

Development of an inventory for consumer products containing nanomaterials

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Abstract

Development of an inventory for consumer products containing nanomaterials

While various databases include consumer products containing nanomaterials, there is no consistent and reliable overview of these products. This study commissioned by DG Environment developed a methodology to identify consumer products containing nanomaterials, and tested it in populating a searchable database with a sample of 200 such products. In designing the database, attention was given to identifying and establishing the purpose and key stakeholders. A data model was developed for a structured record of data on individual products. The data model is directed to meeting user requirements in a searchable database. In addition, a methodology has been developed to address the validity of nano claims given the large degree of uncertainty about claim validity with respect to nanomaterials in consumer products. Using the data model, a sample database was populated with 200 products, which is searchable in various ways, and an output is made available in static HTML pages. This methodology and sample database could form the basis for further development of a database on nanomaterials in consumer products at the EU market. Recommendations for further action are included in the report.

Keywords:

Data model, database, nanomaterials, consumer products, European market

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Summary

Nanomaterials are used in many consumer products available in the EU Member States. To gain insight into the use of nanomaterials in consumer products, DG Environment requested RIVM to develop a methodology to set up a database on nanomaterials in consumer products and to make the initial input of data on selected products into the database.

The work presented in this report has six objectives:

1. To develop a methodology based on scientific literature and research data to identify consumer products containing nanomaterials on the EU market;
2. To develop a data model to be used as the blueprint for developing a structured and multi-searchable database;
3. To construct a sample database of approximately 200 consumer products in key sectors;
4. To compile static HTML output including background information on products that can be integrated in the Europa website;
5. To prepare based on the sample database an example overview of the extent of nanomaterials used in consumer products in the EU, and to provide information on the type of nanotechnology/nanomaterials contained in these products;
6. To identify issues to be addressed in setting up a comprehensive database.

The data model was constructed for a database to provide relevant information to key stakeholders such as policy makers and consumers. The information is presented in lists containing, for instance, product types, product categories, nanomaterials contained, and countries in which the products are produced and marketed. However, the database does neither contain information on market share of products containing nanomaterials, nor on exposure and health risks of such products. This would require incorporating information from additional databases, when such information becomes available.

In compiling the database, product databases and other databases linked to the use of nanotechnology and nanomaterials were reviewed and assessed as well as scientific literature on relevant topics.

A methodology was developed for identifying consumer products containing nanomaterials. For the first time, products were assigned a confidence level with regard to the certainty that a product contains nanomaterials. Three levels of confidence were identified. A *low* confidence level means that the product carries a nano claim on the product label or product website. The confidence level is *intermediate* if the manufacturer verifies the product information. A high confidence level means that analytical measurements are supplied on products, either from literature in the public domain or by the manufacturer.

All data on products containing nanomaterials were included in a data model, which takes the consumer product as starting point. The data model shows how the information is to be stored in a multi-searchable database. Thus, the design of a data model is essential to ensuring that a useful database is constructed.

Based on the data model, a sample database was set up and populated with 200 consumer products representative of products containing nanomaterials. The

sample database was then used in assessing the extent to which nanomaterials are used in consumer products, which is an issue earlier identified as relevant for policy makers. Furthermore, the contents of the sample database have been made available in static HTML pages. Because this is a structured database, an interactive website can be constructed at a later stage.

In future projects, the sample database on consumer products containing nanomaterials could be expanded and updated to a comprehensive database. The present project provides the initial blueprint. Issues to be considered before setting up a comprehensive database are addressed at the final sections of the report. In setting up a useful and transparent database, it is necessary to identify questions of stakeholders as well as the sources of information on products containing nanomaterials. In addition, the issues and intended target groups to be addressed by the database need to be clearly identified.

Recommendations are presented on how to set up a comprehensive database and on organisational and practical issues in implementation.

1 Introduction

1.1 Background

DG Environment is seeking a methodology to set up a database containing information on nanomaterials in consumer products and to record data on identified products in a sample database. The Call for Tender stated that the database should serve various areas of application and should be of use for other directorate Generals interested in nanotechnology.

The main objectives were formulated:

1. To develop a methodology to identify nanomaterials used in consumer products on the EU market (27 Member States);
2. To elaborate an overview of the extent of nanomaterials used in consumer products on the EU market and provide information on the type of nanotechnology/nanomaterials they contain;
3. To prepare an online inventory of the nano products and materials available in a number of key sectors and compile a set of web pages with explanatory material link with the online inventory. The web pages can be integrated in the Europa website.

These objectives need further specification to describe the scope of our assignment. Clarity about restrictions on the use and applicability of the inventory is essential. Many databases have been developed on the assumption that providing large amounts of data is sufficient to respond to almost any demand for information. However, the database needs to be structured to the issues it is intended to address. If not, the data required cannot be retrieved from the database. Thus, the design of the data model is critical to the usefulness of the database. The structure of a database is also strongly related to the stakeholder groups using the database or giving input to the database. Issues such as intellectual property, regular updates, the type of information to be retrieved, and confidentiality need to be addressed beforehand.

Another issue relates to the quality of the data in the database. The questions to be addressed in combination with the groups of users play an important role in the requirements and constraints on the applicability of certain data. For example, data needed for regulatory issues have other requirements than data for generating general overviews.

Review of activities in the field of (safety of) nanomaterials reveals a substantial number of large databases containing important information which have taken a substantial amount of money and time to set up and maintain. Thus, we therefore strive to link data with these databases wherever possible, rather than to rebuild these databases.

1.2 Tasks and translation into operational objectives

The tasks formulated in the Call were:

1. A. Conduct a research/literature review and data collection to gather information on the use of nanomaterials in consumer products on the EU market (27 Member States);
B. Develop a methodology to identify the nanomaterials in consumer products. The methodology should specify sources and techniques employed;
2. Prepare an overview of the extent of nanomaterials used in products; provide information on the type of nanotechnology/nanomaterials they contain and a preliminary assessment of exposure;
3. Prepare an inventory of the products and materials available in a number of key sectors;
4. Compile a set of web pages to link with the online inventory;
5. Recommendations for further work.

These tasks were converted to operational objectives:

1. To develop a methodology to identify consumer products containing nanomaterials on the EU market, using literature and research information (referring to Task 1);
2. To develop a data model to be used as a blueprint for developing a structured and multi-searchable database,
3. To construct a sample database of approximately 200 consumer products in key sectors;
4. To compile static HTML output including background information that can be integrated in the Europa website (referring to Task 3 and 4);
5. To prepare a sample overview of the extent of nanomaterials used in consumer products in the EU market, and provide information on the type of nanotechnology/ nanomaterials contained in these products (referring to Task 2).
6. To identify issues to be addressed in setting up a comprehensive database (referring to Task 5).

Although the terms database and inventory are used in this report to refer to data collection on consumer products containing nanomaterials, these words are not synonymous. An inventory is a list or a register of products, but a database is more because the data stored can be made available in the required form or output, such as a list of all nanomaterials present in consumer products, or personal care products containing nano-platinum manufactured in Germany.

In the current project, nanomaterials refer to *engineered* materials of one or more dimensions smaller than 100 nm. Natural substances or entities such as viruses and volcanic ultra-fine dust in the nano-range dimension were not included in this study.

In addition, although a clear definition of nanomaterials is essential in setting up a database on consumer products containing these materials, the term nanomaterials has not been defined (as is the case for other databases) because as yet there is no generally accepted definition for nanomaterials in the EU.

1.3 Contents of the report

The report presents the approach and the applicability of the sample database in Chapter 2. Example questions are listed to demonstrate the issues on which the database contains information. The review of existing databases and literature is given in Chapter 3, and the methodology to obtain data on consumer products containing nanomaterials is presented in Chapter 4. In Chapter 5, the data model and database are presented. Chapter 6 describes the products selected for the sample database as well as the extent of nanomaterials used in consumer products based on the populated sample database. The development of the static HTML output is given in Chapter 7.

Chapter 8 lists issues to be considered in setting up a database and includes what is required to develop a comprehensive database including its organisation and implementation. General considerations of relevance for successful implementation of a European product database are given in Chapter 9. The electronic form of the data model, data entry application, sample database and web pages, including source codes are presented on the CD delivered with this report.

2 Approach and applicability

2.1 Approach

This project encompasses the development of a methodology for setting up a database containing information on nanomaterials in consumer products, and involves using the methodology to construct a sample database of approximately 200 products.

A methodology was developed to obtain relevant data for the database. Parallel to this, a data model was developed to record all information on a product in a structured and multi-searchable way. The data model is a blueprint for the database

The sample database can be developed into a comprehensive and up-to-date database, which will facilitate learning on how nanomaterials enter the market. Other information on nanomaterials such as production and hazard data are not included in the sample database, but links to other sources with such information are provided.

The methodology for identifying consumer products containing nanomaterials consists of collecting information from various sources:

1. Existing databases (known sources) based on nano claims;
2. Voluntary information from manufacturers;
3. Legal Directives;
4. Information on analytical measurements from literature in the public domain.

The data model was used to construct the sample database with about 200 products. As an example of the applicability of the sample database, it has been used to address the extent of nanomaterials used in consumer products, as shown in static HTML outputs. As the database is populated with a selection of products on the market, the outputs should be interpreted as such. In addition, recommendations to complete the sample database and keep it up-to-date are provided (see Figure 1).

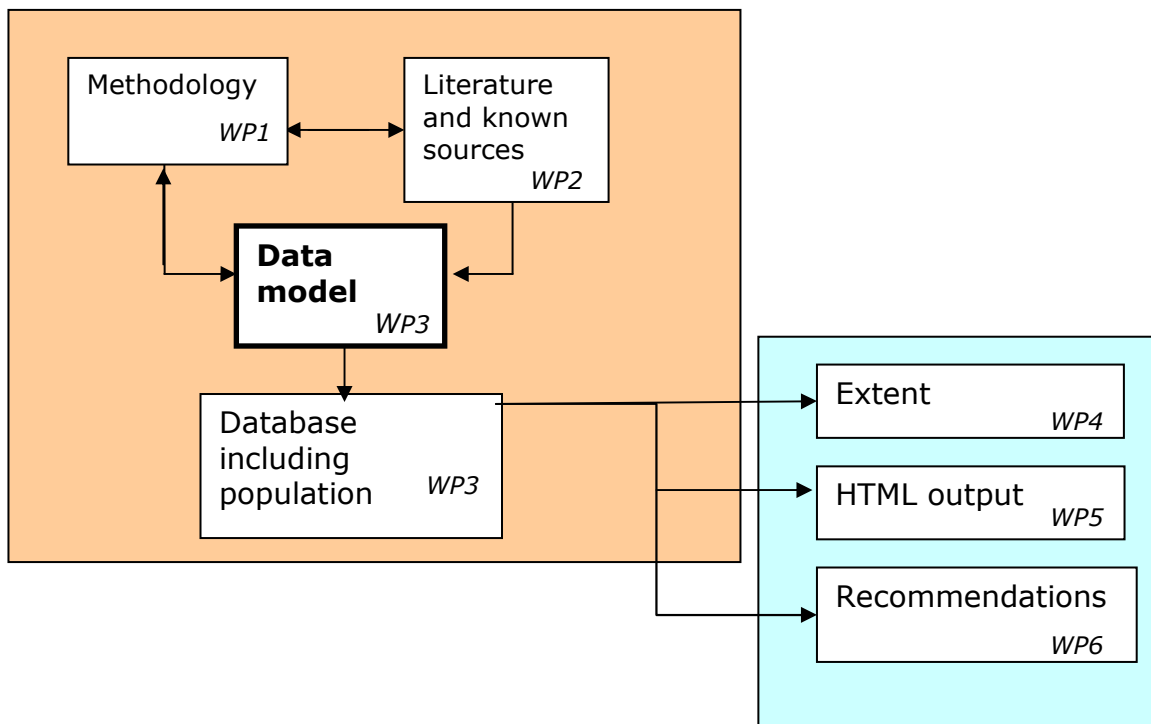


Figure 1. Approach of the current project

2.2 Applicability

The methodology was developed so that when the database is completely filled, it can answer questions for stakeholders such as policy makers in various EC Directorate-Generals interested in nanotechnology, consumers and others interested in learning how nanotechnology enters the market.

Examples of questions from various stakeholders are given in Sections 2.2.1 and 2.2.2. The answers are lists containing the information required such as products and countries. A number of these questions are answered for the sample database in Chapter 6. Section 2.2.3 lists questions that cannot be answered with the current database.

2.2.1 Examples of questions that can be answered by the database when completely filled:

- What products containing nanomaterials are available in Europe?
- What products with a nano claim are available?
- What products with a specific nanomaterial (silver, silica, titanium) are available?
- What products contain nanomaterial in a specific matrix (solid, liquid, gas, cream/emulsion/paint)?
- What products are present in a specific category (sporting goods, personal care products)
- Are there different products available for consumers in the various EU Member States?
- For which products is analytical information available?
- For which products is information from the manufacturer available?
- Which products are covered by which different manufacturers?

2.2.2 *Examples of questions to be answered in the future requiring time-related information.*

- Is there a time trend in the various product categories? For example, an increasing number of products containing nanomaterials in a category.
- Is there a time trend in the use of a specific nanomaterial (silver, silica, titanium)?
- Is there a time trend in the number of products expected to contain nanomaterial?
- Is there a time trend in the number of products with a nano claim?
- Is there a time trend in the ratio of products at the different levels of confidence?
- What products with a nano claim have dropped the claim or have been removed from the market?

2.2.3 *Examples of questions that cannot be answered with the current database*

The database is not designed to answer questions on market share and market penetration of nano products and the location of nanomaterial production. These data are not publicly available and are expensive to collect (data are only available from market reports that are expensive to purchase). Examples of such questions are:

- Where is the nanomaterial produced?
- What is the market share of nano-containing products?
- What percentage of cosmetic products contains nanomaterials?

The following questions on exposure and health risks cannot be answered with the current data model and database alone:

- How (exposure route) are workers exposed during the production of nanomaterials?
- What is the exposure and health risk of using this consumer product with nanomaterials?
- What are the most dangerous products to use?
- How many consumers use toothpaste with nanomaterials in Europe (or in a specific country)?
- Are my children exposed to consumer products containing nanomaterials?

In the future, more information on potential health risks might be obtained by combination with other sources. This issue is discussed in Chapter 8.

3 Review of databases and literature

This chapter presents a review of product inventories in product databases and other databases linked to information on the use of nanotechnology and nanomaterials (Section 3.1). In addition, scientific literature was consulted on topics relevant for the current project (Section 3.2).

3.1 Databases

For the determination of the target groups (the users) of the database as well as the relevant questions that can be answered by the database, it is very important to determine the 'point of departure' for the database. In this respect, two types of databases on nanomaterials/nanotechnology can be distinguished: product databases and non-product databases. Product databases answer questions about products containing nanomaterials, while non-product databases provide information on, for instance, the use of nanotechnology and nanomaterials in general. Both types of databases were reviewed. In addition to the existing product databases (Section 3.1.1), a product database under development - Cosmetic Products Notification Portal - was considered (Section 3.1.2). The non-product databases linked to the use of nanotechnology are described in Section 3.1.3.

3.1.1 Product databases

The concepts (methodology) underlying the databases were investigated to determine whether they could be used in the current project. In addition, data in these databases were studied for applicability for populating the sample database. The following items were considered for each database:

- Who is the target group for the database: Who will visit and use the database?
- What is the method of collecting and selecting products?
- What inclusion criteria are products are defined?
- How are products classified?
- What additional information is given on the database?
- How is the database documented and presented?
- Which countries does the database focus on?
- What are the costs for using the database?

These points are discussed below for each database for which information was available.

The following product databases were investigated:

1. Woodrow Wilson database (The Project on Emerging Nanotechnologies)
2. ANEC-BEUC 2010 inventory of consumer products containing nanomaterials (ANEC-BEUC 2010)
3. Online database of German Environmental NGO 'BUND' (Friends of the Earth Germany)
4. The Mintel Global New Products Database (GNPD)
5. Household Products Database

Databases 1 to 3 are on nano-specific products while databases 4 and 5 are more general product databases. These five product databases are described below.

1. Woodrow Wilson database

The American Woodrow Wilson database was the first publicly available on-line inventory of nanotechnology-based consumer products. The inventory claims to be an important resource for consumers, policymakers, and others interested in how nanotechnology enters the market. Products are selected for the Woodrow Wilson (WW) database from systematic web-based searches. These range from exploratory searches to searches on specific categories of goods, and to following leads from multiple sources (including newspapers).

According to the database's website, products in the database meet the following criteria:

- Are readily purchased by consumers;
- Are identified as 'nano-based' (term not explained by Woodrow Wilson) by the manufacturer *or* by another source;
- The nano-based claims for the product appear reasonable.

In each case, specific products from specific producers were identified.

Products are grouped into the following main categories and subcategories (between brackets):

- *Appliances* (heating, cooling and air; large kitchen appliances; laundry and clothing care)
- *Automotive* (exterior; maintenance and accessories);
- *Goods for Children* (basics; toys and games)
- *Electronics and computers* (audio; cameras and film; computer hardware; display; mobile devices and communications; television; video)
- *Food and beverage* (cooking; food; storage; supplements)
- *Health and fitness* (clothing; cosmetics; filtration; personal care; sporting goods; sunscreen)
- *Home and garden* (cleaning; construction materials; home furnishings; luxury; paint)
- *Cross-cutting* (coatings)

Since nanotechnology has broad applications in many fields, the database includes a number of generic products found in many places in the market, or produced by many manufacturers, such as computer processor chips.

In addition, a company may offer several similar nanotechnology-based products and product lines. To prevent redundancy, only a few samples for each company are included in the WW database. Thus, the database does not describe each product in a product line but provides an initial baseline for understanding how nanotechnology is being commercialised.

The following information is included for each product listed in the inventory: manufacturer, country of origin, product category, claims supporting nanotechnology application, and the date of the last update. Hyperlinks to the manufacturer's website are also provided.

No attempts were made to verify the nano claims of the products. This means that there may be false positives in the inventory (products which producers claim that they contain nanomaterials, but which do not). Furthermore, products that clearly do not use nanotechnology have been avoided in this database, but some products have slipped through. For instance, GreenPan cooking utensils

were mistakenly reported to have been manufactured using nanotechnology. This product was removed from the database in September 2010. Additions to the inventory are made periodically, as new information is received. Since the start of the project in 2005, the inventory has been updated six times. The most recent update of 10 March 2011 added 303 new products since the update of August 2009.

The availability of some products could no longer be ascertained; to indicate this they were marked 'Archive'. At the time these products were added to the inventory, 'live' links were included. However, since then the company may have discontinued the product, gone out of business, removed a self-identifying nano claim, or simply changed their web address. In these instances, a cached version of the product website was located using The Internet Archive with a date when the last update was made.

The database is presented on the website: <http://www.nanotechproject.org/inventories/consumer/>. Although the origin of the database is American, it is applicable for global use. Visiting the website is free of charge.

2. ANEC/BEUC 2010 inventory

The ANEC/BEUC 2010 inventory is a European inventory of products available to consumers with a claim of containing nanomaterials. ANEC and BEUC are both European consumer organisations (ANEC: European Association for the Co-ordination of Consumer Representation in Standardisation, BEUC: Bureau Européen des Unions de Consommateurs). The target group for the inventory is consumers but the website claims that 'it is also useful for citizens, policymakers, and others who are interested in learning about how nanotechnology is entering the market'. Products were obtained via internet searches and/or using feedback from member organisations of ANEC and BEUC. These member organisations searched products in shops or at trade fairs, or found them in their consumer tests and/or when they acted in response to consumer requests.

Products in the ANEC/BEUC database have to meet two criteria:

- claim to contain nanomaterials;
- are available to European consumers.

Several product categories are identified of relevance to consumers, and are based on categories in the WW database. Detailed product categories are provided in Table A1, Appendix 1.

ANEC/BEUC has been able to check claims in different languages because the member organisations are located in different European countries. The inventory has been done twice, in 2009 and again in 2010. The update was carried out in the same way as the initial inventory. The inventory is a Microsoft Excel table available on the BEUC website: www.beuc.org. Visiting and using the inventory is free of charge.

3. Online database of German Environmental NGO 'BUND'

The product database of BUND (acronym for Der Bund für Umwelt und Naturschutz Deutschland) focuses on consumer products claimed to contain nanomaterials in Germany. The target group is 'consumers and everyone else who is interested'. No clear information is given on the website about how products are obtained and the selection criteria used.

The categories of consumer products are presented in Table A2, Appendix 1.

