

SCAFFOLD: Innovative strategies, methods and tools for occupational risks management of manufactured nanomaterials in the construction industry

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Project overview

Introduction

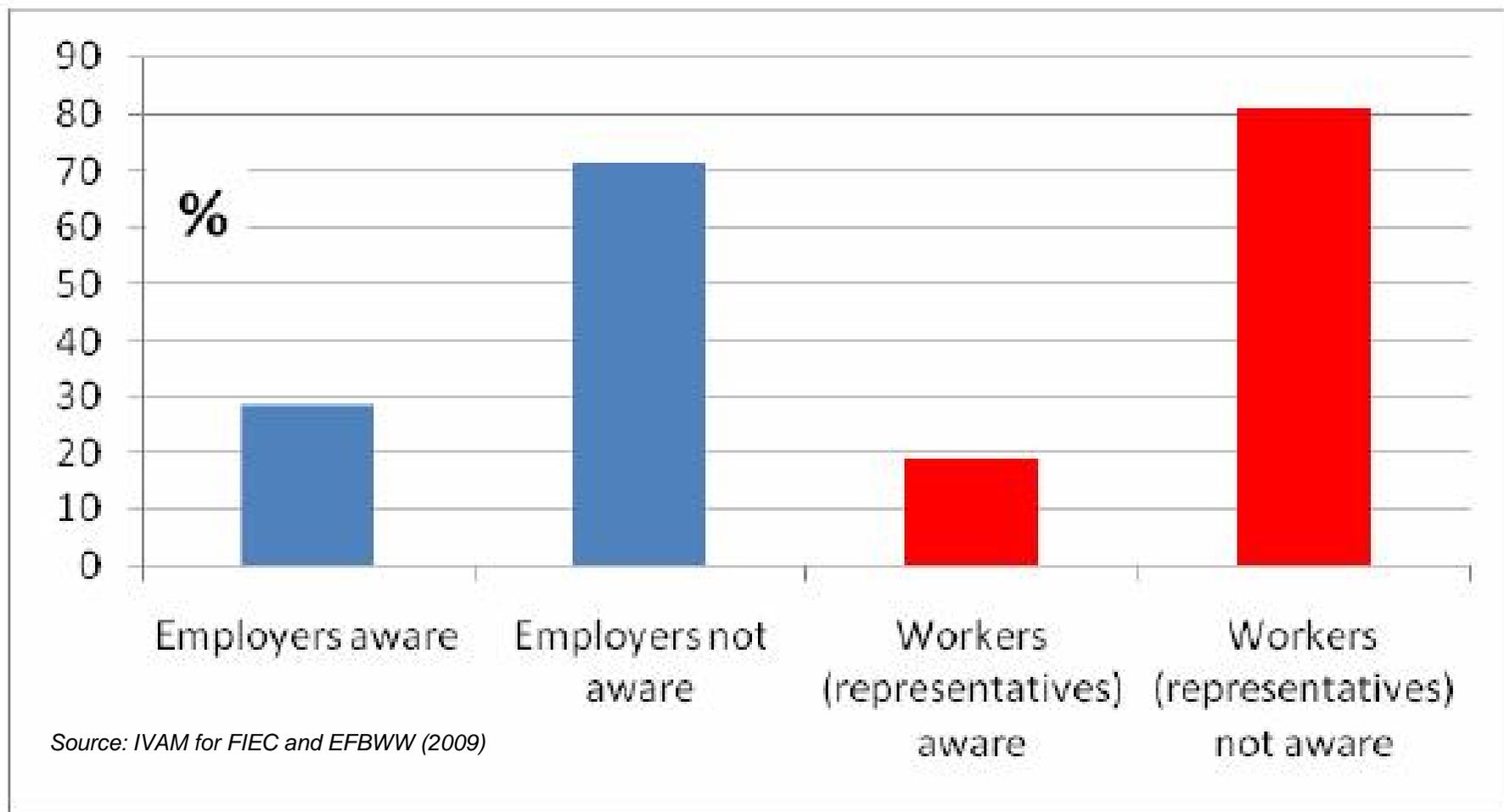
- Use and handling of MNMs and MNM-containing products in construction : large & increasing
- Exposures at different stages of the construction life cycle
- Low awareness
- Occupational Legislation: complex

How to

- **prevent occupational exposure & risks?**
- **reduce uncertainty for stakeholders?**



Low awareness of NPs in construction sector



Aim of the SCAFFOLD project

to develop, test, validate in real conditions and disseminate a **new holistic, consistent and cost effective Risk Management Model (RMM)** towards occupational exposure to MNMs in the construction sector. ...

