed at the AMANAC-CSA mid-term review meeting in November 2015. It was agreed with the Project Officer, Dr Monique Levy, that instead of creating a database with information on nanosafety aspects, a concise document (e.g. of 2-3 pages) should be prepared and uploaded to the wiki. This document would cover nanosafety issues in a user-oriented approach and include a list of websites and reference documents linked to nano-safety aspects.

2.2. Approach and Methodology used

UBAH were assigned responsibility for the production of the deliverable D2.6, supported by NTUA and the AMANAC CSA Steering Committee at the development stage, and all project partners at the review stage.
The approach taken in order to create the required report was to consult sources of information and guidance on nano-safety in construction materials. From this, a draft document was created, including an introduction to nano-safety in construction materials, information on relevant sources of information, and guidance on risk management and communication. Advice was sought from the AMANAC CSA Steering Committee and also from members of the AMANAC Indoor Environmental Quality Thematic Area members regarding suitable references for guidance on the use of nano-materials in construction. The report has been reviewed by the AMANAC CSA Steering Committee, updated in response to feedback received, and uploaded to the AMANAC wiki.

2.3. Development of the report

The report was developed by UBAH, with the support of NTUA, the AMANAC CSA Steering Committee and the AMANAC IEQ Thematic Area. Research was undertaken to identify relevant technical standards and existing research projects which addressed the subject of nano-safety in construction. AMANAC cluster partners were consulted to request links to standards and frameworks providing information on nano-safety aspects in construction materials. The first draft of the report was reviewed internally at UBAH, and by the AMANAC IEQ cluster members. The final draft of the report was reviewed by the AMANAC CSA Steering Committee.

2.3.1. AMANAC contributions and recommendations

AMANAC cluster partners were surveyed, firstly by contacting the AMANAC CSA Steering Committee to request information and ask for recommendations for specific project contacts who

may be able to help, and secondly by contacting members of the AMANAC Indoor Environmental Quality Thematic Area. The following responses were received and reviewed.

NTUA provided inputs and contacts in nano-safety from the SCAFFOLD project. The SCAFFOLD project, which finished in April 2015, focused on the development of new strategies, methods and tools for managing the occupational exposure to manufactured nanomaterials in construction. http://scaffold.eu-vri.eu/

The OSIRYS project provided the following information based on the recommendations of Fraunhofer and AIMPLAS, the partners that are working with nanomaterials in OSIRYS project:

- http://nanopartikel.info/en/ is a website of research findings in nanotechnology explained in plain language based on NanoCare and its follow-on projects, including access to the brochure *Health-related Aspects of Synthetic Nanomaterials,* published by NanoCare Project Consortium, funded by the German Federal Ministry for Education and Research 2009).
- http://www.baua.de/en/Homepage.html is a website of the German Federal Institute for Occupational Safety and Health which includes a section on nanotechnology covering topics such as measurement, risk, guidelines for handling and use in the workplace, and links to research reports.
- http://www.bag.admin.ch/nanotechnologie/index.html?lang=en is the Swiss Confederation's central information hub for nanotechnology, including background information, legislative information, research and guidelines for safe handling.

AIMPLAS also supplied a bibliography on nanomaterials and safety, covering existing standards, research papers and conferences, included in this deliverable as Appendix 1.

2.3.2. Resources and references from existing standards and websites

The following external sources were reviewed and considered for inclusion in the report.

- The NANoREG FP7 project aiming to deliver a common European approach to the regulatory testing of Manufactured Nanomaterials (http://www.nanoreg.eu/).
- The EU NanoSafety Cluster, a DG RTD NMP initiative to maximise the synergies between the existing FP6 and FP7 projects addressing all aspects of nanosafety. http://www.nanosafetycluster.eu/
- ISO Technical Report – ISO/TR 13121:2011, Nanotechnologies - Nanomaterial risk evaluation. This Technical Report is based on the Nano-Risk Framework, an approach created by the Environmental Defense Fund and DuPont (http://www.nanoriskframework.org).
- ISO Technical Report - PD ISO/TR 12885:2008, Nanotechnologies. Health and safety practices in occupational settings relevant to nanotechnologies, utilising banding to assess risks and recommend appropriate risk management techniques, such as Control Banding (http://www.coshh-essentials.org.uk/).
- PD ISO/TS 12901-1:2012 - Nanotechnologies. Occupational risk management applied to engineered nanomaterials. Principles and approaches.