The BUND database contains about 200 products (March 2011), but states that more products will follow in the short term. BUND attempts to give an overview of products available in Germany by giving a selection of products in different product categories. To extend the list, the cooperation of consumers is requested. Consumers in Germany are asked to report all nanomaterial-containing consumer products in shops but not yet included in the database. The database is accessible on the BUND website: <http://www.bund.net>. Use of the database is free of charge.

4. Mintel Global New Products Database (GNPD)

The Mintel Global New Products Database (GNPD) is for manufacturers, agencies and suppliers. GNPD claims to add over 20,000 new products every month from 49 countries worldwide. GNPD is not nano-specific, and does not focus on products with a nano claim. GNPD scans the product labels and stores the information in the database. Thus, products with a nano claim can be selected. No specific criteria are given for inclusion of products in the database. Nevertheless, the database only includes products that can be purchased in the supermarket. Several product categories and subcategories identified in this database described in Table A3, Appendix 1.

The GNPD is accessible via the following link:

http://www.gnpd.com/sinatra/gnpd/frontpage/&s_item=home.

To get information from the GNPD, a paid license is required.

5. The Household Products Database of the National Library of Medicine (US)

This American database with not-nano-specific household products is based on the Consumer Product Information Database ©2001-2010 by DeLima Associates. It includes information on household product types, brand names, chemical constituents, health-related information (acute and chronic effects and target organs), and exposure minimisation techniques are related. The Household Products Database is not suitable for finding products with a nano claim, but it may be possible to use this database if the presence of nanomaterial is expected (see Section 4.2.2 and Appendix 3).

The target groups for the database are consumers; epidemiologists doing scientific research; dermatologists and allergists identifying products and brands that particular patients should avoid; and regulatory agencies in protecting the public against product hazards. Products in the database are selected on the basis of market share in each of nine product categories and shelf presence in retail stores such as drugstores, supermarkets, auto parts stores, building supply stores, office supply stores, craft stores and pet stores.

The main product categories identified are:

- Car products
- Inside the home
- Pesticides

- Landscape/ yard
- Personal care
- Home maintenance
- Arts & crafts
- Pet care
- Home office

All categories consist of multiple sub-categories (see <http://hpd.nlm.nih.gov/about.htm>).

The Household Products Database links over 10,000 consumer brands to the health effects listed in Material Safety Data Sheets (MSDS) provided by manufacturers. The database is designed to help answer the following questions:

- What are the chemical ingredients and their percentage in specific brands?
- Which products contain specific chemical ingredients?
- Who manufactures a specific brand? How do I contact this manufacturer?
- What are the acute and chronic effects of chemical ingredients in a specific brand?
- What other information is available about chemicals in the toxicology-related databases of the National Library of Medicine?

Information in the Household Products Database comes from a variety of publicly available sources including brand-specific labels and Material Safety Data Sheets when available from manufacturers and manufacturers' web sites.

The Household Products Database is accessible via <http://householdproducts.nlm.nih.gov/index.htm>. This is an American website but the products are also available in other countries. Use of the database is free of charge.

3.1.2 *Cosmetic Products Notification Portal (CPNP)*

To implement Articles 13 and 16 of Regulation 1223/2009 on cosmetic products, the European Commission is currently setting up an electronic portal: the Cosmetic Products Notification Portal (beta 1 version currently under testing). This portal will contain two types of information:

- The information requested in Article 13 of the Regulation 1223/2009. This comprises information on whether the cosmetic product contains nanomaterial (yes/no) and the potential exposure conditions. This information is made available to competent authorities and to poison centres or similar bodies established by Member States.
- The information requested in article 16 of the Cosmetics Regulation, which is detailed information on the nanomaterials used in the product. This information is only available to the European Commission.

In the event that the Commission has concerns regarding the safety of a nanomaterial, the Commission will request the Scientific Committee on Consumer Safety (SCCS) to give its opinion on the safety of such nanomaterial for use in the relevant categories of cosmetic products and on the reasonably foreseeable exposure conditions.

3.1.3 *Other databases linked to the use of nanotechnology*

In addition to the product databases discussed above, an overview is presented of databases not predominantly considering products, but containing information related to the potential toxicity or hazard of nanomaterials. Two of the databases provide information on experimental data and the projects and/or organisations in which these data are obtained. Two other databases specifically focus on industry needs.

1. The OECD Database on Research into Safety of Manufactured Nanomaterials
2. JRC NanoHub
3. REACH registration database
4. nanotech-data.com
5. nanoproducts.de

Information on exposure to nanomaterials is outside the scope of the sample database in the current project. However, this information may be included in future versions of the database, by synchronising with (parts of) these other databases. This may facilitate risk assessment of nanomaterials in consumer products because in addition to product information, other exposure data and hazard information is required (see Chapter 8).

1. The OECD Database on Research into Safety of Manufactured Nanomaterials

This database is a publicly accessible database of the Organisation for Economic Co-operation and Development (OECD).

It is an inventory of safety research information on manufactured (engineered) nanomaterials. The database contains information relevant to research on the environmental, health, and safety of nanomaterials. The information is and will be based on projects that are planned, underway or completed. The data on nanomaterials collected in these projects may not be available via this database before published in the scientific literature.

The OECD database has been developed as part of OECD activities to promote international cooperation in addressing human health and environmental safety aspects of manufactured nanomaterials. It is also intended to be an inventory of information on research programmes to help other projects of the OECD Working Party on Manufactured Nanomaterials (WPMN). This may consist of identifying relevant research projects or storing information derived from the projects of the WPMN (including the sponsorship programme on the testing of manufactured nanomaterials).

The following information is stored in distinct fields:

- Project Title; Start date; End date;
- Project Status (Current; planned; or completed);
- Country or organisation;
- Funding information (where available, on approximate total funding; approximate annual funding; and funding source);
- Project Summary; Project URL; Related web links;
- Investigator information: name, research affiliation, contact details;
- Categorisation by material name, relevance to the safety, research themes, test methods;
- Overall outcomes and outputs of the project.

The site is publicly and freely available via:

(<http://webnet.oecd.org/NanoMaterials/Pagelet/Front/Default.aspx>)

2. JRC Nanohub

Nanohub is a comprehensive IT platform (<http://www.nanohub.eu>), dedicated to the management of safety/risk assessment information on nanomaterials (substances).

The information collected in this database has been obtained from EU projects (ENPRA, NANOGENOTOX, NANOMMUNE, NANOPOLYTOX, NANOTEST) and various OECD WPMN activities (Sponsorship programme for testing of a set of representative nanomaterials). The database consists of physicochemical properties and toxicity data on various engineered nanomaterials. These data are not publicly available.

3. REACH registration database

REACH is the European Community Regulation on chemicals and their safe use (EC 1907/2006) dealing with the Registration, Evaluation, Authorisation and Restriction of Chemical Substances. The law came into force on 1 June 2007.

The REACH Regulation places greater responsibility on industry to manage the risks from chemicals and to provide safety information on the substances. Manufacturers and importers are required to collect information on the properties of their chemical substances, which will enable their safe handling. The information is registered in a central database run by the European Chemicals Agency (ECHA) in Helsinki. The Agency acts as the central point in the REACH system. It manages the databases necessary to operate the system, and co-ordinates in-depth evaluation of suspicious chemicals. Currently, the database is not publicly available. However, ECHA is constructing a public database in which consumers and professionals can find hazard information.

4. Nanotech-data.com

This is the database of nanotechnologies for Luxembourg and areas in Germany and Belgium (Luxembourg, Lorraine, Rhineland-Palatinate, Saarland, Wallonia). The database aims to provide information on products, patents, processes, demands, news and events in nanotechnology and to stimulate knowledge transfer between research, small to medium-sized Enterprises (SMEs) and large companies. The target groups for this website are SMEs, companies, researchers, institutions, and private individuals. The website provides detailed information on products, methods and services, application of interactive internet tools, simple and efficient handling. The site is publicly and freely available without charge via http://www.nanodaten.de/site/page_de_garde.html.

5. Nanoproducts.de

The website nanoproducts.de is a freely accessible database that deals with the marketing of products containing nanomaterials and/or products produced with nanotechnology on the internet. According to the website, 'it offers services to industry in the area of product and technology transfer'. The database contains more than 450 nanotechnology products. The product spectrum comprises process engineering, analytics, raw materials, materials and commercial products. The objective is to list all commercial and non-commercial nanotech products and technologies. The website <http://nanoproducts.de/> is publicly available; and its use is free of charge.

3.1.4 Relevance of databases for current project

The information from the different product databases used for the current sample database is presented in Table 1. The criteria for product selection were obtained from WW and ANEC/BEUC. The product categories are based on the WW but there are also similarities with ANEC/BEUC and BUND. In the current database, the main WW categories have been extended with new main categories and more subcategories (see also Section 5.3.4).

Products in WW, ANEC/BEUC and BUND were used to populate the sample database. To collect products expected to contain nanomaterials, the Mintel GNPD and the Household products database could have also been used. These were not used for the sample database but may be used for the future database (see Chapter 4).

Table 1. Information from databases used in the sample database

	Selection criteria for products	Product categories	Products with nano claim for populating sample database
Woodrow Wilson	X	X	X
ANEC/BEUC	X	X	X
BUND database		X	X
Mintel GNPD			
Household products database			

3.2 Literature review

In addition to the review of databases, literature was reviewed with respect to three issues in the development of the data model. These are the product categories, product identification and the matrix of nanomaterials. These three issues are described below.

3.2.1 Products categories

For the current project, the consumer products have to be grouped into main categories and subcategories. These categories need to be general as well as detailed, with preferably a product classified in one category only.

In addition to the categories used in the databases described above (and in more detail in Appendix 1), the categories of consumer products were investigated by studying scientific literature and other sources. First, the standard categories for consumer products in various EU and global frameworks were investigated for their suitability for the current project. The categories of consumer products are presented in:

- the Technical Guidance Document (TGD) on Risk Assessment (ECB, 2004, [http://ecb.jrc.ec.europa.eu/Documents/ TECHNICAL_GUIDANCE_DOCUMENT/tgdpart1_2ed.pdf](http://ecb.jrc.ec.europa.eu/Documents/TECHNICAL_GUIDANCE_DOCUMENT/tgdpart1_2ed.pdf))
- the online Customs Tariff database of the European Commission (TARIC, http://ec.europa.eu/taxation_customs/customs/customs_duties/tariff_aspects/customs_tariff/index_en.htm)

- two widely used tools related to consumer exposure: ECETOC targeted risk assessment (TRA) and ConsExpo (<http://www.rivm.nl/en/healthanddisease/productsafety/ConsExpo.jsp>). The ECETOC TRA list of product subcategories is described in Chapter R12 of the REACH Guidance on Information Requirements and Chemical Safety Assessment (ECHA-2010-G-05-EN, <http://echa.europa.eu>, see also Table A6, Appendix 2).
- the EUROSTAT website, the PRODCOM categories for all types of food and non-food consumer products are described (<http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home/>).

An overview of product categories of some of the abovementioned sources is given in Appendix 2.

All of these categories are considered to be too broad and too general for the current project, except for the PRODCOM categories used in EUROSTAT. In contrast with the other classifications, the PRODCOM categories are extensively described and too detailed for the current project (see example in Table A7, Appendix 2).

Furthermore, consumer product categories in REACH are defined from an exposure perspective - mainly the material (matrix) from which the product is made. These categories are considered to be less relevant to this project. The PRODCOM categories from the EUROSTAT website are also defined from this perspective.

The EU FP 7 project ObservatoryNANO (<http://www.observatory-nano.eu/project/>) supports European policy makers with wide-ranging scientific and economic analysis of nanoscience and nanotechnology developments. This is further supported by assessment of ethical and societal aspects, environmental impacts, health and safety, and the developments in regulation and standardisation. The key sectors in this project include categories of consumer products and non-consumer products (e.g., aerospace). Consumer products described in the technology sectors in the ObservatoryNANO project are limited to cosmetics, textiles, automotive and health. A further subdivision of the categories has not been made (see Table A8, Appendix 2).

3.2.2 *Identification of product ID*

An internationally accepted method of identifying products is to give the products an individual standard, machine readable, bar code. The EAN.UCC System (EAN = European Article Numbering and UCC = Uniform Code Council) is the most widely-used, supply-chain standards system (see <http://www.gs1.org/barcodes> and <http://www.officialeancode.com>).

Generally, a bar code has two parts - numbers, which can be read, and a series of bars that are scanned and tracked by computer. The numbers usually indicate the manufacturer and the specific product. The barcode is printed on the product by the manufacturer. The first two or three digits identify the country in which the manufacturer's identification code is assigned. They do not necessarily indicate the country in which the product has been manufactured. Furthermore, each product of the same manufacturer (mascara, body lotion, and shampoo) has an individual barcode.

All products that can be purchased in a supermarket have a barcode but fresh products from grocery stores, markets and textile products such as clothing do not always have a barcode.

In the database developed in the current project, the EAN code was used in the product descriptions. However, this code was not used as a unique identifier of the product in the sample database because not all products have an EAN code; the same product may have a different EAN code in different countries; and changes in composition may not always be reflected in the EAN code (see also Section 5.3.1).

3.2.3 *Description of location of the nanomaterial in the product (matrix)*

The main characteristics for assessing consumer exposure to nanomaterials by using nano consumer products are the location of the nanomaterial in the product and the matrix in which the nanomaterial is located. For a detailed description of these and other exposure characteristics, see Wijnhoven et al. (2009b). The main exposure characteristics are identified by a panel of experts and based on these exposure characteristics, nano-consumer products have been grouped as potential high, medium and low exposure (Wijnhoven et al., 2009b).

Hansen et al. (2007) have proposed a general framework for categories of all nanomaterials to aid hazard identification of these materials (based on the location of the nanomaterials in the system/ material). Nanomaterials can be grouped in three main categories:

1. Materials that are nanostructured in the bulk of the product
 - one-phase materials, a completely solid product (not a powder);
 - multi-phase materials, a solid packaging with a liquid product inside.
2. Materials that have nanostructure on the product surface:
 - one-phase materials structured on the nanoscale at the surface (the bulk is the same material as the surface);
 - nanoscale thick unpatterned films on a substrate of different material;
 - patterned films of nanoscale thickness or a surface having nanoscale dimensions.
3. As particles:
 - a- surface-bound nanomaterials;
 - b- nanoparticles suspended in liquids;
 - c- nanoparticles suspended in solids;
 - d- free airborne particles.

Of the categories of consumer products devised by Hansen et al. (2008), category 3 (As particles) is relevant. They categorised all nano consumer products in the WW database at that time (580 consumer products). On the basis of the available information, 76% of the 580 products were grouped in categories 1, 2 and 3. Only 6 % of consumer products are in category 1 and 2, and 70% of consumer products are in category 3 (As particles). Of the latter, 19% of the products contained nanomaterial in the form of nanoparticles bound to surfaces (category 3a). Nanoparticles suspended in liquids (category 3b) were used in 37% of the consumer products, and 13% used nanomaterials suspended in solids (category 3c). Of the 580 products, only about 1% are powders containing free potentially airborne nanoparticles (category 3d). Insufficient

information was available to classify 140 of the 580 products (24 %) (Hansen et al., 2008).

Grouping consumer products according to location of the nanomaterial lead to three exposure categories (Hansen et al., 2008):

1. *Expected to cause exposure*; humans come in direct contact with these products. 'Nanoparticles in liquids' (3b) and 'Airborne particles' (3d) are in this exposure category.
2. *May cause exposure*; although the nanoparticles in the products are not meant to be released, a certain amount of wear and tear must be anticipated. 'Surface bound nanoparticles' (3a) are in this category.
3. *No expected exposure to the consumer*; expected negligible exposure because the nanoparticles are encapsulated in the product. 'Nanoparticles suspended in solids' (3c) are in this category.

The Hansen framework was used as the basis for our matrix categories (see Appendix 6).

4 Methodology to identify consumer products potentially containing nanomaterials

4.1 Approach for finding products with potential nanomaterial

This chapter describes the methodology to identify consumer products containing nanomaterials, which also includes information on the probability that these products contain nanomaterials. The methodology was applied in identifying 200 consumer products for a sample database. These products are registered via the data model, which is the blueprint for the database (see also Chapter 5).

The methodology, which is intended for future use in filling the database, is limited to identifying consumer products - 'non-food products that are intended for consumers or are supplied (in the context of a professional service) to consumers' (according to The General Product Safety Directive, 2001/95/EC).

These consumer products include electronics and computers, household products, personal care products and cosmetics, automotive products, sporting goods, and textiles and shoes. The product categories and subcategories are described in Chapter 5 (data model).

The consumer products to be included in the database meet the following criteria:

- ready for use by consumers;
- claimed to contain nanomaterials (or prepared using nanotechnology) or analysed for presence of nanomaterial;
- currently on the market - available in shops in the EU Member States and available on internet provided the manufacturer is located in Europe or is a large multinational (e.g., Samsung). Non-European internet products have been excluded because relevant information is often not available on their websites.

Statement of a nano claim on consumer products is voluntary. At present, there is no legal obligation for consumer products to be labelled as containing nanomaterials. To date, no systematic effort has been made to verify manufacturer claims about nanotechnology in consumer products, and very little independent testing of the products is done. Oomen et al. (2011) has shown that consumer products are on the market with a nano claim but do not contain nanomaterials, and products are on the market that contain nanomaterials but are not labelled as such. Therefore, other approaches should be considered in identifying products that are likely to contain nanomaterials.

The sample database is the first to include information on the confidence level that a product contains nanomaterials. This information will be provided together with other information on the product and will enable users (policy maker, consumer) to weigh the relevance of the information for their purposes. The confidence level of data is a key issue in a high quality database.

The methodology to identify nano-consumer products to be included in the database consists of the following levels (see Figure 2):

- I. A screening level with low confidence data (Level of Confidence = LoC 1). Products with a nano claim without or before response of the manufacturer are given a LoC of 1.
- II. A verification level at which manufacturers can verify the screening data by providing statements on the presence of nanomaterial. This level consists of data with intermediate confidence (LoC = 2).
- III. A confirmation level with high confidence data, consisting of products for which there is analytical data and products in databases for which there is a legal obligation to report the presence of nanomaterial (LoC = 3).

Consumer products for the sample database have been identified at levels I and III.

The levels are discussed in more detail below, including work in the current project for each level. An indication is also given when evaluation of information is required. Recommendations on how to keep the database up-to-date are given in Chapter 8.

4.2 Screening level

In the screening level, products are identified as having the term nano on the product label or website, i.e. a nano claim (Section 4.2.2). In addition, the ways of identifying products expected to contain nanomaterials were explored (Section 4.2.1).

4.2.1 Expectation

As a nano claim on a product label is at present voluntary, not all products can be traced by searching for a nano claim. An alternative approach to identifying additional products with nanomaterial is via scientifically based expectations. The present methodology explores whether this approach could be applied. Products expected to contain nanomaterial can be identified from scientifically based criteria (see Appendix 3). However, these products cannot be included in the database without consent of the manufacturer, because they may not contain nanomaterial. When manufacturer consent is requested, the burden of proof is with the manufacturer. Consideration should also be given to the course of action if manufacturers do not respond. It is not legally justified to include products in the database without a response from the manufacturer who could file a complaint against this action. Finally, this way of identifying products with nanomaterials is very costly because of the amount of work involved. Thus because of possible legal issues and the amount of work involved, this approach was not included in the methodology. For information about the approach, see Appendix 3.