... by developing and integrating a set of strategies, methods and tools for:

- Risk prevention
 - Risk Protection
 - Risk Assessment
- } Risk management

... In line with **state-of-the-art safety management systems (OSHAS 18001 + ISO 31000)**.

Project Duration: Three years (2012 – April 2015)

Project Budget: 3,7 M€, incl. 2,5 M€ EU funding



No.	Beneficiary name	Short name	Country
1	Fundación TECNALIA Research and Innovation	TECNALIA	Spain
2	Commissariat à l'Énergie Atomique et aux Énergies Alternatives	CEA	France
3	National Centre for Scientific Research "DEMOKRITOS"	DEMOKRITOS	Greece
4	Centralny Instytut Ochrony Pracy - Państwowy Instytut Badawczy	CIOP-PIB	Poland
5	Acciona Infraestructuras S.A.	ACCIONA	Spain
6	Asociación Española de Normalización y Certificación	AENOR	Spain
7	Mostostal Warszawa S.A.	MOSTOSTAL	Poland
8	ROSSAL SRL	ROSSAL	Romania
9	Tecnología Navarra de Nanoproductos S. L.	TECNAN	Spain
10	NETCOMPOSITES Limited	NETCOMPOSITES	UK
11	Institutul de Cercetari Pentru Echipamente si Tehnologii in Constructii	ICECON	Romania
12	European Virtual Institute for Integrated Risk Management	EU-VRI	Germany
13	Tyoeterveyslaitos	FIOH	Finland
14	Regents of University of Minnesota	UMN-PTL	United States



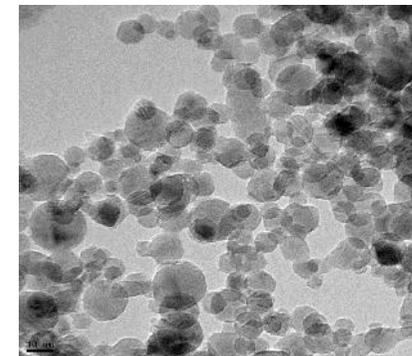
Six applications of MNMs in construction

- | | |
|--|--------------------------------|
| 1. Depollutant mortars | TiO ₂ |
| 2. Self-compacting concretes | SiO ₂ |
| 3. Coating laminates | Carbon NanoFibers (CNF) |
| 4. Self-cleaning external coatings | SiO ₂ |
| 5. Fire-resistant panels | Nanoclay |
| 6. Insulating polyurethane foam | Cellulose NanoFibers (Cell NF) |
| + Composites for electromagnetic shielding | Carbon NanoFibers (CNF) |

Six steps of exposure scenarios

(integrating 26 individual exposure scenarios)

1. Manufacturing NMs
2. Manufacturing products containing MNMs,
3. Preparation, mixing, and application on site
4. Assembly and machining
5. Demolition and disposal
6. + Fires



Demonstration: 5 Industrial Use Cases - 5 stages of the Life Cycle

1.- Manufacturing NMs



TECNAN (ES)

2.- Manufacturing CP containing NMs

Fire retardant panels



ICECON (RO)

3 &4.- Preparation and use of CP containing NMs

Self compacting concrete



ACCIONA (ES)

Application of coating



MOSTOSTAL (PL)

5.- End of life of CP containing NMs

Destruction of fire retardant panels



ROSSAL (RO)

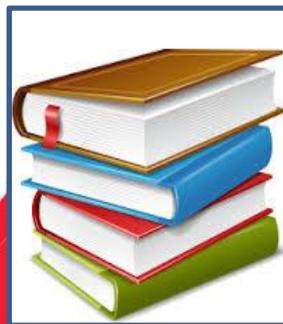
Result overview

1. **Safer nano-enabled products for construction:**
dispersions (TiO₂, SiO₂), fire-retardant panels, concretes, mortars, coatings, insulations.
2. **General quantitative and qualitative approaches for Risk Assessment,**
 1. Strategies and methods for measuring exposures (TiO₂, SiO₂, CNF, CNF, nanoclays)
 2. Proposals for OELs
 3. Models: Air dispersion,...
 4. Control banding tool customized for construction
3. Assessment of **18 specific exposure scenarios at lab, pilot and/or ind. scales (Database):**
on-line equipment (portable + advanced), personal samplers, chemical-SEM-EDX, ..
4. Evaluation of the **efficiency of collective protections** (LEV, glove-box, ..) and **PPEs** typically used in construction (suits, respirators, gloves) .
5. **New device** for trapping nanoparticles
6. **Recommendations** for EU policy
7. Project of **CEN Technical specification**
8. **Library of solutions** (Handbook, Quick guides, Toolkit, Technical Specification)