- PD ISO/TS 12901-2:2014 - Nanotechnologies. Occupational risk management applied to engineered nanomaterials. Use of the control banding approach.

- PD CEN/TS 16937:2016 - Nanotechnologies. Guidance for the responsible development of nanotechnologies.

2.4. Dissemination of the report

The report was disseminated by uploading the report to the AMANAC wiki. The AMANAC wiki is an open resource to support and encourage further collaboration to deliver AMANAC's core aims of maximising the impact of the participating projects. The AMANAC wiki incorporates information on publically available foreground generated by the Cluster projects and their technology achievements. The wiki also contains relevant supporting and reference information and documentation related to cross-cutting issues for the cluster projects, such as this deliverable report, the 'Information and guidance report on nano-safety aspects in construction materials'.

The AMANAC wiki is available in the public area of the AMANAC website, and is therefore open for general viewing and is fully searchable by any visitor to the wiki.

The information and guidance report is therefore easily available to provide support and information to AMANAC projects and to the building and construction industry in order to create increased understanding of nano-safety issues, and give guidance on addressing the hurdles which may arise when introducing new materials.

3. Information and guidance report on nano-safety aspects in construction materials

3.1. Accessing the report

The report can be accessed via the AMANAC wiki, see figure 2.1 below.

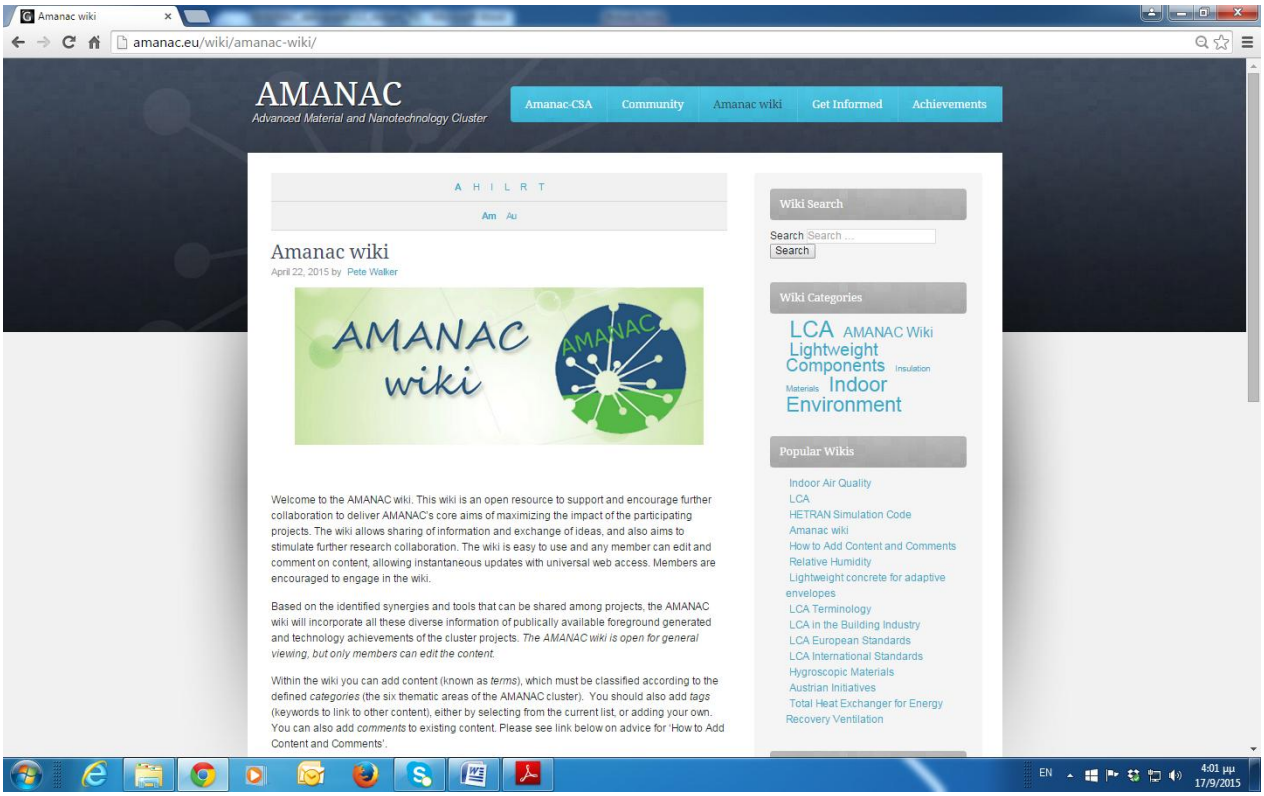

Figure 3.1 The AMANAC wiki where the report can be accessed

3.2. Report on nano-safety aspects in construction materials

The document uploaded to the AMANAC wiki is as follows:

Document text:

Information and guidance report on nano-safety aspects in construction materials

Introduction:
It is widely accepted that there is a need to consider the risks associated with occupational exposure to manufactured nanomaterials in construction, and to develop new strategies, methods and tools for managing these risks. This document gives an overview of the generally accepted risks arising from the use of nanomaterials in construction, and signposts the user to the latest resources and research into the safe use of nanomaterials in the industry.

Nanomaterials consist of particles or physically discrete entities that, in their primary, non-aggregated form, are typically at or below 100 nanometres (nm) in one dimension (e.g. nanoplates), two dimensions (e.g. nanofibres), or three dimensions (e.g. nanoparticles).

Management of risk throughout the lifecycle:
It is generally accepted that the potential risks are associated with releases of manufactured nanomaterials used in construction materials at some point in their lifecycles. It should also be considered that where a product, process or material contains manufactured nanomaterials, it may

not be the nanomaterial component that poses the most significant risk. Hence the management of the risk should not be limited to the evaluation of the nanomaterial component of materials or product, but should consider the entirety of the product, process or material.

The lifecycle of a product system involving nanomaterials encompasses all the processes and activities that occur from initial extraction or creation of the material (or its precursors) from the earth to the point at which any of the nanomaterial's residuals are returned to the environment. When identifying and assessing risks, all established and reasonably anticipated activities or processes to which the nanomaterial might be subject over its lifecycle (either intended or unintended) should be considered. The potential risks to health, environment, and safety should be identified over the entire lifecycle.

It is important in all risk evaluation processes to consider the whole supply chain, therefore effective communication up and down the supply chain is necessary to understand the material's potential uses and end-of-life options.

Relevant national standards/EU recommendations relating to nano-safety to support in the identification and mitigation of risk:

The list of standards below is not specific to construction with nanomaterials, and represents a selection of the available sources to signpost the user to further relevant information as appropriate. Nevertheless, these standards provide useful guidance and recommendations on the identification and mitigation of risk. The standards apply to the development and use of manufactured nanomaterials, to the occupational risk during manufacture and assembly of components, to the handling and use of nanomaterials in the workplace, and to the protection of the public, consumers, workers and the environment. It should be noted that the standards primarily address the risks for the constructor or manufacturer, and further sources of guidance for the user or maintainer would provide support throughout the remainder of the product value chain. Brief details of the standards are given below.

- The Swiss Confederation's Federal Office of Public Health has a central information hub for nanotechnology. This covers a range of issues including guidelines for occupational health protection and guidelines for disposal of industrial nanowaste. http://www.bag.admin.ch/nanotechnologie/12171/index.html?lang=en
  The occupational health protection guidelines use the proven precautionary principle and the STOP principle. The proven precautionary principle calculates health risks the hazard of a chemical as well as the exposure situation. Substances with an unknown hazard potential, such as nanomaterials, should be handled analogously to harmful substances.
  The STOP principle contains a step-by-step description of the procedure aimed at protecting employees from harmful substances using Substitution of less harmful substances, Technical measures to detect, limit and divert exposure, Organisational measures to limited time and number of employees exposed, and Personal protective measures.
  The guidelines for disposal of industrial nanowaste are based on a draft paper containing existing knowledge, with recommendations on the handling of commercial/industrial waste containing free or releasable nanomaterials to help determine the correct methods of disposal.