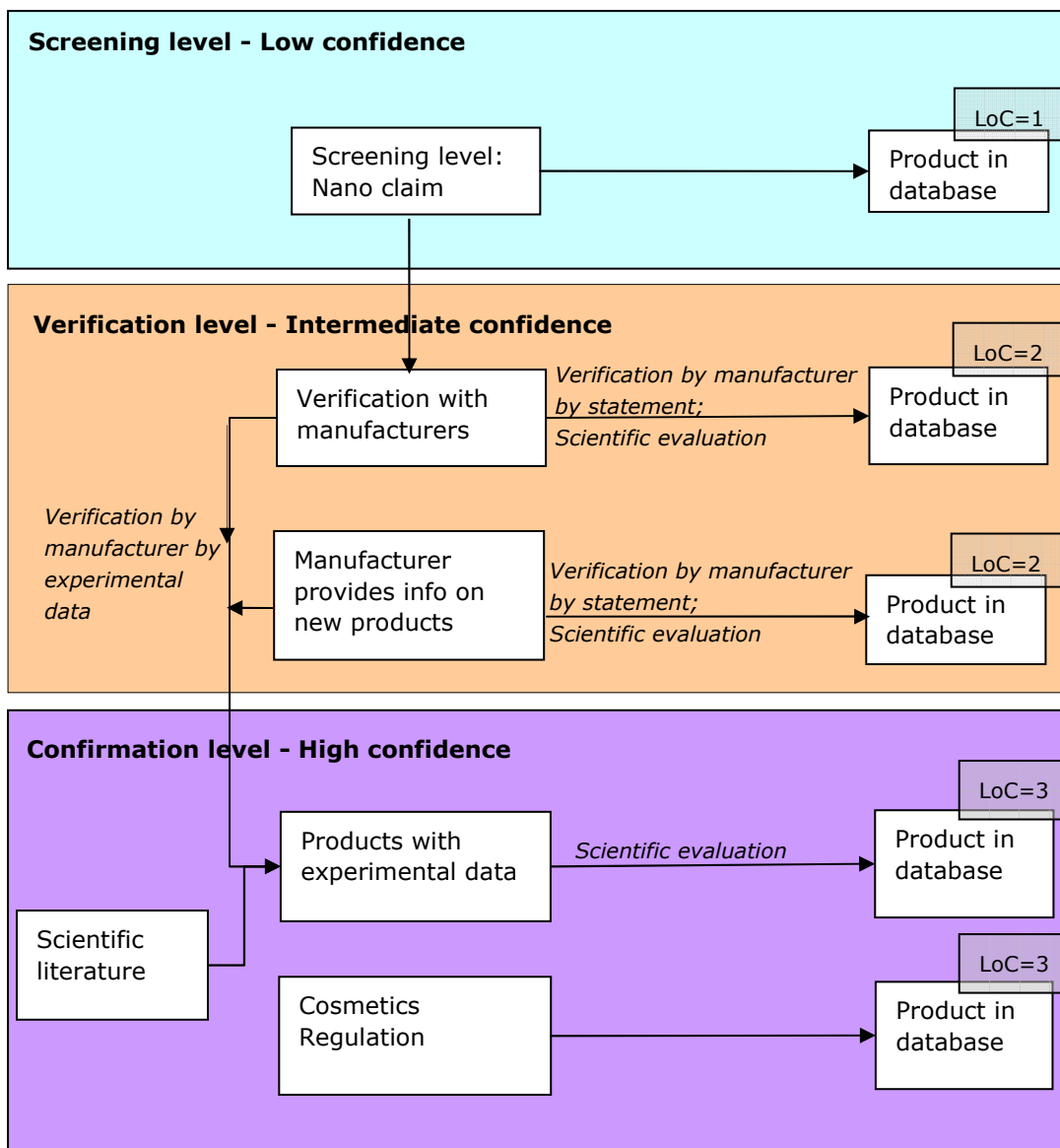


Figure 2 Ways to identify products with nanomaterials for the database, including levels of confidence (LoC 1-3)

4.2.2 Nano claim

The most direct way to identify consumer products containing nanomaterials is to search for consumer products with a nano claim on the product label or website. This method is used in compiling public inventories and databases but has the limitation that the nano claim is voluntary. The manufacturer decides to make a nano claim about a specific consumer product. There is no legal basis for the term nano, which may be used for different reasons, such as applying nanotechnology in the production process, for using nanoparticles in the product, or simply because the product is considered to be small. Thus, the data obtained via this route have low confidence (LoC = 1). Information from the manufacturer to verify the presence of nanomaterial is necessary before the product can be included at a higher confidence level (see Section 4.3).

How to identify products

Some of the products in the sample database are identified from products already listed in other databases. The current data model is the first to utilise data from other databases, and to make a link to other databases. The databases and inventories are stated in the data model as a secondary source for the product (the primary source is the product website).

Databases and inventories that can be used in this level are:

- WW database ('The Project on Emerging Nanotechnologies' <http://www.nanotechproject.org/inventories/consumer/>)
- RIVM study on 'Nano-silver' (Wijnhoven et al., 2009a);
- nVWA fact sheet on nanoparticles in consumer products (nVWA 2010, available via <http://www.vwa.nl/>);
- ANEC-BEUC 2010 inventory of consumer products containing nanomaterials (ANEC-BEUC 2010, available via www.beuc.org);
- Search on nano-consumer products in the Mintel Global New Products Database (GNPD)(from 2000-2010);
- RIVM study on 'Justification of nano claims on consumer products in the EU' (Nano claim report for DG SANCO, Wijnhoven et al., in preparation);
- RIVM study on 'Detection of nanomaterials in consumer products' (IWR report, Oomen et al., 2011);
- RIVM study on 'Nanomaterials in consumer products' (RIVM report for nVWA, Wijnhoven et al, 2010);
- online database of German Environmental NGO 'BUND'

As stated above, these databases only contain products that have a nano claim. As there is no legal basis for nano claims, there is no guarantee of the presence of nanomaterials in a product. Moreover as a nano claim is not obligatory, products containing nanomaterials but without a nano claim are not included in these databases.

In addition to the products already published in nano-specific databases and studies, new products can be searched via new internet searches. Searches can be made on specific products (categories) in the general (non-nanospecific) Mintel GNPD in combination with the term nano.

Work in the present project

The data model was designed to contain consumer products with a nano claim. A large number of products with a nano claim attributed to this screening level were used to populate the sample database (see Chapter 6). The products including product details were identified via the WW, ANEC/BEUC, and BUND databases. A reference to the database was incorporated.

In addition, an internet search revealed new products and these were incorporated in the sample database (Chapter 6).

4.3 Verification level

The aim of the second level of the database, the verification level, is to give manufacturers or distributors the opportunity to provide more information on their products. Manufacturers may pro-actively provide information on products with nanomaterial in this level. A template was developed for manufacturers to complete with the relevant information on their products (Appendix 4).

Because of this extra information, the data obtained in this way will have intermediate confidence (LoC = 2). When manufacturers supply analytical data on their product, this data is subject to scientific evaluation and lead to placing the product in the database at the confirmation level (see Section 4.4).

Manufacturers need to be convinced that providing additional information on their products is useful. Advantages to manufacturers and distributors of providing such information may be:

- For consumer acceptance, for example, transparency in informing consumers
- For acceptance by authorities, for example, transparency in informing governmental organisations - policy makers, evaluators

Work done in the present project

Twenty manufacturers were approached regarding their willingness to 1) provide information on their products, and 2) to think about cooperation of manufacturers/industry in a database for products with nanomaterials. A questionnaire was developed but the response rate was low (1 of 20). The response received was positive about sharing information. The questionnaire is presented in Appendix 4.

4.4 Confirmation level

The third level of the database, the confirmation level, consists of high confidence data (LoC = 3). At present, the only source of this high confidence level is data from analyses of consumer products. The data should provide answers to questions such as does the product contain nanomaterials, what are the characteristics of this material, and is the nano claim on the product label or website justified.

Data could be obtained on analyses of consumer products and nanomaterials in peer-reviewed scientific literature. Data provided by manufacturers will also be considered in this level. All data at this level need to be scientifically reviewed. The review should answer questions, such as have appropriate methods been applied and have the correct conclusions been drawn from the data.

Evaluation could be carried out in line with the terms defined by Klimisch et al. (1997) to assess data reliability. This evaluation should be done by a knowledgeable and independent organisation (see Chapter 8).

Other sources for products containing nanomaterials that are considered to be of high confidence are products for which the nano label is mandatory. For instance, in the Cosmetic Products Notification Portal, reliable information will be available on the presence of nanomaterials in cosmetic products but detailed information on the materials used will not.

Work in the present project

In the current project, the data model is designed to include statements of manufacturers, detailed experimental data of high confidence and information on the presence of nanomaterials from Directives. An initial incomplete literature search was performed to investigate the availability of data and the applicability of including these in the data model and database.

5 Data model and database

5.1 The need for a data model

Parallel to the development of the methodology, a data model was created in order to develop a database that contains all the relevant information on the products. A data model is an essential part of an information system that not only stores but also processes information.

The advantage of a good quality data model is that the flexibility to extend the database with other items, without altering the structure of the database, is known beforehand. Inherently, it also makes clear for which items the database can be less easily changed in the future.

The importance of this issue is often heavily underestimated. We regard the development of a data model as a very important building block of a database that should facilitate future enhancement, extension and maintenance.

From a sound data model a database is relatively easily built and populated. It also serves as the basis for web templates for users to retrieve information from the database.

In the model, the information is laid down in units (entities) and relations between the different units are indicated. Entities contain information about the real world, in this case the 'world' of products, nanomaterials, shapes, substances etcetera. The main goal of a data model is to specify the structure and properties of data in an accurate and unambiguous way. From the data model, a multi-searchable database can be created; using this database, the user should be able to find answers to various types of questions with respect to the contents of the database.

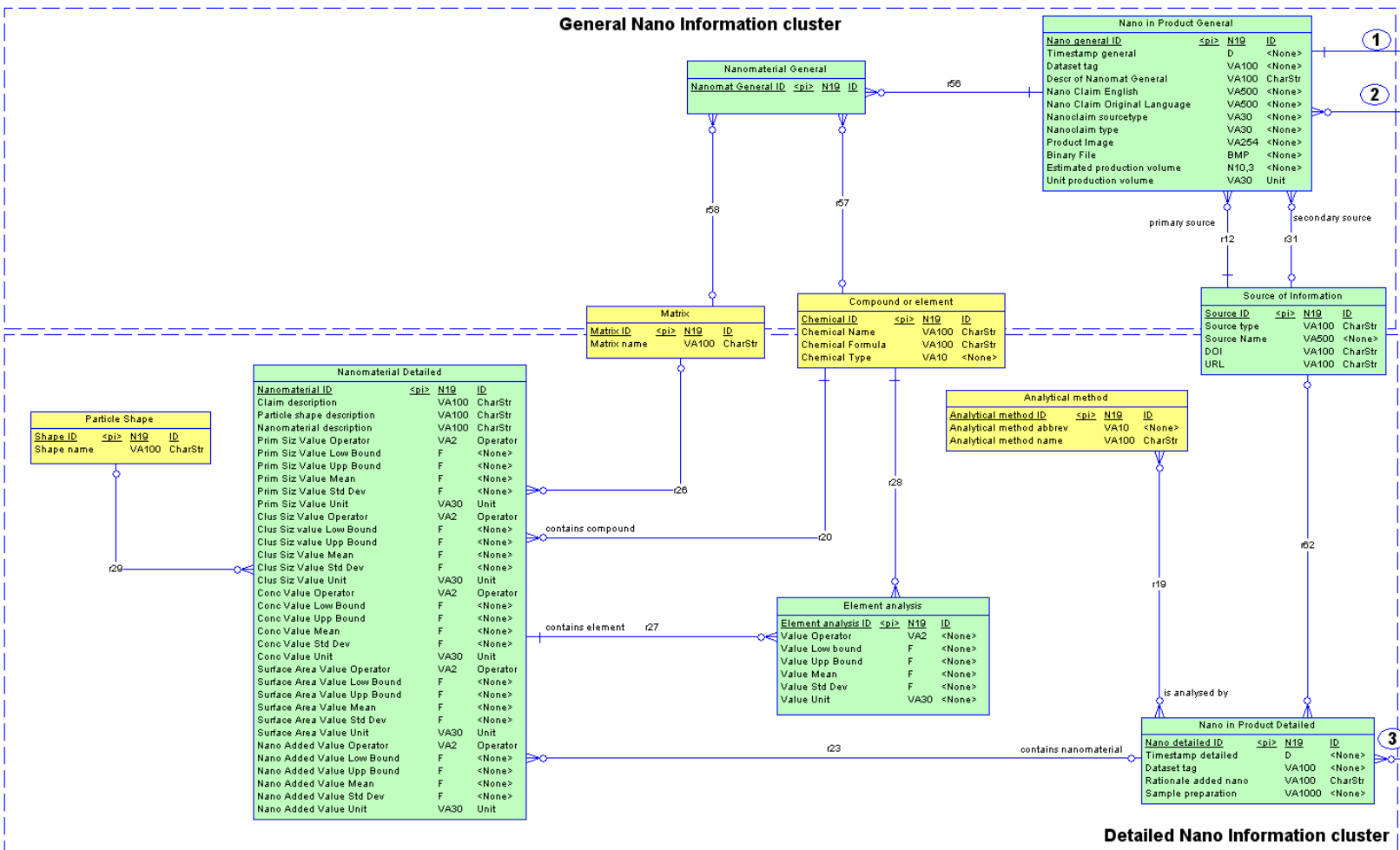
The central entity selected for the present data model is the entity 'Product', in which the term 'Product' stands for a consumer product that (potentially) contains nanomaterials. Consequently, the questions addressed by the database are focused on these products, similar as presented in Chapter 2. Answers generated by the database are for example a list of products from a specific category, or a list of countries where products containing nanomaterials are produced. Nevertheless, the database can also answer very specific questions; for example it can select all products containing nanogold which are manufactured in Poland.

Furthermore, the data model is a means to facilitate communication about the information and data within and between teams that play a role during the different stages of developing an information system. For instance, knowledge collected by a team of domain experts and information analysts can be transferred to a software development team by handing over a data model. The data model specifies the most stable aspect of an information system, i.e. its inherent structure (how are various parts of the content linked to each other).

5.2 Description of the current data model

A schematic overview of the data model developed in the current project is given in Figure 3 on the next pages. This data model is the result of various intensive discussions, mainly between experts in data modelling, experts in the field of potential human health risks of nanomaterials, experts in consumer products and consumer exposure and database experts.

General Nano Information cluster



Detailed Nano Information cluster

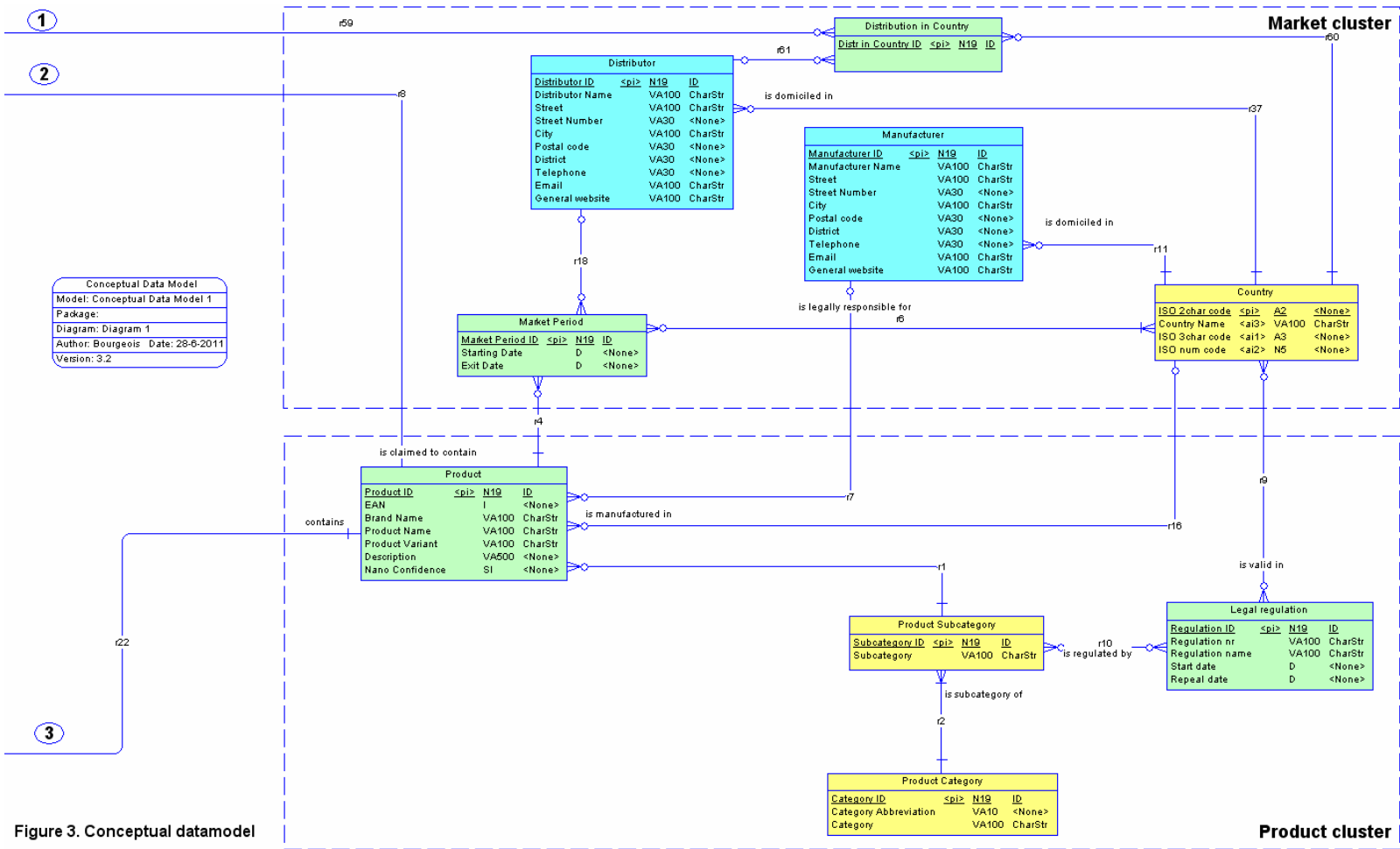


Figure 3. Conceptual datamodel

5.2.1 Clusters

The present data model can be roughly divided into four clusters indicated by rectangles with dotted lines in Figure 3. Below these clusters are described and examples of questions to be answered by a specific cluster are given.

- *Product cluster*; provides information on the consumer product potentially containing nanomaterials, which is the point of departure of the data model. From this cluster, information can be obtained from the Category and Subcategory in which the product can be categorized as well as the Legal aspects that are linked to the consumer product (category).

Data in this cluster provide answers to questions on the different product (sub-)categories; i.e. which consumer product (sub-)categories contain a substantial number of products containing nanomaterial?

- *Market cluster*; provides information on the manufacturing and distribution chain of the consumer product. Also information on the time period the product is or has been on the market can be obtained from this cluster.

Questions on the countries of manufacturing as well as countries of distribution of the product can be answered with the information present in this cluster. Also questions on the time of presence of the product on the market or the withdrawal of the product from the market may be answered with this cluster (if the information is available).

- *General nano information cluster*; provides information on the specific compound present in the product, the matrix in which the nanomaterial is located (categorised according to Hansen et al. 2008, see Section 3.2.3) and the source of the product information (website, database, catalogue).

This cluster answers general questions on the nanomaterial in the consumer product: Which material is present and where in the product is the material located?

- *Detailed nano information cluster*; provides more detailed information on the nanomaterial in the product. This information is only available when analytical measurements are carried out and when this information has been made public.

If the information is available, this cluster contains important detailed information on the nanomaterial in the products. The size distribution and shape of the nanomaterial as well as the analytical method can be obtained from the data in this cluster.

Furthermore, different colours have been used in Figure 3. These colours represent different types of entities like Base entities (yellow), Situational entities (blue) and Core entities (green). More details on the different types of entities are provided in Appendix 5.

5.2.2 Links between entities

All information of the abovementioned clusters (the so-called attributes or fields; the former term is used for the data model, the latter for the database itself) is

stored in the entities. In the entity 'Product' properties are registered which on the one hand identify the product, and on the other hand are useful to the users of the database. The entity 'Product' contains the following attributes: the product identifier, the European Article Number (EAN), the brand name, the product name, the product variant, the product description and the level of confidence that the product actually contains nanomaterial. Detailed information on attributes of all entities can be found in Appendix 6.

Examples of entities that are directly linked to the entity 'Product' in the *Product cluster* are 'Product Category', 'Product sub category' and 'Legal regulation'.

Furthermore, the entities of the other clusters are (see also Figure 3):

Market cluster: 'Manufacturer', 'Distributor', 'Market period', 'Country' and 'Distribution in country';

General nano information cluster: 'Nano in product general', 'Nanomaterial General', 'Matrix', 'Compound or element', 'Source of information'

Detailed nano information cluster: 'Nano in product detailed', 'Nanomaterial detailed', 'Analytical method', 'Element analysis', 'Particle shape', 'Matrix', 'Compound or element', 'Source of information'.

There is some overlap between a few entities of the two latter clusters (see Figure 3).

5.3 Critical issues with respect to current data model

5.3.1 Product ID and EAN

A requirement for the database is that products have to be identified uniquely. The European Article Number (EAN) is used in the current data model. Although the EAN code can often be used to identify the product, there are situations in which the identification is not unique (see Section 3.2.2). Therefore, additional to the EAN a simple serial number is used as a product identifier in the current database. This serial number is for database internal use only (it is neither visible nor relevant for the external users of the database).