**20 Documents
online**

2. QUICK GUIDES:

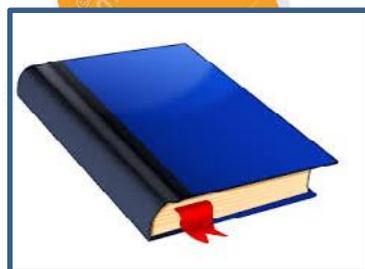
1. Risk Prevention
2. Risk Assessment
3. Risk Protection
4. Risk Management



3. TOOLKIT (Integration)

*Library of solutions
for
Risk Management*

Scaffold



1. HANDBOOK

(Project knowledge,
Inputs from partners)

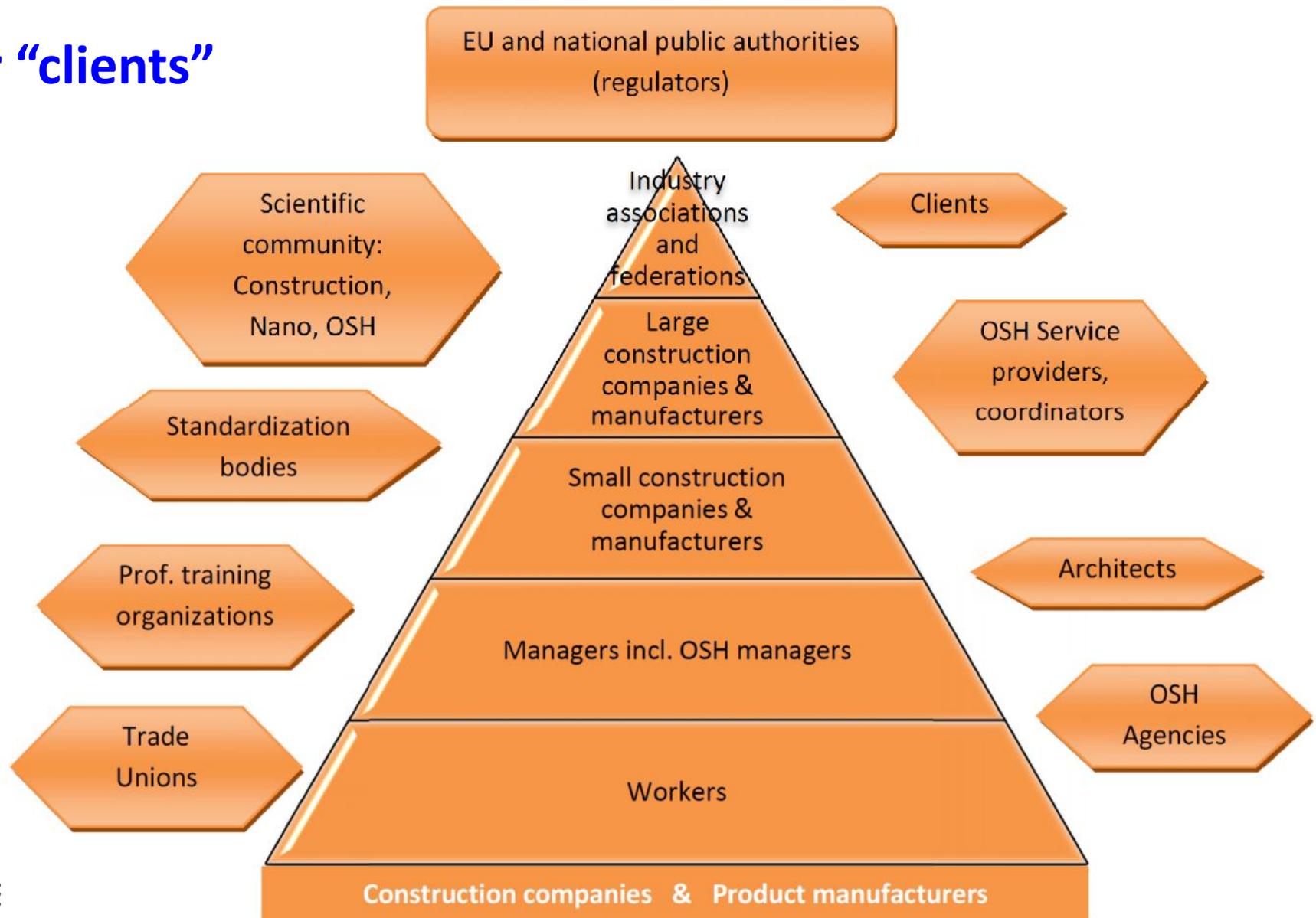


4. STANDARDIZATION (CEN TC 352/WG 3/PG 5/Scaffold)



GA: 280535

Our “clients”



2-way communication →

better Outcomes
more impact



- Identification of needs
- **Common visions:**
Delphi workshops
- **Reviewing**
- **Joint dissemination:**
- ...