- http://www.baua.de/en/Homepage.html is a website of the German Federal Institute for Occupational Safety and Health which includes a section on nanotechnology covering

topics such as measurement, risk, guidelines for handling and use in the workplace, and links to research reports on occupational health and safety in the handling and use of nanomaterials. In a long-term research strategy, the German higher federal authorities, responsible for human and environmental safety, are accompanying the rapid pace of development of new materials from the points of view of occupational safety and health, consumer protection and environmental protection. Example reports include "Tiered Approach to an Exposure Measurement and Assessment of Nanoscale Aerosols Released from Engineered Nanomaterials in Workplace Operations" (2011), and an update of the guidance for handling and use of nanomaterials at the workplace published by the BAuA and the VCI in May 2012

- ISO Technical report - PD ISO/TR 12885:2008, Nanotechnologies. Health and safety practices in occupational settings relevant to nanotechnologies: This Technical Report recommends a standard risk assessment process comprising:
    - Hazard Identification-identifies those hazards that make a significant contribution to exposure and risk;
    - Exposure-Response Assessment-identifies the potential adverse health effects associated with the hazards of concern identified at the workplace;
    - Exposure Assessment-evaluates the pathways by which individuals could be exposed to hazards present in a workplace;
    - Risk Characterization-incorporates information from the three previous steps to evaluate the potential risk to exposed individuals at the workplace.

- ISO Technical report – ISO/TR 13121:2011, Nanotechnologies – Nanomaterial risk Evaluation: This Technical Report is based on the Nano-Risk Framework, an approach created by the Environmental Defense Fund and DuPont - http://www.nanoriskframework.org. The Framework helps to:
    - Organise and evaluate existing knowledge;
    - Assess, prioritize and address data needs;
    - Communicate clearly how risks are mitigated.

  The ISO Technical Report describes a process for identifying, evaluating, addressing, making decisions about, and communicating the potential risks of developing and using manufactured nanomaterials, in order to protect the health and safety of the public, consumers, workers and the environment. While the overall product stewardship and risk management process given in the Technical Report is not unique to nanomaterials, it supplements recognised approaches by providing, where possible, a focus on information and issues specific to nanotechnologies. It offers guidance on the information needed to make sound risk evaluations and risk management decisions, as well as how to manage in the face of incomplete or uncertain information by using reasonable assumptions and appropriate risk management practices. Further, it includes methods to update assumptions, decisions, and practices as new information becomes available, and on how to communicate information and decisions to stakeholders.

  The ISO Technical Report also suggests methods organisations can use to be transparent and accountable in how they manage nanomaterials. To that end, it describes a process of organising, documenting and communicating what information organisations have about nanomaterials. This includes acknowledging where information is incomplete, explaining how information gaps were addressed, and explaining the rationale behind the organisation's risk management decisions and actions.

- ISO Technical Specification - PD ISO/TS 12901-1:2012, Nanotechnologies. Occupational risk management applied to engineered nanomaterials. Principles and approaches.

  The first part of ISO/TS 12901 supports international standardisation on nanotechnologies to allow the potential of this technology to be realised economically and sustainably, whilst improving and protecting public health and the environment. The principles of an occupational risk management framework and practical advice on implementation are provided in the specification based on the best current emerging evidence concerning the potential risks of nanomaterials. The approach to risk management suggested is as included in the UK Control of Substances Hazardous to Health Regulations (COSHH) 2002, which are based on a risk assessment approach and provide a framework for assessing and managing the potential risks from nano-objects, and their aggregates and agglomerates greater than 100 nm (NOAAs). The framework comprises eight main steps:

  - Identify the hazards and assess the risks;
  - Decide what precautions are needed;
  - Prevent or adequately control exposure;
  - Ensure that control measures are used and maintained;
  - Monitor the exposure;
  - Carry out appropriate health surveillance;
  - Prepare plans and procedures to deal with accidents, incidents and emergencies;
  - Ensure employees are properly informed, trained and supervised.

- ISO Technical Specification - PD ISO/TS 12901-2:2014, Nanotechnologies. Occupational risk management applied to engineered nanomaterials. Use of the control banding approach.

  This second part of ISO/TS 12901-2 describes a specific approach based on control banding to further support the implementation of good practice in occupational risk management for nanomaterials. Control banding is a pragmatic approach which can be used for the control of workplace exposure to possibly hazardous agents with unknown or uncertain toxicological properties and for which quantitative exposure estimations are lacking. This part of ISO/TS 12901 proposes guidelines for controlling and managing occupational risk based on a control banding approach specifically designed for NOAAs. The control banding approach consists of the following steps: Information gathering; assignment of the NOAA to a hazard band: hazard banding; description of potential exposure characteristics: exposure banding; definition of recommended work environments and handling practices: control banding; evaluation of the control strategy or risk banding.