The matter of identifying a product is not merely a technical issue. The owner of the database must decide whether a product found during a market research is a product already existing in the database, or is a new product. There should be some protocol to guide this decision. The following guidelines are proposed:

A product is identified to be a new product on the market when:

- The manufacturer is altered (and therefore the EAN code as well), even when the brand and product name stay the same.
- The brand and/or product name changes.
- The composition / ingredient list alters. Note that it is not known how the information on a change in composition becomes available.

These guidelines on product identification should be kept in mind when considering the output of the database. This is especially true for questions about the number of products that are entering or disappear from the market.

5.3.2 Nano confidence

The attribute *Nano confidence* in the entity 'Product' is the level of confidence (LoC) that the consumer product actually contains nanomaterial. This level of confidence is divided in a scale of low (LoC=1), intermediate (LoC=2) and high

confidence (LoC=3). Each product is assigned a level of confidence; its value depending on the source of information (see Figure 2, Chapter 4).

The *Nano confidence* is registered once for each product. If the level of confidence changes in time, the new level replaces the old one.

5.3.3 Product category and product subcategories

With respect to the entities 'Product categories' and 'Product sub categories', the following categorisation of consumer products is proposed (see Table 2). This categorisation is based on the WW database and has been described earlier in RIVM inventories of Dekkers et al (2007) and Wijnhoven et al (2010) with some slight modifications. The major change in the current product categorisation is within the WW category 'Health and Fitness'. In the current project, the subcategories 'Cosmetics', 'Clothing' and 'Personal care' were removed from the 'Health' category and placed in two separate main categories 'Personal Care and Cosmetics' and 'Textile and Shoes' (see Table 2). Furthermore, the main categories 'Miscellaneous' and 'Cross Cutting' were removed from the list. Instead, the sub category 'Coating' was added to the main categories 'Home', 'Motor vehicles' and 'Textiles and Shoes'.

These categories are included as a drop down list in the database.

Table 2 List of product categories as applied in the current database

Product category	Product subcategory
Appliances	<ul style="list-style-type: none"> Appli-Large appliances (refrigerators) Appli-Laundry and clothing care (washing machines) Appli-Air Filtration and purification Appli-Air Conditioning Appli-Air/water Sanitizers/Neutralisers Appli-Batteries
Electronics & computers	<ul style="list-style-type: none"> Electr-Audio Electr-Cameras and film Electr-Computer hardware Electr-Displays Electr-Mobile devices and communications Electr-Television Electr-Video Electr-Memory Electr-Personal care Electr-Ink and paper
Home furnishing & household products	<ul style="list-style-type: none"> Home-Cleaning products Home-Cooking utensils (cutting board) Home-Furnishing (pillows, etc.) Home-Luxury (jewellery, etc.) Home-Construction materials Home-Paint Home-Coating
Motor vehicles	<ul style="list-style-type: none"> Motor-Exterior (paint, tiers) Motor-Maintenance and accessories (air purification) Motor-Coating/cleaning Motor-Catalytic converters

	Motor-Interior
	Motor-Other (fuel, oil)
Packages (incl. for food)	
	Pack-Food packaging
	Pack-Sensors in food packages
Personal care products & cosmetics	
	Care-Sun cosmetics
	Care-Baby care products
	Care-Hair care (shampoo, gel, hair dyes, etc.)
	Care-Skin care (shower gel, creams, deodorant, foot care, shaving soap, etc)
	Care-Oral hygiene (toothpaste, mouth wash)
	Care-Make-up and nail care (lipstick, eye shadow, etc.)
	Care-Over the counter health products
Health	
	Health-Wound dressing
	Health-Hearing aids
	Health-Other health products
Sporting goods	
	Sport-Rackets, bats, golf clubs, etc.
	Sport-Balls
	Sport-Other (wetsuit, fishing lure, horse shoes)
Textile and shoes (incl. clothes & upholstery)	
	Textile-Clothing (incl. prof clothing)
	Textile-Other textiles (sheets, etc.)
	Textile-Coating
Toys & games	
	Toy-Cuddly toys
	Toy-Games

5.3.4 *Level of detail*

At the lower level of confidence (screening level) the information on nanomaterials will not be very detailed. Information on the presence of nanomaterial at this level will originate from the (packaging of the) product itself, from (web) catalogues of products, or from publicly accessible databases fed by the aforementioned sources. It mostly consists of textual information about the nano claim and/or the nanomaterial. The entity 'Nano in Product General' is provided for this screening level. It is foreseen however that at this level also information may be provided about the matrix and the chemical compounds. Therefore there is a connection to the entities 'Nanomaterial General', 'Matrix' and 'Compound or element'.

Information for the higher levels of confidence (verification level and confirmation level) is more detailed than at the screening level. It may come directly from the manufacturers themselves or from third parties. It consists of information about analytical methods, compounds and elements, concentration of nanomaterial, matrix in which the nanomaterial is contained, shape and size of the particles etcetera. Apart from this detailed fields, free textual fields are also present at this level, because beforehand it is unclear whether the information can always be expressed in a predefined structured way. The entities 'Nano in Product Detailed', 'Nanomaterial detailed', and 'Element Analysis' are provided for these higher levels.

5.3.5 *Timestamp and Dataset Tag*

One property of the current database is of special importance and must be taken into account from the beginning when setting up the model: The requirement that the database must not only show the situation on the market at a specific moment of time, but also the changes on the market during a period of time. This means that, when a new market search is performed, the collected information must be added to the database, as well as information on the actual moment of the finding, via a so-called timestamp.

The 'Timestamp' attributes within different entities thus describe the time that the market research is performed, rather than the time the information was entered into the database.

A market search may take some time and so different dates may be entered in the timestamp fields for different products. It may be convenient to mark these entries in the database as belonging to the same market search. For this the attribute 'Dataset Tag' may be used.

The above requirement results in a distinction between the entity 'Product' on the one hand and the entities 'Nano in Product General' and 'Nano in Product Detailed' on the other hand. The entity 'Product' is the "stable" entity in the sense that for a specific product there is only one occurrence of 'Product', during the full lifetime of the product on the market. So, although a new market research is performed, the information in Product stays the same. The only thing that may change is the level of confidence (in that case the old value is overwritten by the new value)

The entities 'Nano in Product General' and 'Nano in Product Detailed' are extended with each new market search, i.e. a record is added each time a market research is performed and the specific product is found to be present on the market. Both entities are marked with a timestamp attribute.

To compare the information on one or more products between different time points, the user may select the information he/she is interested in (e.g. the information on the compound present) at the different market searches. This can be done by selecting this information together with the relevant timestamps (e.g. March 2011 and August 2012) or the dataset tags (e.g. Dataset Tag 1 and Dataset Tag 2) from the database using a dynamic website (see also Section 7.1) or software that creates queries for the database. For example it may be that in the first market search detailed information on the compound was not available but it appeared to be titanium oxide in the second one.

The sample database has only one time point, and thus information on time trends cannot be obtained.

5.3.6 *Legal regulations*

Some products containing nanomaterials are already known to be specifically regulated (e.g. cosmetic products). In the future more regulations may come into force. It was decided desirable to be able to retrieve the regulated products from the database. Rather than to record this information with each individual product, it is expected that storing this at the level of Product Subcategories would be appropriate.

In the current version of the data model 'Legal Regulation' may be stored, identified by a Regulation Number and a Regulation Name. Also the dates that the regulation comes into force (Start Date) and the date the regulation is repealed (Repeal Date) may be stored.

A Legal Regulation may be valid in one or more countries and may regulate one or more Product Subcategories.

5.4 Creation of sample database

To come from the developed data model to a physical database, the data model was edited and stored with a software modelling tool. When the definitive data model of the sample database was established, it was transformed to an empty database. From this database, a data entry and edit application was built. A scheme that clarifies this process is given in Appendix 7.

6 Population of the sample database

This chapter contains the approach for the population of the created database. For the population, approximately 200 consumer products have been selected which were available in a number of key sectors representative for the total market of consumer products claimed to contain nanomaterial. First, the selection of products is described, followed by a description of the sources in which the products were found. Difficulties encountered during the population process are reported as well as answers to the questions on the extent of consumer products potentially containing nanomaterials.

6.1 Selection of consumer products for inclusion in sample database

For the selection of consumer products to be included in the sample database a list of consumer products potentially containing nanomaterial was made using the WW, the ANEC/BEUC, Mintel and the BUND databases. In this list a wide range of variables are covered; different product (sub) categories, different sources, and different product manufacturers. In order to do this, the number of products per product category was estimated, based on the product information described in the recent RIVM inventory of Wijnhoven et al (2010, see for more details the text below). The aim was 1) to have all different product categories represented in the population list and 2) in the same ratio as the number of products found in the recent inventory. Table 3 describes the number of products theoretically needed for a representative population of the sample database.

Within these categories, the aim was to have as much different subcategories, sources and manufacturers as possible. The final list of product names in the sample database is described in Section 6.4 (and Appendix 8). In that section, an example-overview is given of the extent of nanomaterials used in consumer products on the EU market based on the products in the sample database. It needs to be stressed here that the uptake of products in the sample database is not related to any priority list with respect to confidence of nanomaterial being present in the product or any potential health risk of using the product.

Table 3 Number of products per product category for a representative population of the sample database

Product category	Number of products in Wijnhoven et al (2010)	% of total	Number of products aimed to include in sample database	Actual number of products in sample database
Appliances	25	3	6	7
Electronics & computers	16	2	4	2
Home furnishing & household products	188	21	49	49
Motor vehicles	118	13	32	43 (+11)
Packages	2	0	1	0
Personal care products & cosmetics	317	35	69	58 (-11)
Health	15	2	4	9 (+5)
Sporting goods	49	5	10	6 (-4)
Textile & shoes	95	11	22	26
Toys & games	2	0	1	0
Cross cutting*	59	8		
Micellaneous**	9	1		

* Since this product category has disappeared in the current sample database (see Section 5.3.4) these products are categorised in the categories "Motor vehicles" and "Home furnishing and household products"

** Since this product category has disappeared in the current sample database (see Section 5.3.4) these products are categorised in various other categories

6.2 Sources of nanomaterial containing consumer products used for population

6.2.1 Existing nanomaterial containing consumer products databases

The main source of consumer products claimed to contain nanomaterials are the existing product databases available via internet (WW, ANEC/BEUC and Mintel). Recently, a RIVM inventory has been published in which these databases have been analysed (Wijnhoven et al., 2010), with the aim to gain more insight in the European market for consumer products with a claim to contain nanomaterials or that are produced by nanotechnology. Within this analysis, a former RIVM product inventory of 2007 (Dekkers et al., 2007) with consumer products containing a nano claim has been updated in two different steps.

First, the consumer products with a nano claim identified in the 2007 inventory were reanalysed. Of the 143 products previously identified, 53 products with a nano claim had disappeared from the market, while 90 products were still present. In a second step, different sources were used to identify new nanomaterial containing products on the European market between 2007 and 2010. This resulted in a total of 715 new consumer products with a nano claim that had been introduced on the market between 2007 and 2010. The overlap between the different sources was low: Less than 10% of the products were

found in more than one source, indicating that the method of the various databases for identifying products was rather different. Most of the new products were found within the category of 'Personal care products and cosmetics' (n=304). The two other main categories were 'Home furnishing and household products' (n=108) and 'Motor vehicles' (n=103). Furthermore, there had been a very large increase in coating products for different purposes between 2007 and 2010.

In total, 858 consumer products with a nano claim were identified by Wijnhoven et al. to be present on the European market, representing a six-fold increase of the market between 2007 and 2010. From this report we selected approximately 100 products for the population of the current sample database.

In the current project, the recent update of the WW database (d.d. March 10th 2011, <http://www.nanotechproject.org/inventories/consumer/>) was analysed for additional products on the European market based on the same criteria as mentioned in the above mentioned RIVM report. In total 280 new European products have been added to the WW website. A small number of products were used for the population of the sample database.

In addition to the databases mentioned in the RIVM report, the product database of BUND (see Section 3.1.1) was used in the current project for the population of the database.

6.2.2 *Products found via internet searches and scientific literature*

A small number of products for population were obtained via internet searches and scientific literature.

The internet searches have been performed via the websites of manufacturers that have already introduced consumer products with nanomaterials on the market. For instance when a consumer product carrying a nano claim has been identified in an existing database, this product has been verified on the manufacturer's website. This website has subsequently been searched for additional products containing a nano claim resulting in new products for the population process.

In the past years, also some experimental data on nanomaterials in (consumer) products have been published in peer-reviewed scientific journals. For instance, Lorenz et al. (2010) analyzed engineered nanoparticles in four commercially available consumer sprays, one anti-perspirant, two shoe impregnation sprays, and one plant-strengthening agent. For population of the sample database, this anti-perspirant and one of the shoe impregnation sprays have been selected.

6.3 Challenges during population process

As mentioned in Section 6.1, a list of products was made out of existing databases for inclusion in the sample database. During the population process it appeared difficult to collect the representative numbers of products for all product categories (see also Table 3). In practice, products were hard to recover on the internet after a period of time because in a lot of cases products' web pages do not longer exist. The actual number of products per product category in the sample database is described in the right column of Table 3.

One important explanation for the poor recovery could be that a substantial number of consumer products in the categories 'Personal care and cosmetics'

and 'Textile and shoes' lost their nano claim in Europe in the past few months. Some of the products however retained their claim in the United States (meaning that the claim is still available on the website of the WW database, but not on the website of the manufacturer in Europe). These products were not included in the sample database.

6.4 Extent of consumer products potentially containing nanomaterials

Clear insight into the extent of nanomaterials used in consumer products on the EU market can only be derived from the database when the database is more accurately filled with nanomaterial containing consumer products available in the different Member States in the future. However, already on the basis of this sample database containing only 200 products, indicative answers to some of the relevant questions for various stakeholders as identified in Section 2.2.1 can be given. For practicality, a couple of these questions have been slightly adapted ('how many products' instead of 'which' products). The answers to these questions are described below.

Again, one should bear in mind that these absolute numbers of products only give an impression, since the products in the sample database are only a subset of the products that are currently on the market.

Question 1. Which products with potentially nanomaterial are available on the European market?

The complete list of 200 products in the sample database is given in Appendix 8.

Question 2. How many products with a nano claim are available?

All 200 products in the sample database have a nano claim.

Question 3. How many products with a specific nanomaterial (silver, silica, titanium etc) are available?

The products in the database contain the following specific nanomaterials (numbers in brackets are the numbers of products):

Calcium (1)	Polyquaternium 61 (1)
Calcium peroxide (2)	Silicium (4)
Carbon (1)	Silicium oxide (1)
Copper (1)	Silver (44)
Diamond (1)	Titanium (9)
Fullerenes (30)	Titanium oxide (1)
Gold (2)	Triceramide (1)
Iridium (1)	Zinc (1)
Magnesium (1)	Unknown (123).
Platinum (1)	

Question 4. How many products contain nanomaterial in a specific matrix?

The specific matrices in which the nanomaterial is located in products are:

Nanoparticles suspended in solids (16)
 Nanoparticles suspended in liquids (7)
 Nanoparticles in cream/ emulsion/ paint (5)

Surface-bound nanomaterials (1)
Unknown (171)

- Question 5. How many products are present in a specific category?*
The number of products per product category is presented in Table 3.
- Question 6. For which products is analytical information available?*
For 3 products, analytic information is available, namely the antiperspirant and shoe impregnation spray obtained from Lorenz et al. (2010) and the 'Crystal colloidal silver (and others)'.
- Question 7. For which products is information from the manufacturer available?*
'Crystal colloidal silver (and others).'

7 From database to website

One of the operational objectives of this project is to compile a set of static HTML pages presenting the contents of a sample database of ca. 200 consumer products. This chapter explains the character of a static website in contrast to a dynamic website and clarifies the process that was carried out to design and generate the set of static web pages from the contents of the sample database.

7.1 Static versus dynamic

A static website consists of a set of web pages connected to each other through static links. When the user clicks on a link the server sends a new page to the user's browser. During this process the web server does not in any way interact with a database; it only finds the requested page in a collection of pages that were generated beforehand.

A dynamic website on the other hand does interact with a database at runtime. Typically such a dynamic website contains pages with some sort of selection mechanism using menu structures, drop-down lists or search fields. With the user-provided selection criteria the web server searches the database, generates pages at runtime and sends them back to the web browser.

In this project static HTML pages were requested as output of the database. However, the desired use of the database requires the application of all kind of cross-sectional queries which are not fully supported by static HTML. For example, selections like 'all products in the inventory containing nanosilver', or 'all sunscreens with nanomaterial' cannot be answered by the static mechanism. However in this sample phase we agree that a tool for static HTML output from the database, which is well searchable by means of Google and enabling updates when required, will be satisfactory.

Furthermore, the storage of the information in a structured database (i.e. based on a data model) ensures the possibility to develop a dynamic website at a later stage. In the recommendations (see Chapter 8), special attention will be paid to this issue. Especially if more data will be stored, the desirability of using a dynamic access may become more apparent.

7.2 Structure of static website

The main purpose of the website is to present information about consumer products that may contain nanomaterial to the user of the website. Because the product is the point of departure of the database, it is obvious that 'Product' is the central point for the website. Eventually the user should see all the information about a product on a 'product page'.

There are several ways to arrive at such a product page. The website starts with a homepage that shows seven selectable items:

- [Categories and Subcategories](#)
- [Matrices](#)
- [Compounds](#)
- [Particle Shapes](#)
- [Manufacturers](#)
- [Countries of Manufacturing](#)
- [All Product Names](#)

Selecting one of the first six of these items will provide a list of the 'values' of this item. For instance when [Compounds](#) is selected, the list of compounds is shown:

- [Magnesium](#) Mg (element)
- [Platinum](#) Pt (element)
- [Polyquaternium-61](#) (compound)
- [Silicium oxide](#) SiO₂ (compound)
- [Silicon](#) Si (element)
- [Silver](#) Ag (element)
- [Titanium](#) Ti (element)

etcetera.

Selecting one of the compounds from this list, e.g. [Silver](#), will give a page with a list of products containing silver as a nanomaterial:

- Crystal [colloidaal zilver](#) food supplement
- FAN Frankenstolz Schlafkomfort [FAN Nanofill Steppbett](#)
- JR Nanotech [SoleFreshT nanosilver socks Colour Black](#) 80% Cotton, 20% Elastic yarn
- Malwa Foot Care [Protectice Foot and Toe Nail Cream](#)
- Medima [Medima Silverline Damen Hemd 1/4 arm](#)
- Medima [Medima Silverline Damen Hose lang](#)

Finally, selecting one of the products will give all the product information on the product page.

As a second example, [Countries of Manufacturing](#) can be selected from the home page, resulting in a list of countries:

- [Austria](#) (codes: AT, AUT, 40)
- [Denmark](#) (codes: DK, DNK, 208)
- [France](#) (codes: FR, FRA, 250)
- [Germany](#) (codes: DE, DEU, 276)
- [Gibraltar](#) (codes: GI, GIB, 292)
- [Israel](#) (codes: IL, ISR, 376)

By selecting a country, for example [Germany](#), a page with a list of products manufactured in Germany will be given:

- Cenano [Antibakterielles Schuhdeo mit Silber Ionen](#)
- Cenano [Nanofix Sanitärreiniger](#)
- Cenano [Nanotol](#)
- Continental [ContiSportContact 5 P](#)
- De Scheller Cosmetics [Day Cream Anti- Wrinkle](#)
- Deichmann [Nano Wet Blocker](#)

Again, by selecting one product, the 'product page' with all the information becomes visible.

It is also possible to go directly to a product via the list of all products in the sample database by selecting the seventh item on the home page:

- [All Product Names](#)

The structure of the static website is schematically described in Figure 4.

Technically the static pages were generated from the database using the FreeMarker preprocessor (FMPP) open source software.