Expected Impact

1. European Construction Industry and Society:

- ✓ Risk reduction for Workers exposed
- ✓ Know what to do (companies, esp. SMEs)

2. Market (products):

- ✓ Safe Nanoproducts (e.g. Nanocomposites)
- ✓ Safety Management systems (e.g. OHSAS 18001)
- ✓ New safety services for market (e.g. OHS, certification)

3. European policies, regulations and standards:

- ✓ Information for better regulations and new standards (OHS & Safety of products)

4. Strategic Research Agendas (SRAs).

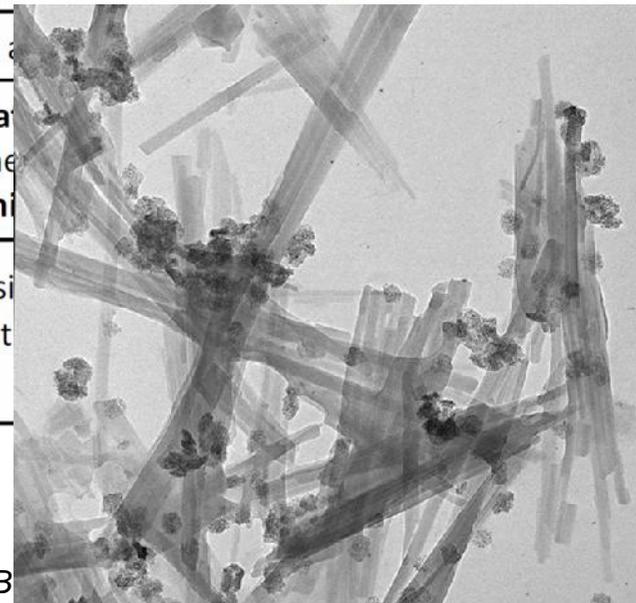
Key results

Prevention

- ✓ **Substitution** by conventional particles or less hazardous MNMs
- ✓ **Confinement** / Isolation in the process, in the product, or in a stable matrix.
 - **Information & Training**
 - Problem: **MSDS, OELs: Ø**

Scaffold: Safer product / Safe by design

MNMs	Application	Strategy
TiO ₂	Self-cleaning and depolluting mortar	Concentrated and stable dispersions Use n-TiO ₂ supported on sepiolite microfibers
SiO ₂	Self-compacting concrete	Concentrated a
Nanoclay	Fire resistant polymeric panels	Thermal treat reduction in he Low energy m
Celulose NanoFibers	Insulating polyurethane foam	Good dispersi
Carbon NanoFibers	Composites for electromagnetic interference shielding	Reduction of t matrix





Protection

- ✓ **Current PPE (gloves, masks, Tyvek) are efficient** towards NPs incorporated in a material at realistic concentrations (between 0,4 and 1,7%).

Whether as **powder** (synthesis of NPs, manufacturing of the mortar), as **solid** (mortar with water, applying on a wall) or as **sol-gel** state (liquid mortar), we never observed SiO₂, TiO₂, nanoclay or nanocellulose inside PPEs.



Main difficulty: **leakage at mask / face contact**

- ✓ **Other clothes:**
 - ✓ **Rain coating = the most efficient** : no diffusion observed at all (aerosol and liquid).
 - ✓ Polyester 65%/cotton 35% : efficient only for SiO₂ aerosol
 - ✓ Fleece jacket: efficient only for SiO₂ aerosol and TiO₂ aerosol

Risk assessment



Nano-object	OEL (mg/m ³) or fibers/cm ³ (1)	Reference Values particles/cm ³ or fibers/cm ³ (1)
nano-TiO ₂	0.1	40.000
nano-SiO ₂	0.3	40.000
nano-clay	0.3 (respirable) & 4 (inhalable)	40.000
Low toxicity dust	0.3 (respirable) & 4 (inhalable)	
nano-cellulose	0.01 (1)	0.01 (1)
Carbon nano-fiber	0.01 (1)	0.01 (1)