  In order to perpetuate the benefits of control banding and to justify decisions related to the levels of control that have been chosen, it is recommended to base the management on a continual improvement approach. Control banding is not a static method and improvements should be made continuously.

  Full details on implementing the approach are given in the technical specification ISO Technical Specification PD CEN/TS 16937:2016, Nanotechnologies. Guidance for the responsible development of nanotechnologies. To ensure the responsible development of nanotechnologies, this Technical Specification (TS) provides guidance on communication

and interaction with relevant stakeholders. It describes the process that an organisation or group of organisations may choose to follow to ensure accountability, transparency, safety (for workers, consumers, and for the environment) and clear communication. The guidance references two OECD reports:

- OECD. 2013, Current landscape of alternatives assessment practice: a meta-review Series on Risk Management, No. 26. ENV/JM/MONO, 2013, pp. 24.
- OECD, 2015 Guidance Manual Towards The Integration of Risk Assessment into Life Cycle Assessment of Nano-Enabled Applications OECD Series on the Safety of Manufactured Nanomaterials No. 57 ENV/JM/MONO(2015)30 (July 2015).

Research projects addressing nano-safety which provide support in the identification and mitigation of risk:

- The SCAFFOLD project - http://scaffold.eu-vri.eu/

  This project concluded on April 30 2015, and was funded by the EC under the FP7 (NMP4-SL-2012-280535). This project focused on the development of new strategies, methods and tools for managing the occupational exposure to manufactured nanomaterials (MNMs) in construction.

  The SCAFFOLD project collected, reviewed and analysed relevant quantitative and qualitative information and data on current strategies, methods and tools for workers protection against MNMs in order to identify the needs and gaps for proper risk management. Four main topics were analysed: Risk prevention (MNMs safe design, safe design of manufacturing processes, etc.), Risk assessment (occupational exposure and toxicology, measurement equipment and procedures, exposure limit values, etc.), Risk protection and control (filtration, PPEs, etc.) and finally Risk management (safety management models, tools, implementation level, work procedures, “good practices”, risk communication, etc.).

  Among the project results is a set of tools for risk management, including good practice guidelines, which can be found at:
  http://scaffold.eu-vri.eu/home.aspx?lan=230&tab=2633&itm=2633&pag=1566.

  The SCAFFOLD project also developed a roadmap on occupational exposure to MNMs in the construction sector. The roadmap has been designed to support the identification of future product, service and technology needs for occupational MNMs risk management in the construction sector and the evaluation and selection of the technology alternatives to meet these needs. The roadmap can be accessed at http://scaffold.eu-vri.eu/filehandler.ashx?file=13828.

- The NANoREG project – http://www.nanoreg.eu/

  The NANoREG project ran from March 2013 until September 2016 with the aim of delivering a common European approach to the regulatory testing of Manufactured Nanomaterials. NANoREG is the first FP7 project to deliver the answers needed by regulators and legislators on environmental health and safety by linking them to a scientific evaluation of data and test methods. The NANoREG project has four main objectives,

including one objective to provide a tool box of relevant instruments for risk assessment, characterisation, toxicity testing and exposure measurements of MNMs, and a further objective to establish a close collaboration among authorities, industry and science leading to efficient and practically applicable risk management approaches for MNMs and products containing MNMs.

- The NanoSafety Cluster - http://www.nanosafetycluster.eu/

  The EU NanoSafety Cluster is a DG RTD NMP initiative to maximise the synergies between the existing FP6 and FP7 projects addressing all aspects of nanosafety including toxicology, ecotoxicology, exposure assessment, mechanisms of interaction, risk assessment and standardisation. A stated objective is to provide industrial stakeholders and the general public with appropriate knowledge on the risks of NanoParticles and nanomaterials for human health and the environment.