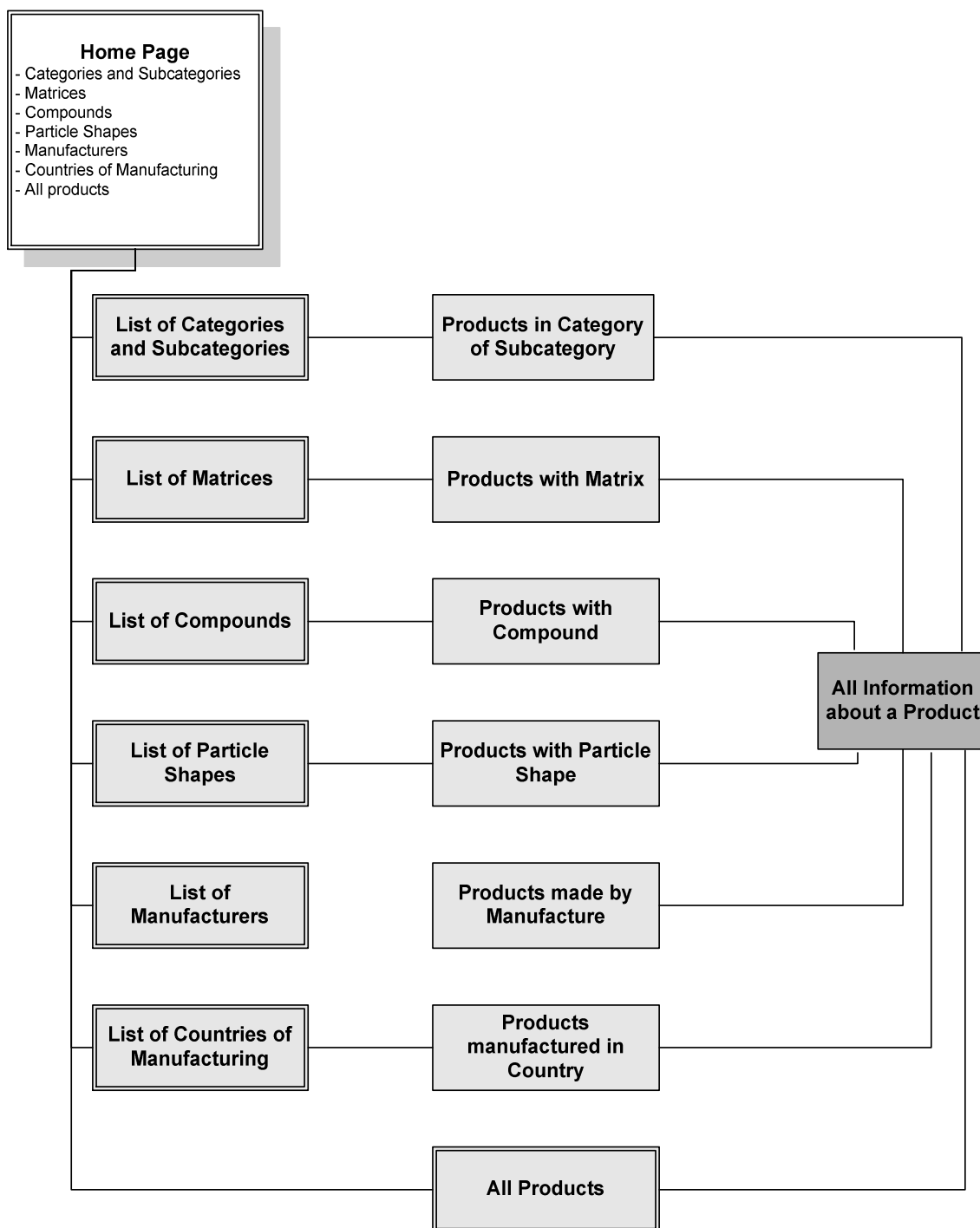


Figure 4 Structure of the website

8 Considerations in setting up a database

The project delivered a sample database including the underlying methodology and example static HTML pages as output. In setting up this sample database, various factors had to be addressed:

- Issues regarding the database. Who are the stakeholders? Which questions are to be answered? And who will have access to the information? The set-up and information included in the database has to be adjusted to the questions to be answered (see Section 8.1).
- Issues regarding ownership of the website and database (see Section 8.1).
- Issues regarding acquisition of data on products containing nanomaterials (see Section 8.2).
- How can a measure of confidence be ascribed to the information obtained (see Chapter 4 for proposals), which is important to assure high quality of the database content.
- General issues to be addressed in completing the sample database and keeping it up-to-date (see Section 8.3).
- Organisational issues for completion of the sample database and in keeping it up-to-date (see Section 8.4).
- Practical implementation issues (see Section 8.5)

A number of these issues are addressed in this chapter.

8.1 Determination of position and conditions of database

In the present project, attention focused on the essentials for setting up a database to give insight into consumer products containing nanomaterials available in the EU. The sample database is a 'proof of principle' of the proposed methodology and helps to gain understanding of issues in implementing the methodology. When the sample database is converted to its final form, the following issues need to be addressed:

Determination of the position and conditions of the database

- What type of information should the database provide and who are the stakeholders. Who should have access to the database, for instance, policy makers only, consumers, and specific organisations. To what extent should, for instance, product details be anonymous. The set-up and information included in the database should be adjusted accordingly.
- What approach should be taken to obtain information on products containing nanomaterials, for instance, using legal means or on a basis of trust (see Section 8.2).

Before finalising the database, matters such as ownership of data, database and website need to be decided, as well as who should host the website and the stakeholders responsible for updating the content. These decisions are related to whether the database is to be a central database for Europe or whether a network of national databases based on the same data model (see Section 8.4).

8.2 Acquiring information on products with nanomaterials

In the last few years, voluntary schemes for reporting on the presence of nanomaterials in consumer products have not been adequate in gaining insight into this issue. This is because either products were not reported or the presence or absence of a nano claim was not correct in some cases (Oomen et al., 2011). Thus, recommendations for optimising the quality and extent of data have been included in the methodology. These recommendations are restricted to the present status of EU regulations.

To obtain a high level of confidence that products contain nanomaterials, products can be acquired based on legally binding directives or regulations, in which manufacturers can be required to state nanomaterials on the product label. For instance, this is a requirement under the Cosmetics Regulation (Cosmetic Products Notification Portal).

In addition, manufacturers and producers could be stimulated to provide information voluntarily. This depends on trust between stakeholders and requires clear understanding by stakeholders on the use and application of the database. This is essential for dialogue where there are conflicting interests. For example, manufacturers and producers may be reluctant to cooperate if information on specific products is made public, whereas policy makers want transparency for consumers. Interactive discussion between stakeholders would help to build shared interests and goals.

8.3 Towards a comprehensive database

When the position and conditions for the database are established, two tasks are foreseen in converting the sample database into a comprehensive database: 1) the sample has to be extended to a complete database (Section 8.3.1); and 2) the database needs to be updated regularly (Section 8.3.2). An overview of the tasks is given in Table 4.

8.3.1 Complete database

Consideration needs to be given to the following aspects in order to convert the sample database into a complete database after the present project:

- The sample database needs to be expanded with more data and all relevant products should be imported into the database using the methodology presented in the current report.
- The presentation of the data should be improved, for instance, a common language - English - should be used. In the sample database, product claims are in the language of the Member State in which it is produced or distributed. In addition, it should be decided whether all information in the database including the static HTML pages should be made available, and thus translated into the languages of the other 26 EU Member States.

- Consideration needs to be given to the type of output. The static HTML pages as developed for the sample database limit full use of the complete database. One of the credentials of applying a data model is the freedom of different queries one can make. Static web pages are pre-selected lists such as list of all products, manufacturers, compounds and thus different queries cannot be made. A more dynamic and interactive website should be developed to fully utilise the potential of the data model and database (see also Section 7.1). This would enable users to select the information they need from the database without going through lists. For example, 'select all products with nanosilver produced in Spain' would result in a tailor-made list of products. A user friendly way to gain access to information is the use of drop-down menus from which the relevant entities and attributes can be selected.

8.3.2 *Regular update of complete database*

After completion of the database, regular updates will be required. Updates are foreseen every 6 to 12 months because products with a nano claim change rapidly (Wijnhoven et al., in preparation). New products and new information on existing products will need to be searched for and evaluated at each level of confidence.

Before updating the database, the criteria used to select products (see Section 4.1) should be evaluated and adapted where necessary. For example, the present requirement for products available via the internet is that the manufacturer is located in Europe or is a large multinational. This approach may be adapted when non-European web shops give better information about products on their websites. The selection criteria may also need to be adjusted if a definition of nanomaterials is established or if the definition changes.

Screening level

The first task at the screening level is to search for new databases and new information sources, such as product catalogues.

In addition, at this level new products with nano claims and new information on existing products with a nano claim will need to be searched in existing databases, such as the Woodrow-Wilson, the Mintel GNPD, the ANEC-BEUC and any other database with information on nanomaterials in consumer products (such as the Cosmetic Products Notification Portal, see Section 3.1.2).

Arrangements will need to be made with the owners of these databases for regular searches, as well as with consumer organisations at national and European level. These organisations may mobilise their members to identify new products with a nano claim.

The claim texts of the newly found products should be translated into English or other EU languages when required.

Table 4 Tasks to complete and regularly update the database

Tasks	Confidence level	Subtasks
Complete sample database (once)	All levels	Complete products in database Better presentation of information
Regular update of completed database (every 6 to 12 months)	All levels	Evaluation of selection criteria
	Screening level; General	Search for new sources of information
	Screening level; Nano claim	Search new products and new information on existing products
	Verification level	Evaluate information from manufacturers
	Confirmation level	Evaluate information from manufacturers and from scientific literature Import information from Directives

Verification level

At the verification level, manufacturers/distributors will be given the opportunity to provide additional information on the presence of nanomaterials in their products preferably in their own language. The information should be supplied by completing a template available via the database website. Consideration should be given to whether the manufacturer's statement should be signed by the company's quality assurance manager.

Confirmation level

To update the database with information on the confirmation level, i.e. with analytical data, a search of the scientific literature has to be done every 6 to 12 months. A second source of information may be manufacturer's experimental data on their products. All analytical data need to be reviewed scientifically to determine whether appropriate methods have been used and whether the correct conclusions have drawn from the data. Criteria on data reliability proposed by Klimisch et al. (1997) could be applicable for the evaluation. The data validation should be done by a knowledgeable and independent organisation.

In addition to analytical data, databases containing high confidence data may be available in the near future as future Directives that legally require manufacturers to state nanomaterials on the product label comes into force (for

instance, Cosmetic Products Notification Portal, see Section 3.1.2). Although this information will probably not include experimental data, confidence in the presence of nanomaterial in the products is expected to be high. It will, however, depend on whether the nano label is mandatory (for instance, the quantity and definition of nanomaterials) and on the extent to which the Directive is enforced. When in force, these Directives should be evaluated to assess the level of confidence in the data.

It may be possible to regularly synchronise with these databases. Some of the updated information on products that fall under legislation may be found at the screening level (via the nano claim). In this case, the product will have the highest confidence level - Confirmation level (LoC 3).

8.4 Organisational issues

This section considers issues on the organisation of a comprehensive database of products containing nanomaterials. The more practical issues in implementation are stated in Section 8.5.

8.4.1 Complete database

Completing the database with relevant products and improving the presentation as described in Section 8.3 can be done by a commercial agency or research institute with experience in databases and nanomaterial-containing products. Translation issues can be handled by a language institute, and IT aspects by an experienced commercial agency or research institute.

It would be preferable if the database is expanded and managed by a 'Central Organisation' in charge of the work (Figure 5). This is preferably the party that expands the database with more products, as this group is experienced with the subject.

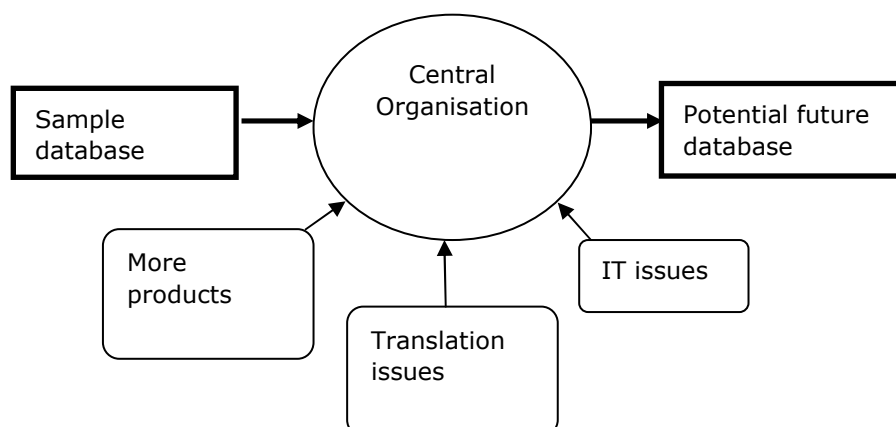


Figure 5: Transition from sample to comprehensive database

8.4.2 *Regular updates of the database*

Regular updates of the database (see Table 4) can be divided into two parts - search for new information and scientific evaluation of information - and carried out by two groups. Activities and responsibilities of each group are set out in Figure 6 and worked out detailed below.

New information may be collected from existing databases (including databases based on Directives), consumer organisations, Food Safety Authorities, catalogues and other sources. The group needs to search for:

1. New sources
2. New products with a nano claim
3. New information on products from manufacturers/producers
4. New products in databases based on legal directives.

This group needs to be knowledgeable about the use of databases, but does not necessarily need to have scientific expertise in nanomaterials. The group does not necessarily have to work at one location. It may be more practical for each Member State to have a representative - Information Contact Point - responsible for identifying products in their Member State. The country representatives could be coordinated by the central organisation. Products identified are uploaded by the national Information Contact Points into a network of national databases built with the same data model. This network is coordinated by the central organisation.

The group responsible for scientific evaluation should independently evaluate:

1. Selection criteria for products (in combination with the definition of nanomaterials used);
2. Data delivered by the manufacturer (call for verification);
3. Data from the scientific literature.

These tasks require scientific knowledge of nanomaterials and can be carried out by Scientific Contact Points. To ensure scientific excellence and independence, these scientific contact points should be selected by means of an application procedure for a limited period of time; and declarations of interest requested and regularly updated.

The evaluations can be done as desk evaluations and the group could meet regularly. These evaluations can be based, for example, on criteria in line with the terms defined by Klimisch et al. (1997) for assessment of data reliability. Assessing data quality is a key issue for a reliable database. The evaluations should be systematically published and may be included in the database. The work of this group should be coordinated by the central organisation.

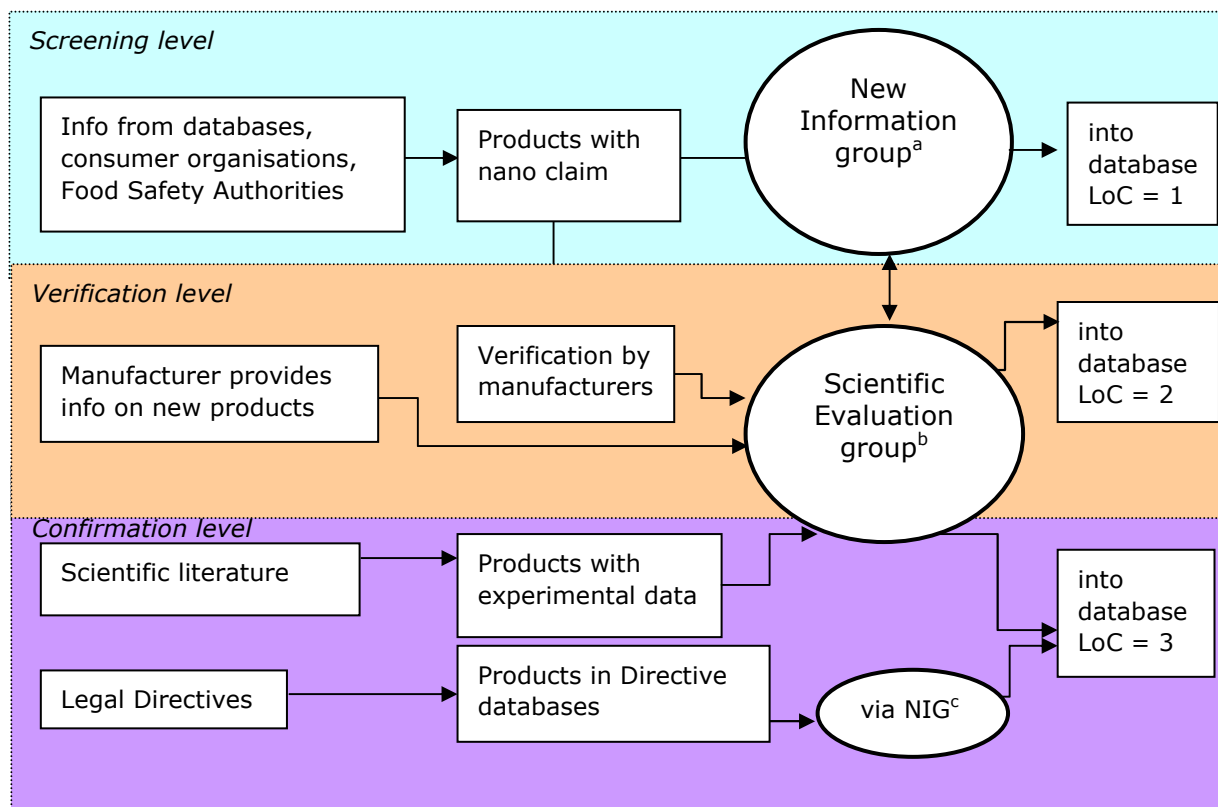


Figure 6 Information flow in a regular update of the database

a: The new information group searches new sources to collect information on 1) products with nano claims, and 2) products with additional information of manufacturers/producers and 3) products falling under legal Directives.

b: The scientific evaluation group evaluates and adapts the selection criteria for products and the expectation criteria.

c: NIG = New Information group

8.5 Practical implementation issues

Language

Since the database will contain products from different EU Member States, product information, for instance the nano claim, may only be available in the national language. As stakeholders in other Member States may want access to this information, it is recommended that all information in the future database is available in English. However, there is also a need for information in national languages. Thus, it would seem more practical if all information in the database is presented in English and in the language of product's country of origin. The English translation could be coordinated by the central organisation.

Exposure and risk

The present database and methodology has no link to exposure and risks of nanomaterials in consumer products because at present very little information is available on exposure and/or risks. Moreover, the little information that is presently available has not been gathered in this project. Information on exposure and risk not being present in the sample database may imply that questions of one group of stakeholders – consumers- cannot be satisfactorily

answered, as this group is predominantly interested in the possible risks of exposure to nanomaterials.

In the future, more information on potential health risks might become available and may be obtained by combining information in the database with other sources, such as Nanohub. For this purpose, entries on Nanomaterial (General and Detailed), Matrix and Compound or Element have been included in the database.

Furthermore, the data in the sample database describe the nanomaterial present in the product. It may be defended however, that the material present during the use of the product should also be described in the database. For instance, the material in a spray may be different from the material in the air when the spray can is used and where exposure may occur. The data model may be adapted to store information on exposure and risk. It may be useful to assign a level of 'expected exposure' (1: expected to cause exposure; 2: may cause exposure; 3: not expected to cause exposure), similar to Hansen et al. (2008). See Section 3.2.3. It will not be possible to provide detailed information because exposure and thus risk in case exposure leads to a risk depends on how the product is used.

Flexibility of data model

One of the advantages of a data model is flexibility. When understanding of products with nanomaterials increases, it may be necessary to expand the data model with more attributes or entities. For example, the data model is set up so that additional categories of (non-consumer) products can be included, such as Food, Environment and other sectors mentioned in the ObservatoryNano project (see Table A8, Appendix 2; <http://www.observatory-nano.eu/project/>).

However, as the present data model is set up, any changes to its basic structure, such as splitting entities into new entities, will be relatively time-consuming.

The data model developed may not be suitable for complex 'detailed' information on nanomaterials. At present, information on nanomaterials in products is limited, and can be entered into the database under entities General Nanomaterial and Detailed Nanomaterial. However, when more detailed information is available, data entry will be more complicated. For example, in Lorenz et al. (2010), more than one type of particle - namely round and long particles - are present, with the long particles having more than one particle size distribution. At present, this type of information can only be stored in the free text field of the entity Detailed Nanomaterial. The design of the data model will need to be adapted to accommodate this information.

Reliability

Since data were imported into the sample database from other databases, the reliability of the information at confidence level 1 cannot be higher than that of its sources and is therefore relatively low. For example, as stated in Section 4.1, there are consumer products with a nano claim that do not contain nanomaterials, and products containing nanomaterials but not stated as such. At the higher levels of confidence, the information has been checked and can therefore be considered reliable.

In addition, it should be noted that products may be entered into the database based on different definitions by different sources. This issue should be solved when the EU has a definition for nanomaterials.

Ensuring data quality is also critical to the reliability of the potential future database. For this reason, the establishment of a scientific evaluation group is recommended (Figure 6). The group should be responsible for data checking for confidence levels 2 and 3 and the new information group responsible for information at the lower confidence level.

For transparency, a distinction should be made between information provided by the manufacturer and by scientific evaluation. Even in spite of the efforts of the scientific evaluation group, the database may contain an error that leads to judicial dispute. For this reason, the database needs a disclaimer.

Claim texts imported into the database are taken from the product label or website and do not necessarily reflect the opinion of the authors of the present report. At present, products are included in the sample database for monitoring purpose only. This does not indicate that the product is a hazard or risk. In the future, the database could include the first step for an exposure assessment for consumers.