Risk management - Toolkit

AENOR

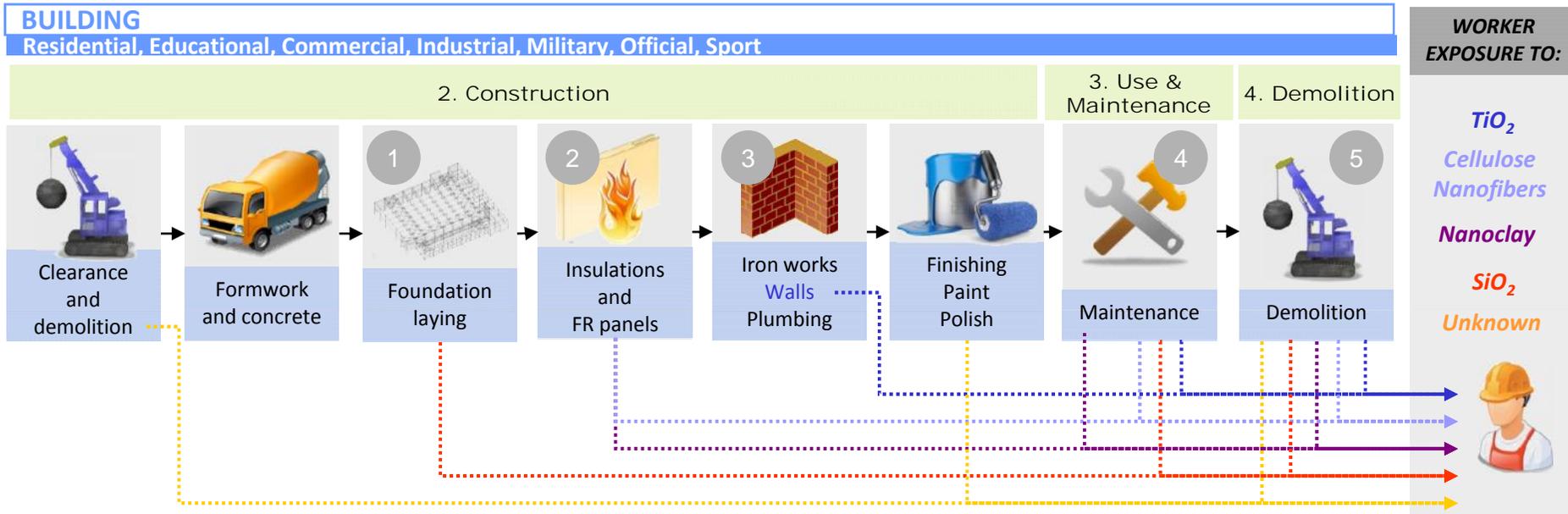
V2 online Nov. 2015

- ✓ Computer application
- ✓ Evaluates MNMs RMM implementation inside a construction company
- ✓ Adaptable to any company and especially to SMEs
 - + SMEs version : simpler, for SMEs with/without OSHAS model / RMM experience
 - Integrates the RMM from the company (with or without OSHAS 18001)
- ✓ Easy-to-use, practical, interactive, didactic
 - Also for training, personnel involvement, communication with stakeholders
 - Facilitates the legal compliance
 - Helps for continual improvement
 - Final example diagrams in each module

LCA - Process



Process Data Sheet



EXPOSURE SCENARIOS:

- 1 FOUNDATION LAYING
 - ES7: Concrete mixing for piles, slabs and special structures
 - ES8: On-site Assembly/Machining
- 2 INSULATIONS AND FIRE RESISTING PANNELS
 - ES19/ES23: Off-site manufacturing → *Not considered in the project*
 - ES20/ES24: Fitting of the pannles and machining for the superficial instalations of other elements

- 3 WALLS
 - ES15: Preparation, dosification of coatings
 - ES16: Application of coatings, superficial machining
- 4 MAINTENANCE
 - ES10/ES18/ES22/ES26: Accidental Fire: MNMs combustion
- 5 DEMOLITION
 - ES9/ES17/ES21/ES25: Demolition, end of life

For EU Policy: OSH information down the user chain

Issue	Objectives	Actions	Ordering	When
	<p>Better transmission of OSH information down to final products</p> <p>(--> also: raise awareness)</p>	<p>1. Initial check of MSDS of construction products ==></p> <ul style="list-style-type: none"> - feedback to individual producers - guide for producers <p>2. Routine control of some MSDS of construction products</p> <p>Notification of products containing nanos</p>	<p>Ind. OSHAs Adm.</p>	<p>2015-16</p> <p>2017-</p> <p>-</p>

Ind.: industry; OSHAs: OSH Agencies; Adm: administration: EC, national ministries



For EU Policy

Exposure and Risk assessment

Awareness and Best practices

Issue	Objectives
	Establishment of OELs
	Better adequation of measurement capacities for assessment needs
	Availability of typical exposure data in some activities

Issue	Objectives
	Raise awareness , disseminate best practice , increase the culture of safety



Acknowledgement

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