  The NanoSafety Cluster publishes a compendium to signpost information on how European nanosafety research projects tackle the emerging safety and health challenges of novel engineered nanomaterials and nanotechnologies. The Compendium provides descriptions of the EU funded nanosafety projects in sufficient detail to allow readers / end-users / stakeholders to assess which projects might provide relevant information for them, or which might be relevant to collaborate with, as well as providing contact information of the coordinators of the projects.
  http://www.nanosafetycluster.eu/uploads/files/pdf/2015_NSC_Compendium.pdf
  The NanoSafety Cluster is also involved in the development of tools for enabling safety in the use and delivery of nano-materials, such as the "Closer to the Market" Roadmap (CTTM). The CTTM aims to speed up the progress towards market implementation of nanotechnologies by outlining the steps needed to develop a framework for implementation. In its current form it is addressed towards policy makers, but the ultimate framework will be designed for use by SME and enterprise organisations. Nano-products and nano-enabled applications need a clear and easy-to-follow human and environmental safety framework for the development along the innovation chain from initial idea to market and beyond that. The CTTM facilitates navigation through the complex regulatory and approval processes under which different product categories fall.

- http://nanopartikel.info/en/ is a website of research findings in nanotechnology explained in plain language based on NanoCare and its follow-on projects, including access to the brochure *Health-related Aspects of Synthetic Nanomaterials,* published by NanoCare Project Consortium, funded by the German Federal Ministry for Education and Research 2009.

Summary of tools and techniques available to mitigate the risks:

Tool/Technique	Link/Publication	Life Cycle phase addressed	Publication date/Project end date
STOP principle and Proven Precautionary principle, Occupational health protection	http://www.bag.admin.ch/nanotechnologie/12171/index.html?lang=en	Manufacture Construction	2008
Guidelines on disposal of nanowaste	http://www.bag.admin.ch/nanotechnologie/12171/index.html?lang=en	End of life	2012
German Federal Institute for Occupational Safety and Health, risk measurement and safe handling	http://www.baua.de/en/Homepage.html	Manufacture Construction	Ongoing
Standard risk assessment	PD ISO/TR 12885:2008	Manufacture Construction	2008
Nano-Risk Framework	http://www.nanoriskframework.org.	Manufacture Construction	2011
(COSHH) 2002 Risk management	Referenced in PD ISO/TS 12901-1:2012	Manufacture Construction	2002
Control Banding	PD ISO/TS 12901-2:2014 and PD CEN/TS 16937:2016	Manufacture Construction	2014 and 2016
Stakeholder Communication and Interaction	PD CEN/TS 16937:2016	Manufacture Construction Use	2016
SCAFFOLD tools for Risk Management and Good Practice Guidelines	http://scaffold.eu-vri.eu/home.aspx?lan=230&tab=2633&itm=2633&pag=1566	Manufacture Construction	2015
SCAFFOLD Roadmap for occupational safety in construction	http://scaffold.eu-vri.eu/filehandler.ashx?file=13828	Manufacture Construction	2015
NANoREG tool box of relevant instruments for risk assessment, characterisation, toxicity testing and exposure measurements of MNMs	http://www.nanoreg.eu/	Development and testing	2016
NanoSafety Cluster "Closer to the Market" Roadmap (CTTM).	http://www.nanosafetycluster.eu/	Manufacture Construction Use	Ongoing
NanoCare and subsequent projects focus on health risks	http://nanopartikel.info/en/	Manufacture Construction	2009

Summary of guidance on nano-safety aspects in construction materials:

Despite the potential risks, the use of nano-materials in the construction industry can be expected to increase in the near future. This leads to a general uncertainty with respect to the health and safety risks and how to properly manage them to protect workers and users and be in compliance with Health and Safety legislation. This document has provided signposts to current tools and techniques to assess and manage the risks through an appropriate framework, and the following points are highlighted for consideration when selecting appropriate risk management tools:

- Follow a recognised risk evaluation and mitigation framework
  There are many approaches to risk management, based on national occupational health standards, or on the findings of research projects. The information given above signposts the user to a selection of these approaches, from which a suitable framework for the situation under consideration can be defined based on the current approaches available.
- Consider and liaise with the whole supply chain when evaluating risk
  It has been recognised that many of the approaches focus on manufacturing and construction and occupational exposure to risk. This should be extended to include the requirements of all stakeholders, including users, and all stages of the product lifecycle, including end of life considerations.
- Communicate risks to all stakeholders and users based on their specific needs and timescales
  It is important that specific stakeholders are given the information relevant to them, using terminology which they understand. Manufacturers and constructors of nanomaterials should make users aware of any risks and mitigation strategies required throughout the life of the product.

Appendix 1 - Bibliography on nanomaterials and safety

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