Application for data entry and editing

The completion of the sample database with additional products and an improved presentation has been explained in Section 8.3. In addition, it is recommended that the user interface for the data entry be improved (for data entry and edit application, see Section 5.4). For instance, a function could be introduced to facilitate product searches. In addition, it would be helpful for users to be able to sort products in alphabetical order.

Traceability

Currently, an important issue in Europe is the traceability of products. In the event of an incident with a group of consumer products containing nanomaterials, the database could be used to identify products and to trace the manufacturer or distributor. However, even with a comprehensive database, it is not likely that the information stored is specific enough for this purpose. It should be investigated whether in combination with other information sources, such as data streams within REACH, product traceability could be enhanced from (groups of) products to nanomaterial to manufacturer and bulk material, and back to other products in which the bulk material is applied.

Widespread nanomaterials

Nanomaterials may be widespread in one or more product categories, similar to, for example, the presence of nanosilica in salt in food products. For instance, if all products in a specific category contain nanomaterials, the number of products in the database for this category will be multiplied. This may be undesirable, as it blurs the overview of products containing nanomaterials with a large number of products in this category.

There are several options to deal with this:

- 1) Include all products, even though this hampers the overview because the information is relevant and should be included in the database.

- 2) Adapt the selection criteria for products so that these products are not included in the database.
- 3) Group these products according to manufacturer and include the groups in the database, rather than each product individually (as, for example, in the Woodrow Wilson database for different products or product lines from a company, see Section 3.1.1).

Option 1 is recommended for the present database.

9 General considerations

This chapter presents some considerations relevant to the success of a database with consumer products containing nanomaterials.

This project provides a sound basis for an up-to-date and searchable database on nanomaterials in consumer products. A blueprint was made for a data model by combining information on nanomaterials, consumer products, analytical methods and data, and information technology. In addition, recommendations are made on how to update the sample database and on practical implementation issues. However, a considerable effort is required to make a comprehensive and up-to-date database that is multi-searchable and user-friendly.

In the present project, nanomaterials refer to engineered materials with one or more dimensions smaller than 100 nm. However, as nanomaterials consist of a distribution of sizes, a clear definition is required. To aid the adoption of a definition in Europe, the Scientific Committee for Emerging and Newly Identified Health Risks (SCENIHR) has published an opinion on the scientific basis for a definition of the term "nanomaterial" (http://ec.europa.eu/health/scientific_committees/emerging/docs/scenihr_o_032.pdf). However, discussions on the nanomaterial definition are still ongoing. The definition is needed to distinguish between products with and without nanomaterial.

A final consideration is the availability of information and data on nanomaterials in consumer products. To that end, industry needs to play an active role because only industry can provide reliable information on the presence and application of nanomaterials for the whole spectrum of products.

In the present setting, a database containing only products with a voluntary nano claim is of limited use, as products with such a claim may not contain nanomaterial, and products without such a claim may contain nanomaterial (Oomen et al., 2011). In order to get a database with more products with nanomaterials and more information, i.e. not only based on products with a voluntary nano claim, there are two potential options. Firstly, manufacturers can be required to label a product as 'nano' if it contains nanomaterials under, for example, a legally binding Directive. Secondly, manufacturers can be stimulated to provide information on a voluntary basis. To be successful, a basis for trust has to be established with manufacturers. Although some effort will be required, manufacturers may well be willing to cooperate when presented with convincing arguments such as consumer acceptance and a requirement for marketing their products.

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Glossary

Agglomerate: A group of particles held together by weak forces, such as van der Waals forces, some electrostatic forces and/or surface tension. It should be noted that an agglomerate will normally retain a high surface to volume ratio (SCENIHR 2007a).

Aggregate: A group of particles held together by strong forces such as those associated with covalent or metallic bonds. It should be noted that an aggregate may retain a high surface to volume ratio (SCENIHR 2007a).

Attributes: Information in the data model that is structured per subject in tables (entities).

Bulk material: In the context of nanomaterials, the term bulk material is in common use to describe the same material in other, more conventional, physical forms (SCENIHR 2007a).

Consumer product: a non-food product intended for consumers or supplied (in the context of a professional service) to consumers (The General Product Safety Directive, 2001/95/EC).

Database: A database is an organised collection of data for one or more purposes, usually in digital form (Wikipedia).

Data model: A data model is a model of how the data are structured and stored in a database.

EAN code: European article numbering, the most widely-used supply-chain standards system to give the products an individual standard, machine readable, bar code.

Engineered nanomaterial (ENM): Rationally designed, manufactured nanomaterial (ISO 2010).

Entity: In a data model an entity is some unit of data that can be classified and have stated relationships to other entities. When a data model is transformed to a database an entity may become a database table.

Level of confidence (LoC): the level of trust that the nanomaterial is really present in the consumer product

Manufactured nanomaterial: Nanomaterial intentionally produced to have specific properties or composition (ISO 2010).

Nano claim: the claim on a products label or website that a product contains nanomaterial or is produced using nanotechnology.

Nanomaterial: Material with any external dimension in the nanoscale or having internal or surface structure in the nanoscale (ISO 2010).

Nanoparticle: A discrete entity which has three dimensions of the order of 100 nm or less (SCENIHR 2007a).

Nanotechnology: The application of scientific knowledge to control and utilise matter in the nanoscale, where properties and phenomena related to size or structure can emerge (ISO 2010).

Product database: an organised collection of data on (nano) consumer products in digital form usually published on a website

Product inventory: a list of (nano) consumer products compiled for some formal purpose and presented in a database

Timestamp: A sequence of characters, denoting the date and/or time at which a certain event occurred.

Appendix 1. Consumer product categories as described in different product databases

Table A1 Product categorisation of the ANEC/BEUC inventory

Category	Sub-Category
Appliances	Kitchen Appliances Laundry/ Clothing Care
Automotive	Maintenance & Accessories
Cross Cutting	Coatings Others
Electronic & Computers	<i>No subcategory</i>
Food & Beverage	Supplements Others
Goods for Children	<i>No subcategory</i>
Health & Fitness	Clothing Personal Care Sporting Goods
Home and Garden	Cleaning Construction Materials Others

Table A2 Product categorisation of BUND database

Category	Subcategory
Auto	Autopflege (<i>car maintenance</i>)
<i>Automotive</i>	Fahrzeugbestandteile (<i>car components</i>)
Electronic und Computer	Computer Hardware
<i>Electronics and Computers</i>	Electronische Zubehören und Pflegemittel für Elektronik (<i>equipment and maintenance</i>)
	Mobiltelefone (<i>mobile phones</i>)
Freizeit	Reisutensilien, Tassen und Koffer
<i>Leisure</i>	(<i>travelequipment, bags and luggage</i>)
	Sonstige (<i>other</i>)
	Sportgeräte und Zubehör (<i>sports equipment and accessories</i>)
Gesundheit	Sonstige (<i>other</i>)
<i>Health</i>	
Haus und Garten, Tiere	Baumaterialien (<i>construction materials</i>)
<i>Home,Garden, and (domestic)</i>	Farben und Lacke (<i>paint</i>)
<i>Animals</i>	Gärtnern und Landwirtschaft
	Haustierzubehör und-plege (<i>pets equipment and maintenance</i>)
	Möbel (<i>Furniture</i>)
	Wasch-, Reinigungs- und Pflegemittel (<i>Cleaning and coating products</i>)
Haushaltsgeräte	Grosse Küchengeräte (Large kitchen appliances)
<i>Appliances</i>	Heizung, Kühlung, Lüftung (<i>Heating, Cooling and Air</i>)
	Kleingeräte (<i>small appliances</i>)
	Kochutensilien (<i>cooking utensils</i>)
	Sonstige (<i>other</i>)
Körperpflege	Kosmetika (<i>cosmetics</i>)
<i>Personal Care</i>	Körperpflegeartikel (<i>personal care products</i>)
Lebensmittel und Getränke	Kochutensilien (<i>cooking utensils</i>)
<i>Foods and Beverage</i>	Lebensmittelaufbewahrung (<i>food package</i>)
	Nahrungsergänzungsmittel (<i>food supplements</i>)
	Zusatzstoffe und Verarbeitungshilfe
Medizinische Anwendungen	Medizin produkte (<i>medical products</i>)
<i>Medical Use</i>	
Produkte für Kinder	Spielzeug (<i>toys</i>)
<i>Goods for Children</i>	
Sonstig	Beschichtungen und Pflegemittel für mehrere Anwendungsbereiche (<i>coating for multiple purposes</i>)
<i>Other</i>	
Textilien und Schuhe	Bekleidung und Wäsche (<i>upholstery</i>)
<i>Textile and Shoes</i>	Textiel- und Schupflege (<i>Textile and shoe maintenance/ coating</i>)

Table A3 Product categorisation of Mintel GNPD (non-nano-specific)

Category	Sub-Category
Air care	Candles Non-powered air fresheners Powered air fresheners/ deodorants
Cleaning Equipment	Shoe Care Sponges, Mops, Dusters & Dry Cloths
Cosmetics	Body Colour cosmetics Eye Colour Cosmetics - Eye Brow Eye Colour Cosmetics - Eye Lash Eye Colour Cosmetics - Eye Liner Eye Colour Cosmetics - Eye Shadow Eye Colour Cosmetics - Blush Face Colour Cosmetics - Bronzer Face Colour Cosmetics - Concealer Face Colour Cosmetics - Foundations / Fluid Illuminators Face Colour Cosmetics - Powder Face Colour Cosmetics - Primer Lip Colour Cosmetics - Lip Colour Lip Colour Cosmetics - Lip Liner Multi-Use Nail Colour Cosmetics
Deodorants	Deodorants
Diapers and Feminine hygiene	Diapers Feminine Hygiene Products Incontinence Products Pads Tampons Wipes
Dishwashing	Automatic Dishwasher care Diswashing hand Rinse Aid
Fabric Care	Automatic Detergents Bleach/ fabric brighteners Conditioners & Softeners Fabric fresheners/ moth repellents Hand detergents/ shampoos Ioning aids Stain/ spot removal Upholstery/ carpet Washing machine/ ion care
Fragrances	Men's Fragrances Unisex fragrances Women's fragrances
Hair care	Conditioner Hair colorants Hair styling Hair treatments Shampoo
Hard Surface Care	All-Purpose/Multi-Purpose Surface Care Bath, shower and tile care Bleach/ disinfectant Drain care Floor Care Furniture care Glass Care Household Appliance Care Kitchen care Metal Cleaners

Healthcare	Allergy relief Anti-fungal Anti-septic treatments Contraception & Sexual Health Decongestive, cough, cold and flu relief Digestive and detoxifying treatments Eye, ear and mouth care Pain relief Personal insect treatments/ repellents Plasters and bandages Skin Conditions Sleep aids Smoking cessation Stimulants Test kits Vitamins & Dietary Supplements Other healthcare
Home storage	Bags and containers Disposable plates and cups Wraps and foils
Oral Hygiene	Dental ancillaries Mouthwash Toothbrushes Toothpaste
Paper products	Facial tissue Kitchen and multi-purpose paper Toilet tissue (dry and wet)
Pest control	Dust mites Insect killers/ repellents Rodenticides
Pet products	
Shaving & Depilatories	Shaving razors Shaving Preparations Depilatory products
Skincare	Body Care Eye Care Eye - cleansers Face/Neck Care Foot Care Hand/Nail Care Lip Care Nail enamel removers Sets Sun - After Sun Sun - Sun/Sunbed Exposure Sun - self tanning
Soap & Bath Products	Bath additives Bar Soap Liquid soap Shower products
Toilet care	Toilet (bowl) cleaners Toilet (bowl) fresheners

Appendix 2. Consumer product categories as described in other relevant sources

Table A4. Product categorisation as described in TGD

Category of Product/ general characterisation	Subcategories
<p>CLEANER / POLISH The category covers all products that are used in the household for cleaning, polishing and care. Some subcategories can be defined by different use characteristics. A comprehensive overview on household cleaners and its subcategories has been published by the IKW (IKW,2001)</p>	<ul style="list-style-type: none"> • Cleaning of machines and vehicles (e.g. cars, bikes, motorbikes) • General household (All Purpose Cleaners) • Dish washing, manual • Dish washing, machine • Sanitary cleaners • Textile cleaners e.g. Powder Laundry Detergents, Laundry Liquid Detergents • Oven cleaners • Shoe and leather cleaner • Furniture cleaners • Drain cleaners • Metal cleaners
<p>ADHESIVE / SEALANT The category covers all products that are used in the household as adhesives or sealants. Some subcategories can be defined by different use characteristics (The list of subcategories of adhesives has been prepared by the WHO/IPCS).</p>	<ul style="list-style-type: none"> • General purpose adhesive • Floor covering adhesives • Dental plate cement • Fabric adhesive • Film cement, photographic • Leather adhesive • Metal adhesive • Paper adhesive • Plastic adhesive • Rubber adhesive • Wallboard joint cement • Wallpaper adhesive • Wood adhesive • Dye • Ink • Etching fluid • Correction fluid • Crayon • Pen marker • Toner
<p>PRINTING / WRITING MATERIAL The category covers all products that are used in the household for writing and printing. Some subcategories can be defined by different use characteristics: (The list of subcategories of adhesives has been prepared by the WHO/IPCS).</p>	<ul style="list-style-type: none"> • Solvent based paint • Water based paint • Resin based paints • Aerosol paints • Paints for special purposes • Industrial paints • Varnish • Bleaching paints • Paints for conservation • Thinner • Paint remover • Gasoline • Fuel oil • Liquid lamp oils and grill lighters • Solid grill lighters • Solid lighteners, other • Bleaches • Sterilizers
<p>PAINTING MATERIAL AND ADDITIVES The category covers all products that are painted to an area for renewing, or to protect the areas against wetness or corrosion etc. Some subcategories can be defined by different use characteristics. The classification of subcategories has been prepared according to Baumann & Muth (1997) and Bremmer and van Veen (2000a).</p>	
<p>FUELS This category covers products that are used for feed machines (cars, motorbikes) or lamps or to lighten fires.</p>	
<p>BLEACH / DISINFECTANT / STERILIZER The category covers all products that are used in the household as a bleach or for sterilization. Some subcategories can be defined by different use characteristics.</p>	
<p>REMOVERS The category covers all products that are used in the household to remove substances, from surfaces and thus cleaning them. Some subcategories can be defined by different use characteristics.</p>	<ul style="list-style-type: none"> • Adhesive/glue remover • Dye/ink remover • Seal remover • Polish remover • Limescale remover/descaler • Oil/grease remover • Rust remover

PHOTOGRAPHIC CHEMICAL

The category covers all products in the household that are referred to photography. Some subcategories can be defined by different use characteristics:

TEXTILE CHEMICAL

The category covers all products that are exposure related to the use of textiles. Some subcategories can be defined by different use characteristics.

VEHICLE MAINTENANCE

The category covers all products that are used in the household to make vehicles (cars, bikes, motorbikes, caravans, boats etc.) ready for use. Cleaning is covered by the category "cleaner/polish". Some subcategories can be defined by different use characteristics:

COSMETIC / PERSONAL HYGIENE PRODUCT

The category covers all products that are used in the household to clean and care the body in particular e.g. hair and skin. Some subcategories can be defined by different use characteristics. Categories of cosmetics are extensively described by the compilation of cosmetic frame formulations (COLIPA, 2000). For composition of cosmetic products and for further use levels see also Section 4.

CONTAMINATION OF FOOD

The category covers exposures that can be referred to the consumption of food. In particular, it is referred to contaminations of food and is subcategorized to the different kinds of food. Most of the data referring to this type of exposure are available from food surveillance studies (e.g. BGVV, 1995).

AIR CONTAMINANT / POLLUTANT

The category covers all exposures that are referred to the emission of chemicals from materials in the household except textiles.

TOY / JOKE / CHILDREN'S PLAYTHING

(Bremmer and van Veen, 2001)

OTHER CATEGORIES NOT MENTIONED OTHERWISE

- Stain remover
- Wall paper remover
- Photographic chemicals
- Photographic paper

- Textile colours/dyes
- Emission from textiles
- Residues from cleaning textiles
- Fabric softeners
- Fire protecting agents in textiles

- Lubricants
- Repairing material
- Antifreeze (vehicle)
- Screen wash
- Brake fluid
- Fuel additive
- Radiator fluid
- Transmission fluid

- Rinse off products (e.g. Hand Dishwashing Liquids)
- Non-rinse products
- Spraying
- Products that can contact mucous membranes

Categories of food consumption should be taken according to the EFG food grouping system (EFCOSUM, 2001).

- Contamination of food by processing and packaging material

- Furniture chemicals
- Building chemicals
- Emissions from vehicles (e.g. cars)

- Refrigerant, coolant
- Solvent
- Water softener
- Aerosol propellant
- Aquarium product
- Art/craft material
- Deodorizer/air freshener
- Sports product
- Swimming pool product
- Waterproofing compound
- Agricultural products other than pesticides
- Medical devices
- Piercings

Table A5. ECETOC-TRA list of chemical product categories as described in REACH Guidance on Information Requirements and Chemical Safety Assessment

Chemical Product Category (PC)		
Category for describing market sectors (at supply level) regarding all uses (workers and consumers)	Examples and explanations	
PC1	Adhesives, sealants	
PC2	Adsorbents	
PC3	Air care products	
PC4	Anti-Freeze and de-icing products	
PC7	Base metals and alloys	
PC8	Biocidal products (e.g. Disinfectants, pest control)	PC 35 should be assigned to disinfectants being used as a component in a cleaning product
PC9a	Coatings and paints, thinners, paint removers	
PC9b	Fillers, putties, plasters, modelling clay	
PC9c	Finger paints	
PC11	Explosives	
PC12	Fertilizers	
PC13	Fuels	
PC14	Metal surface treatment products, including gal-vanic and electroplating products	This covers substances permanently binding with the metal surface
PC15	Non-metal-surface treatment products	Like for example treatment of walls before paint-ing.
PC16	Heat transfer fluids	
PC17	Hydraulic fluids	
PC18	Ink and toners	
PC19	Intermediate	
PC20	Products such as ph-regulators, flocculants, pre-cipitants, neutralization agents	This category covers processing aids used in the chemical industry
PC21	Laboratory chemicals	
PC23	Leather tanning, dye, finishing, impregnation and care products	
PC24	Lubricants, greases, release products	
PC25	Metal working fluids	
PC26	Paper and board dye, finishing and impregnation products: including bleaches and other processing aids	
PC27	Plant protection products	
PC28	Perfumes, fragrances	
PC29	Pharmaceuticals	
PC30	Photo-chemicals	
PC31	Polishes and wax blends	
PC32	Polymer preparations and compounds	
PC33	Semiconductors	
PC34	Textile dyes, finishing and impregnating products; including bleaches and other processing aids	

Table A6. ECETOC-TRA list of Consumer Products as described in REACH Guidance on Information Requirements and Chemical Safety Assessment

Product preparation category	Product (preparation)- subcategory
PC1: Adhesives, sealants	Glues hobby use
	Glues DIY use
	Glue from spray
	Sealants
PC3. Air care products	Air care, instant action
	Air care, continuous action
PC9a. Coatings, paints, thinners, removers	Waterborne latex wall paint
	Solvent rich, high solid water borne wall paint
	Aerosol spray can
	Removers
PC9b. Fillers, putties, plasters, modeling clay	Fillers and putty
	Plasters and floor equalizers
	Modelling clay
PC9c. Finger paints	Finger paints
PC12. Fertilizers	Lawn and garde preparations
PC13. Fuels	Liquids
PC24. Lubricants, greases, release products	Liquids
	Pastes
	Sprays
PC31. Polishes and wax blends	Polishes, wax/cream
	Polishes, spray
PC 35. washing and cleaning products	Laundry and dish washing products
	Cleaners, liquids
	Cleaners, triggers sprays

Table A7 Fragment of categorisation PRODCOM list from Eurostat

13961620	Textile hosepiping and similar textile tubing, whether or not impregnated or coated, with or without lining, armour or accessories of other materials
13961650	Textile wicks, conveyor belts or belting (including reinforced with metal or other material)
13961680	Textile fabrics and felts, for paper-making machines or similar machines (including for pulp or asbestos-cement)
13961730	Narrow woven fabrics other than labels, badges and other similar articles
13961750	Labels, badges and similar articles in textile materials (excluding embroidered)
13961770	Braids in the piece; tassels and pompons, ornamental trimmings (excluding knitted or crocheted)
13991130	Tulles and other net fabrics (excluding woven, knitted or crocheted)
13991150	Machine-made lace in the piece, in strips or in motifs
13991170	Hand-made lace in the piece, in strips or in motifs
13991230	Embroidery (without visible ground) in the piece, in strips or in motifs
13991250	Cotton embroidery in the piece, in strips or in motifs
13991270	Embroidery of textiles in the piece, in strips or in motifs (excluding without visible ground, cotton)
13991300	Felt, whether or not impregnated, coated, covered or laminated, n.e.c.
13991400	Textile flock and dust and mill neps
13991500	Gimped yarn and gimped strip and the like, of man-made textile materials of an apparent width ≤ 5 mm; chenille yarn; loop wale-yarn
13991600	Quilted textile products in the piece (excluding embroidery)
13991900	Powder-puffs and pads for the application of cosmetics or toilet preparations
14111000	Articles of apparel of leather or of composition leather (including coats and overcoats) (excluding clothing accessories, headgear, footwear)
14121120	Men's or boys' ensembles, of cotton or man-made fibres, for industrial and occupational wear
14121130	Men's or boys' jackets and blazers, of cotton or man-made fibres, for industrial and occupational wear
14121240	Men's or boys' trousers and breeches, of cotton or man-made fibres, for industrial or occupational wear
14121250	Men's or boys' bib and brace overalls, of cotton or man-made fibres, for industrial or occupational wear
14122120	Women's or girls' ensembles, of cotton or man-made fibres, for industrial or occupational wear
14122130	Women's or girls' jackets and blazers, of cotton or man-made fibres, for industrial or occupational wear
14122240	Women's or girls' trousers and breeches, of cotton or man-made fibres, for industrial or occupational wear
14122250	Women's or girls' bib and brace overalls, of cotton or man-made fibres, for industrial or occupational wear
14123013	Men's or boys' other garments, of cotton or man-made fibres, for industrial or occupational wear
14123023	Women's or girls' other garments, of cotton or man-made fibres, for industrial or occupational wear
14131110	Men's or boys' overcoats, car-coats, capes, cloaks and similar articles, of knitted or crocheted textiles (excluding jackets and blazers, anoraks, wind-cheaters and wind-jackets)
14131120	Men's or boys' anoraks, ski-jackets, wind-cheaters, wind-jackets and similar articles, of knitted or crocheted textiles (excluding jackets and blazers)
14131230	Men's or boys' jackets and blazers, of knitted or crocheted textiles
14131260	Men's or boys' suits and ensembles, of knitted or crocheted textiles

Table A8. Categorisation of the technical sectors in the ObservatoryNano project

Sector	Subsector
Aerospace, automotive and transport	<ol style="list-style-type: none"> 1. Technologies to produce bulk nanostructured metals 2. Technologies to produce nanocomposites 3. Technologies to produce and apply tribiological nano-coatings
Agrifood	<ol style="list-style-type: none"> 1. Agricultural production 2. Food processing and functional food 3. Food packaging and distribution
Chemistry and materials	<ol style="list-style-type: none"> 1. Carbon based nanomaterials 2. Nanocomposites 3. Nanostructured metals and alloys 4. Nano-polymers 5. Nano-ceramics 6. Nano-fabrication technologies
Construction	<ol style="list-style-type: none"> 1. Cement-based materials 2. Coatings 3. Living comfort and Building safety 4. Sustainability and Environment 5. Civil- and underground construction
Energy	<ol style="list-style-type: none"> 1. Photovoltaic 2. Thermoelectricity 3. Fossil fuel 4. Energy harvesting 5. Nuclear 6. Renewable energy 7. Fuel cells 8. Hydrogen production and storage 9. Batteries and supercapacitors
Environment	<ol style="list-style-type: none"> 1. Air purification 2. Wastewater purification 3. Drinking water treatment 4. Groundwater remediation 5. Soil remediation
Health, medicine and nanobio	<ol style="list-style-type: none"> 1. Cosmetics 2. Diagnostics 3. Novel bionanostructures 4. Implants, surgery and coatings 5. Therapeutics 6. Regenerative medicine
Information and Communication	<ol style="list-style-type: none"> 1. Integrated circuits 2. Memory 3. Displays 4. Manufacturing 5. Photonics 6. Beyond CMOS
Security	<ol style="list-style-type: none"> 1. Anti-counterfeiting, authentication, and positioning 2. Incident support 3. Detection of chemical, biological, radiological, nuclear, explosives, weapons and narcotics 4. Protection
Textiles	<ol style="list-style-type: none"> 1. Nanostructures 2. Fibre production 3. Finishing treatments 4. Textile products

Appendix 3. An approach to find nano consumer products based on expectation

This appendix describes an approach to find products based on the expectation that they contain nanomaterials. This approach is not included in the present methodology for reasons that are described in Section 4.2.

Products which are expected to contain nanomaterials could be identified based on specific reasons. In order to avoid incorrect information, the products with an expectation should not be included in the database before the presence of nanomaterials is confirmed by the manufacturers. Manufacturers could be asked for a statement on the presence of nanomaterials in their products, or provide experimental data. In addition, the information provided by the manufacturers should be evaluated to be scientifically valid before inclusion in the database. The level of confidence of these data could depend on the type of information provided by the manufacturer, e.g. statement versus experimental information.

How to obtain products

Examples of criteria that could be used to identify consumer products which are expected to contain nanomaterials are listed below. These criteria are based on literature and experience (e.g. Oomen et al, 2011).

- Silver in combination with antibacterial properties (with the exception of the products that claim to use silver ions) in for instance cosmetics, textiles
- Sun screen, lip balm or facial cream with high sun protection factor (>30) in combination with mineral UV filters (TiO₂, ZnO) on the label
- Temperature sensor or sensor for spoiled food in food packaging
- Claim for stronger material for sporting goods
- Claim for making textiles more resistant against stains, water and making them more breathable
- Claims for making glass more resistant against stains and water
- Products that originally carried a claim which had been removed at a later stage
- Products that carry a claim in the USA, but not in Europe

The expectation criteria could be used to acquire additional (new) products that might contain nanomaterials, by visiting large general product databases in which the products are selected that match these criteria. One important condition for this approach to work is the availability of large product databases (or other information sources such as product catalogues) that cover many product categories and that are regularly updated. For a number of consumer products categories such as 'personal care products and cosmetics', 'health products' as well as 'cleaning products' this method seems to be feasible since these product categories are all included in the Mintel Global New Products Database (GNPD), which appears to be the most suitable database for this purpose. Furthermore, products with a certain expectation to contain nanomaterial can be selected by using other information sources to match with the criteria, e.g. catalogues, internet etc.

An issue to be addressed would be to find databases, inventories or other sources that include general products for the categories not available via Mintel GNPD:

- Appliances
- Electronics and computers
- Motor vehicles
- Sporting goods
- Textile and shoes
- Toys and games

A good candidate as additional database is the American Household Products Database (see Chapter 3). Apart from the categories in the Mintel database, it covers some additional consumer product categories. Examples are 'car products', 'home office products' and 'arts and crafts'. Furthermore, the complete ingredient list of the product is given coupled to a Material Safety Data Sheet (MSDS) and the database is updated twice a year. However, it is an American database with mostly American products and still not all product categories are covered. A European version of this database may prove a useful reference for the missing product categories in the GNPD.

The issue of finding products for all product categories with the expectation that they contain nanomaterial should be further addressed in the future. Other databases and other sources of information such as product catalogues could be searched for; if not available or accessible, it will not be possible to cover all product categories via this approach.

Appendix 4. Questionnaire for manufacturers

Questionnaire

Name company:.....

Name product:.....

Note: If your company is producing more than one product with 'nano' on the label and/or website, please keep in mind the product with the highest production volume when completing this questionnaire.

1. What is your specific reason to display the term 'nano' on the product label and/or website (more than one answer possible).

- for reasons of transparency
- to inform the consumer
- for marketing reasons
- other, namely.....

2. What do you understand under the term "nano"?

.....

3. Do you apply specific criteria to differentiate between nano and non-nano? Could you describe these criteria?

.....

4. Did your company add nanomaterials to the product?

- yes, continue with question 5
- no, please go to question 12

5. For what reason are the nanomaterials added to the product? (more than one answer possible)

- to increase the strength of the product
- for an increased antibacterial effect
- for an increased UV protection
- to make the product water/ dirt/ scratch resistant
- other, namely.....

6. We have mentioned the information issues that we think are relevant for our product database in the table below. Could you comment on these by filling in Yes or No in the column for relevance?

What kind of product information would you like to share with us? Please indicate in the second column what type of information you would like to provide for publication in the database.

	Relevance for the database (Y/N)	Willingness to share product information (Y/N)
Analytical method to determine characteristics of nanomaterial (e.g. TEM)		
Compound of nanomaterial (e.g. Ag, Si, CNT, organic)		
Concentration of nanomaterial in product (in mg/kg or number of particles/ product)		
Particle shape description (e.g. spherical, tube, encapsulate)		
Particle size (distribution) (mean \pm sd)		
Surface area (m ² /g)		
Matrix (e.g. particles suspended in liquid, bound on surface)		
Other type of information, namely...		

7. Would you be willing to fill in the values of the characteristics for your product in the table below?

- yes → please fill in the table and continue with question 8
 no, → please go to question 12

Your product (values)

Analytical method to determine characteristics of nanomaterial (e.g. TEM)
 Compound of nanomaterial (e.g. Ag, Si, CNT, organic)
 Concentration of nanomaterial in product (in mg/kg or number of particles/ product)
 Particle shape description (e.g. spherical, tube, encapsulate)
 Particle size (distribution) (mean \pm sd)

Surface area (m²/g)

Matrix in which the nanomaterial is present

Other types of information, namely..

- Surface structure / film
 Surface-bound nanomaterials
 Nanoparticles suspended in liquids
 Nanoparticles in cream/ emulsion / paint
 Nanoparticles suspended in solids
 Free airborne particles
 Powders
 Unknown

8. Are the values that you filled in based on analyses on the nanomaterial added to the product, or did you perform measurement in the consumer product itself?

- analysis on nanomaterial added to the product
 performed measurement on the consumer product itself

9. Would you agree with publication of the product data?

- yes → please go to question 11
 no, → continue with question 10

10. If you do not agree with publication of the data, would you be willing to share the product data only with policy makers?

- yes
- no

11. If you are willing to share information, what is your specific reason to share this information with us (more than one answer possible)

- for reasons of transparency
- to inform the consumer
- for marketing reasons
- as an opportunity to provide direct information from the manufacturers in a database
- to give concrete input for development of the database
- other, namely.....

12. In the methodology of the database, we will recommend that manufacturers should have the opportunity to provide the information on their products to (EU and national) central points, which collect the information, check for consistency and insert the data in the database. Would your company be willing to cooperate on this in the future?

- yes, my company is interested in cooperation
- no, my company is not willing to cooperate on this

13. As mentioned earlier, we are developing a blue print for a database. Are you willing to think with us how this database could be well-designed?

- yes
- no

14. When in the future you would send us data, would you be willing to declare that these are filled in truthfully?

- yes
- no

Appendix 5. Background information on data models

Components of a data model

In practice the data model is presented as a drawing of boxes and lines, representing the structure of the information. It is important to realize though that the model in a broader sense not only consists of the drawing, but also contains detailed information about data types, the length of attributes or fields and also definitions of the attributes and entities.

The following components of the model are the most important:

The smallest units of information. These are formally called *attributes*, but be considered fields that are filled in on a web form. The attributes are characterized by a name and the type of data that it may contain (a number, text, image, etc.).

The blocks of logical coherent information. These are called *entities* and are represented in the drawing by a rectangular box. They assemble a set of attributes that are always stored as a unit. Entities can be considered as record types. So in the language of a physical database it means that a set of coherent attributes may be stored once, twice or any number of times as different records.

The relations between the entities. In the drawing these are represented by lines between the entities with specific symbols at both ends of the line. A relation means that one entity is connected with another entity. Again in a database context this means that one record of a certain type is connected with one, two or more, other records of another type. The number of connected records is dependent of the type of symbol at both ends.

The different symbols that are used in the drawing of a data model will be explained below.

An entity is represented by a rectangular box. The upper part of the box contains the name of the entity; the lower part contains a list of attributes in the entity, e.g.:

Product Category			
<u>Category ID</u>	<pi>	NO	<None>
Category		VA100	CharStr

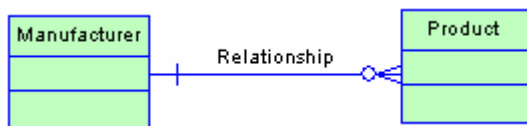
Apart from the name of the attribute, some other properties are shown, that will only be mentioned shortly here: an indication of the primary identifier(s) (<pi>) and the datatype, possibly a domain (e.g. CharStr).

Relationships are represented by lines connecting entities. There are symbols at both ends of the relationship line. These are:

- + meaning "exactly one"
- meaning "zero or one"
- ≠ meaning "one or more"
- ≠ meaning "zero or more"

This property of a relationship is called the "cardinality" of a relationship. Each binary relationship, i.e. a relationship between two entities, has two cardinalities. The order in which this cardinality must be read from the drawing and the interpretation of it, is important.

For instance, from the drawing of the entities Manufacturer and Product and their relationship,



the following may be concluded:

There is exactly one manufacturer of a product, and a product may only be registered when at the same time its manufacturer is registered.

And also:

Starting from a specific manufacturer we may find zero or more products, meaning that a manufacturer may be registered even when no products of this manufacturer are registered at the same time.

Different types of entities: degree of extension

To better understand the data model it is useful to classify the entities in three types. This grouping is based on the rate at which the entity is extended with new information; in database language: the rate at which new records of that type are added to the database.

These types are distinguished:

Base entities (yellow). Very seldom will these entities be extended with new information. They represent lists of items that will be known before information about nanoproducts will be entered. Typically, this will be pick lists in the user interface of the application with which the database will be filled. Examples are: Country, Product Category en Product Subcategory, Compound or element.

Situational entities (blue). These are extended more regularly than the base entities, typically when situation, the "business" or context with respect to nanoproduct will change. For instance when a new manufacturer or distributor goes to market it must be entered in the database.

Core entities (green). These will be extended every time new information about nano products is registered. These contain the core information for which the database is build.

It must be emphasized that there is no strict distinction between these three categories. All of them may be extended at any time during the lifetime of the database. Especially the distinction between Base entities and Situational entities may be arbitrary.

Appendix 6. Background information on current data model

In this appendix is described what information is covered in the entities and their attributes in de datamodel. Only those are explicitly explained that are not self explanatory.

Entities names are shown in ***Bold italic*** and attributes in *italic*.

All entities contain an attribute with a name ending in "ID"; this unique identifier is necessary relating the entities and has no meaning for the user of the database.

1. Product cluster

This cluster contains the information that identifies and describes the product itself.

Product

Product Variant may be used to discern different forms of essentially the same product, like different colors or different sizes.

When the function or use of the product is not clear from the product name the *Description* may be used to describe the product function or use.

The attribute *Nano Confidence* is a number from 1 to 3, meaning the Level of Confidence (LoC) as been described in Chapter 4.

Product Category

Category is the full name of the category like "Home furnishing and household products" and *Category Abbreviation* is a short name like "Home" and may be conveniently used when listing subcategories.

Product Subcategory

The only attribute is Subcategory containing the full description of the subcategory like "Maintenance and accessories (air purification)".

Legal Regulation

For identifying the regulation there are the attributes *Regulation Nr* and *Regulation Name*. Two date attributes *Start Date* and *Repeal Date* designate the dates that the regulation started and was repealed respectively.

2. Market cluster

This cluster contains information relating to product on the market: by whom it is manufactured and distributed and also in which countries.

Market Period

With each product one or more market periods may be registered, each with a *Start Date* and an *End Date*, a distributor (optional because not always known) and one or more countries.

Manufacturer* and *Distributor

These are two entities for manufacturer and distributor. They could also have been taken together in one entity called Company. They contain the same attributes and most of them are self explanatory.

The *General Website* is the general website of the company, not the specific site that shows the product.

Distribution in Country

This entity may look to have the same function as Market Period but it not quite the same. In Distribution in Country one can register that at a certain moment in time, designated by the Timestamp attribute in the Nano in Product General with which it is related, the product was on the market, distributed by the distributor with which it is related (optional) in the country with which it is related. Every country has it own Distribution in Country.

Country

This is the list of countries to choose from when registering the domicile of a manufacturer or distributor, a market period or when choosing a country of manufacturing. To be complete the 2- and 3-character and the numeric ISO country codes are stored together with the official name of the country.

3. General nano information cluster

In *Nano in Product General* the following is recorded:

Nano claim	The text in which the manufacturer claims the presence of nanomaterial and/or claims (advantageous) properties of the product due to nanomaterial.
Nano claim sourcetype	The place where the nano claim was found: product label, product website, product catalogue. The source of information itself is recorded as the relation "primary source" to Public Source of Information.
Nano claim type	Whether the claim is about the presence of nanomaterial in the product or about the use of nanotechnology.
Description of Nanomaterial General	A description in text about the nature, particle size and other properties of the compilation of nanomaterial (claimed to be) present in the product.
Product Image	The filename from which the product image was loaded into the database.
Binary File	An (thumbnail) image of the product.
Estimated production volume	The estimated production volume of the product in the unit specified in "Unit production volume".
Unit production volume	E.g.: pieces/year, kilograms/year. The weight or quantity refers to the product rather than the nanomaterial in it.

If there is more, i.e. structured, information on the chemical compounds and/or the matrix in which the nanomaterial is present in the product, this can be recorded in the entity **Nanomaterial General**. It stores one or more occurrences from the picklists of Matrix on the one hand and Compound or element on the other hand. An occurrence of Nanomaterial General can refer to one of them, or both.

An example is a case where both matrix and compound/element is once specified:

<i>Compound/Element</i>	<i>Matrix</i>
Titanium oxide	Surface-bound nanomaterials

Another example is the following case where there are two types of nanomaterial in the product, of one of which also the matrix is known:

<i>Compound/Element</i>	<i>Matrix</i>
Silver	Nanoparticles suspended in solids
Silicium oxide	Unknown

Source of Information

Information sources can be of different nature: resources on the web, labels on the product itself, (paper) catalogues, magazine articles, databases or data-sets collected by third parties.

Source type	The type of the source of information: Product label, Product website, Third party database, Distributor catalogue, Article, Review article, (to be extended)	
Source Name	The name of the (digital) document. Content is dependent of the source type:	
	Product label	empty
	Product website	Title of the website or page (if needed)
	Third party database	Name of the database e.g. Woodrow Wilson database
	Distributor catalogue	Title of the catalogue (if needed)
	Article	Title of the article
	Review article	Title of the article
DOI	Digital Object Identifier (see: http://en.wikipedia.org/wiki/Digital_object_identifier)	
URL	Universal Resource Locator (see: http://en.wikipedia.org/wiki/Uniform_Resource_Locator)	

4. Detailed nano information cluster

In **Nano in Product Detailed** the following is recorded:

Rationale added nano	The reason why the nanomaterial was added to the product.
Sample Preparation	The way the sample(s) was (were) prepared in case the product was analyzed. In the current design of the database there is one free text field in which the sample preparation(s) of possibly more than one analyses can be described.

The rest of the detailed nano information is stored in one or more occurrences of a **Nanomaterial Detailed** record. In one such record the properties of one specific nanomaterial is recorded. After all more than one nanomaterial (Compound/Matrix/Shape may be present in the product.

In **Nanomaterial Detailed** the following is recorded:

Claim description	The text in which the manufacturer claims the presence of this specific nanomaterial and/or claims (advantageous) properties of the product due to this specific nanomaterial.	
Compound or element	The chemical compound or element that comprises the nanomaterial. For a list see below.	
Matrix	The matrix in which the nanomaterial is present. For a list see below.	
Particle Shape	The shape of the nano particles.	
Particle Shape Description	A description of the particle shapes when a simple choice from a picklist is not sufficient.	
Nanomaterial Description	A description of the nanomaterial when listing the compound, matrix and particle shape not fully describes the nature of the material..	
Primary Size	The primary size of the particles as a "value" (see below)	
Cluster Size	The cluster size of the particles as a "value" (see below). Particles may be clustered into larger "particles" or clusters.	
Concentration	The concentration of the nanomaterial as a "value" (see below). Different units are possible e.g. mg/product-unit, ng/kg.	
Surface Area	The surface area of the nanomaterial as a "value" (see below).	
Element Analysis	When the compound is designated as "organic", a list of elements and their respective content may be recorded as a list of	
	Element	The element from the list of "Compounds or Elements"
	Content	The content of the element as a "value" (see below)

The "value" datatype.

At different places mentioned above a "value" may be registered. This value may be a single value, or an value with a certain standard deviation, a range of values in the form of een open or closed interval.

To be able to register all these types of "values" the following fields were created:

Operator	The '>' or '<' sign
Lower Boundary	A number (floating point)
Upper Boundary	A number (floating point)
Mean	A number (floating point)
Std Dev	A number (floating point)
Unit	A character string specifying the unit in which the numbers mentioned above are expressed

By filling the first five of these fields in a certain combination the above mentioned types of "values" may be created. A few examples:

<i>meaning</i>	<i>operator</i>	<i>lower boundary</i>	<i>upper boundary</i>	<i>mean</i>	<i>std dev</i>
larger than 10.5	>	10.5			
less than 67	<		67		
a mean of 10 and a standard deviation of 2				10	2
from 20 to 30		20	30		

Matrix

This entity contains een list of matrices from which may be chosen when entering the matrix in *Nanomaterial Global* or *Nanomaterial Detailed*:

Surface structure / film
Surface-bound nanomaterials
Nanoparticles suspended in liquids
Nanoparticles in cream / emulsion / paint
Nanoparticles suspended in solids
Free airborne particles
Powders
Unknown

Compound or element

This entity contains a list of chemical compounds, elements and compound groups that are relevant for the products at hand. The list may be extended when needed.

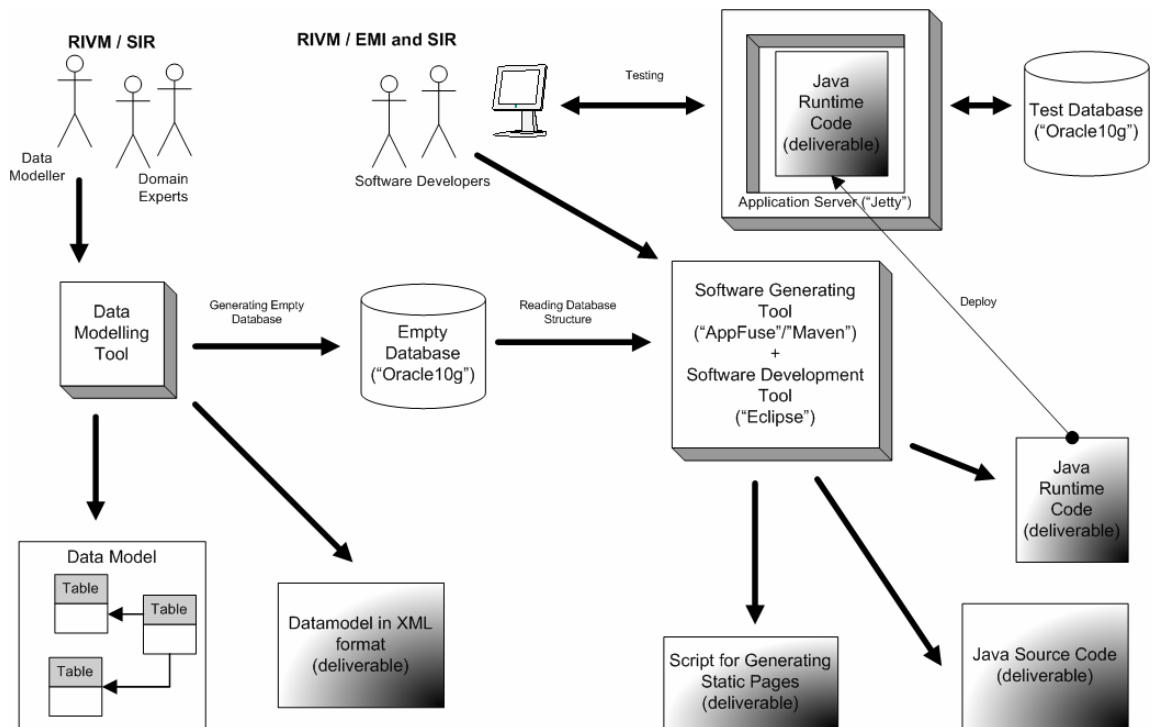
<i>Chemical name</i>	<i>Chemical Formula</i>	<i>Chemical type</i>
Aluminum	Al	element
Calcium	Ca	element
Calcium peroxide	CaO ₂	compound
Carbon	C	element
Chlorine	Cl	element
Copper	Cu	element
Diamond	C	element
Fullerenes		compclass
Gold	Au	element
Hydroxylapatite	Ca ₁₀ (PO ₄) ₆ (OH) ₂	compound
Iridium	Ir	element
Magnesium	Mg	element
Oxygen	O	element
Platinum	Pt	element
Polyquaternium-61		compound
Silicium oxide	SiO ₂	compound
Silicon	Si	element
Silver	Ag	element
Titanium	Ti	element
Titanium oxide	TiO ₂	compound
Triceramide		compound
Zinc	Zn	element
Zinc oxide	ZnO	compound
organic		compclass
unspecified		compclass

Analytical method

This entity contains a, extendable, list of analytical methods, e.g.:

<i>Analytical method abbreviation</i>	<i>Analytical method name</i>
EDX	Energy-dispersive X-ray Spectroscopy
ICPMS	Inductively Coupled Plasma Mass Spectrometry
SEM	Scanning Electron Microscopy
SMPS	Scanning Mobility Particle Sizer
STEM	Scanning Transmission Electron Microscopy
TEM	Transmission Electron Microscopy
XPS	X-ray Photoelectron Spectroscopy

Appendix 7. Scheme of software development process



NANO DG ENV Project, Set-up of Software Development Proces

This scheme shows in a birds-eye view the process of developing the deliverables.

- A team consisting of domain experts and a data modeller develops the datamodel. This is recorded with a data modelling tool and stored.
- When the datamodel is accepted by the team from the datamodel the empty database is created.
- With a software generating tool based on the open source packages AppFuse and Maven a raw, not fully functional, application is generated in the java programming language according to the MVC (Model View Controller) software architecture.
- By modifying and extending this raw application in the open source Eclipse software development enviroment a fully functional application is built.
- In a iterative way the runtime java application is built (java runtime code) and this is deployed in the open source Jetty application server.
- With the combination Jetty/Application it is possible to enter data in the database via a browser.
- The application is tested and subsequently modified and rebuilt.
- For generating the set of static html-pages a set of scripts is written. When running these script in the open source FreeMarker package, a set of pages in generated.
- When these pages are stored in a webserver (e.g. the open source Apache webserver) the pages may be accessed en viewed by users.

Appendix 8. List of products included in sample database

Brand	Product Name	Product Variant	Product Description	Country of Manuf	Cat	Subcategory
4Care	Lenscare nano-Behälter		nano anti-bacterial eye-lens case	DE	Health	Other health products
Acticoat	Antibacterial barrier			GB	Health	Wound dressing
Artdeco Beauty Desire	Nail Colour Cosmetics	Apple red 11.18	Patented formula with ceramic nano particles	DE	Care	Make-up and nail care (lipstick, eye shadow, etc.)
Babyliss	ST95E ipro 230 Steam			FR	Care	Hair care (shampoo, gel, hair dyes, etc.)
BabylissParis	BaByliss lpro pro steam straightener			FR	Electr	Personal care
BabylissParis	babyliss Pro Stylist	Nano Titanium Satin Straightener		FR	Electr	Personal care
Baur Versand	Nanogrit-Spüle	Sydney		DE	Home	Construction materials
Bielita	Bielita Q10 Face Beauty serum			RU	Care	Skin care (shower gel, creams, deodorant, foot care, shaving soap, etc)
Bielita	Bielita Q10 Face mask			RU	Care	Skin care (shower gel, creams, deodorant, foot care, shaving soap, etc)
Butai Marine Cosmetics	Butai Body Care	Hand Cream	Soft E hand cream	IL	Care	Skin care (shower gel, creams, deodorant, foot care, shaving soap, etc)
Butai Marine Cosmetics	Butai Face Care	Day Cream		IL	Care	Skin care (shower gel, creams, deodorant, foot care, shaving soap, etc)
Butai Marine Cosmetics	Butai Face Care	Gentle Cleanser		IL	Care	Skin care (shower gel, creams, deodorant, foot care, shaving soap, etc)
Butai Marine Cosmetics	Butai Face Care	Night Cream		IL	Care	Skin care (shower gel, creams, deodorant, foot care, shaving soap, etc)
Cenano	Antibakterielles Schuhdeo mit Silber Ionen			DE	Textile	Other textiles (sheets, etc.)
Cenano	Nanofix Sanitärreiniger			DE	Home	Cleaning products
Cenano	Nanotol		Oberflächenschutz durch Nanotechnologie nanometric moisturizing drops	DE	Home	Construction materials
Chanel	Le Blanc	Lightning Moisture Nanolotion		FR	Care	Skin care (shower gel, creams, deodorant, foot care, shaving soap, etc)
Continental	ContiSportContact 5 P		tyre	DE	Motor	Maintenance and accessories (air purification)
Crystal	Colloidaal Iridium		supplement	NL	Health	Other health products

Crystal	Colloïdaal Platina		food supplement	NL	Health	Other health products
Crystal	Colloïdaal Silica		supplement	NL	Health	Other health products
Crystal	Colloïdaal Zink		food supplement	NL	Health	Other health products
Crystal	colloïdaal zilver		food supplement	NL	Health	Other health products
DHC	After Bath Hair Treatment			US	Care	Hair care (shampoo, gel, hair dyes, etc.)
De Scheller Cosmetics	Day Cream	Anti- Wrinkle	with natural Nanosolve micro-capsules	DE	Care	Skin care (shower gel, creams, deodorant, foot care, shaving soap, etc)
Deichmann	Nano Wet Blocker			DE	Textile	Coating
Dior	DiorSnow Pure UV Base SPF 50 DiorSkin Extreme Fit Wear Flawless Makeup SPF 15			FR	Care	Skin care (shower gel, creams, deodorant, foot care, shaving soap, etc)
Dior	DiorSkin Forever	Vanilla		FR	Care	Skin care (shower gel, creams, deodorant, foot care, shaving soap, etc)
Dior	DiorSkin Forever	Extreme Wear Flawless Makeup FPS 25		FR	Care	Skin care (shower gel, creams, deodorant, foot care, shaving soap, etc)
Dior	DiorSkin Forever compact		Peach	FR	Care	Make-up and nail care (lipstick, eye shadow, etc.)
Dorco Xpec3 Nano	Xpec3 Nano	Triple Blade Shaving System		KR	Care	Skin care (shower gel, creams, deodorant, foot care, shaving soap, etc)
Dr Irena Eris Nano Entrée	Eye NanoCream			PL	Care	Skin care (shower gel, creams, deodorant, foot care, shaving soap, etc)
Dr Irena Eris Nano Entrée	anti-winkle nanoNcream night care			PL	Care	Skin care (shower gel, creams, deodorant, foot care, shaving soap, etc)
Dr Irena Eris Nano Entrée	anti-wrinkle nanoDcream day care			PL	Care	Skin care (shower gel, creams, deodorant, foot care, shaving soap, etc)
Dr Irena Eris Nano Entrée	Precise anti-wrinkle serum			PL	Care	Skin care (shower gel, creams, deodorant, foot care, shaving soap, etc)
Dr Scheller Cosmetics	Dr. Scheller Distelöl & Chiasamen Hautentspannende Tagescreme Dr. Scheller Johannisbeere & Marula	,50 ml		DE	Care	Skin care (shower gel, creams, deodorant, foot care, shaving soap, etc)
Dr Scheller Cosmetics	Aktiv Nachtcreme Dr. Scheller Jojoba & Shisandra	50 ml		DE	Care	Skin care (shower gel, creams, deodorant, foot care, shaving soap, etc)
Dr Scheller Cosmetics	Balance Feuchtigkeitscreme 50 ml	50 ml		DE	Care	Skin care (shower gel, creams, deodorant, foot care, shaving soap, etc)
Elefanten	Elefanten Nano Pflegeschäum			DE	Textile	Coating
Erdal	Dauer Imprägnierspray			DE	Textile	Coating
Erdal	Parkett & Laminat Feuchttücher			DE	Home	Cleaning products
FAN Frankenstolz Schlafkomfort	FAN Nanofill Steppbett			DE	Textile	Other textiles (sheets, etc.)
GA.MA	IHT Tourmaline Slim		hair straightner	IT	Care	Hair care (shampoo, gel, hair dyes, etc.)
GA.MA	IHT Tourmaline Wide			IT	Care	Hair care (shampoo, gel, hair dyes, etc.)

GA.MA	Tourmaline Laser Ion		hair straighter	IT	Care	Hair care (shampoo, gel, hair dyes, etc.)
Gastrolux	frying pan			DK	Home	Cooking utensils (cutting board)
JR Nanotech	SoleFreshT nanosilver socks	Colour Black Day and Night Protective Cream	80% Cotton, 20% Elastic yarn	GB	Textile	Clothing (incl. prof clothing)
Kiko	Kiko Manis skin care for men		skin care for men	IT	Care	Skin care (shower gel, creams, deodorant, foot care, shaving soap, etc)
Kosmoteros	Lady Moisturising Daily Cream			RU	Care	Skin care (shower gel, creams, deodorant, foot care, shaving soap, etc)
Kérastase	Aqua-oleum haarkur			DE	Care	Hair care (shampoo, gel, hair dyes, etc.)
LA Science	LA Science Anti Hair loss Serum		daily intensive treatment for thicker, healthier looking hair	GB	Care	Hair care (shampoo, gel, hair dyes, etc.)
LA Science	LA Science Shampoo		Daily tretament shampoo with peptide complex	GB	Care	Hair care (shampoo, gel, hair dyes, etc.)
Lancôme	Hydra Zen Cream			FR	Care	Make-up and nail care (lipstick, eye shadow, etc.)
Luxaflex	Rolgordijnen	nano Collectie			Home	Furnishing (pillows, etc.)
Malwa Foot Care	Protectice Foot and Toe Nail Cream			PL	Care	Skin care (shower gel, creams, deodorant, foot care, shaving soap, etc)
Mark Hill	Salon Professional Straight & Define Male Ceramic Styler			GB	Care	Hair care (shampoo, gel, hair dyes, etc.)
Mark Hill	Sexy Waves & Curls Pro-Magic Wand			GB	Care	Hair care (shampoo, gel, hair dyes, etc.)
Medima	Medima Silverline	Damen Hemd 1/4 arm		DE	Textile	Clothing (incl. prof clothing)
Medima	Medima Silverline	Damen Hose lang		DE	Textile	Clothing (incl. prof clothing)
Medima	Medima Silverline	Damen-slip		DE	Textile	Clothing (incl. prof clothing)
Medima	Medima Silverline	Herren Hemd 1/4 Arm		DE	Textile	Clothing (incl. prof clothing)
Medima	Medima Silverline	Herren Hose Lang		DE	Textile	Clothing (incl. prof clothing)
Medima	Medima Silverline	Herren Hose kurz (retro)		DE	Textile	Coating
Medima	Medima Silverline	Herren-Slip		DE	Textile	Clothing (incl. prof clothing)
Medima	Medima silverline	Herren Hemd ohne Arm		DE	Textile	Clothing (incl. prof clothing)
Medima	Medime Silverline	Damen Schlüpfen		DE	Textile	Clothing (incl. prof clothing)
Medima	Medima Silverline	Damen Hemd ohne arm		DE	Textile	Clothing (incl. prof clothing)
Medosan	Antidruck-Schuh Sporty mit Nano			DE	Textile	Other textiles (sheets, etc.)
Minox	APO HG 10x43 BR asph.	10 x43	binoculars	DE	Sport	Other (wetsuit, fishing lure, horse shoes)
Minox	APO HG 8,5x43 BR asph.	8,5x43	binoculars	DE	Sport	Other (wetsuit, fishing lure, horse shoes)
Miradent	Miradent gelée			DE	Care	Oral hygiene (toothpaste, mouth wash)

Miradent	Nanosensitive hca	with Novamint		DE	Care	Oral hygiene (toothpaste, mouth wash)
NCM	Nano Q10 Anti Aging Creme	50 ml		DE	Care	Skin care (shower gel, creams, deodorant, foot care, shaving soap, etc)
NanoCosmetic	Sealing Stick			AT	Care	Make-up and nail care (lipstick, eye shadow, etc.)
Nanojewellery	Nano-Titan Siegelring			DE	Home	Luxury (jewellery, etc.)
Nanolex	Nanolex premium textile			DE	Textile	Coating
Nanonordisk	Bilrudesæet	2 x 50 ml	car cleaner	DK	Motor	Coating/cleaning
Nanonordisk	FÆLGEFORSEGLING			DK	Motor	Coating/cleaning
Nanonordisk	FÆLGERENS			DK	Motor	Coating/cleaning
Nanonordisk	MULTISKUM		cleaning product	DK	Home	Cleaning products
Nanonordisk	nanosvamp		spons	DK	Home	Cleaning products
Nanoprotect	Nanoprotect Après Sun			DE	Care	Sun cosmetics
			The world's most effective topical hair loss treatment			
Nanormin	Spectral DNC		Nanotechnology Hair Growth Stimulating Shampoo	GB	Care	Hair care (shampoo, gel, hair dyes, etc.)
Nanormin	revita			GB	Care	Hair care (shampoo, gel, hair dyes, etc.)
Nansulate	Crystal Clear Roof Coating			US	Home	Coating
Nansulate	HomeProtect Clear Coat			US	Home	Coating
Nansulate	HomeProtect Clear Coat			US	Home	Coating
Nansulate	Ldx Lead Encapsulating Coating			US	Home	Coating
Neosino	Gesichtscreme			AT	Care	Skin care (shower gel, creams, deodorant, foot care, shaving soap, etc)
Neosino	Nano Fluid			AT	Care	Over the counter health products
Neosino	Nanosilimagna Kapseln			AT	Health	Other health products
Neosino	Spray Forte	50 ml		AT	Care	Skin care (shower gel, creams, deodorant, foot care, shaving soap, etc)
Neosino	Spray Mild	50 ml.		AT	Care	Skin care (shower gel, creams, deodorant, foot care, shaving soap, etc)
Nigrin	NIGRIN NanoTec Cockpit Spray	400 ml		DE	Motor	Coating/cleaning
Nigrin	NIGRIN NanoTec Glass Coating Set NIGRIN NanoTec Screenwash			DE	Motor	Coating/cleaning
Nigrin	summer Concentrate	pleasant orange 5l.		DE	Motor	Coating/cleaning
Nigrin	NIGRIN NanoTec Tyre Care	500 ml		DE	Motor	Coating/cleaning

Nigrin	Nigrin EvoTec Paintwork Sealant with microfibre cloth	500 ml		DE	Motor	Coating/cleaning
Nigrin	Nigrin NanoTec Color Polish	500 ml, black		DE	Motor	Coating/cleaning
Nigrin	Nigrin NanoTec High Gloss Paint Coating	500 ml		DE	Motor	Coating/cleaning
Nigrin	Nigrin NanoTec Leather Care	250 ml		DE	Motor	Coating/cleaning
Nigrin	Nigrin NanoTec Upholstery Sealant	300 ml		DE	Motor	Coating/cleaning
Nivea	Mascara	Extaension Mascara	mascara with nanometric precision	DE	Care	Make-up and nail care (lipstick, eye shadow, etc.)
Nivea	Nivea Silver Protect for men	deodorant		DE	Care	Skin care (shower gel, creams, deodorant, foot care, shaving soap, etc)
Ortodent	Antibacterial Toothbrush	Gold		NO	Care	Oral hygiene (toothpaste, mouth wash)
Percenta	Ceramic cooking ring coating	500 ml bottle with sprayer		DE	Home	Cooking utensils (cutting board)
Percenta	Nano Glas- & Keramiek-reiniger	20.000 ml Can		DE	Home	Cleaning products
Percenta	Nano Multi Schuim (antibacterieel)	250 ml aerosol spray can		DE	Motor	Coating/cleaning
Percenta	Nanotechnology Anti-Condensation for Synthetic Materials	200 ml bottle with sprayer		DE	Motor	Coating/cleaning
Percenta	Nanotechnology Car Glass Cleaner	250 ml bottle with sprayer		DE	Motor	Coating/cleaning
Percenta	Nanotechnology Carpet & Cushion Cleaner	250 ml bottle with sprayer		DE	Home	Cleaning products
Percenta	Nanotechnology Furniture Polish with Anti-Static Effect	250 ml bottle with sprayer		DE	Home	Coating
Percenta	Nanotechnology Furniture Polish with Anti-Static Effect	5.000 ml Can		DE	Home	Coating
Percenta	Nanotechnology Leather & Textile Cleaner	50 ml bottle with sprayer		DE	Home	Cleaning products
Percenta	Nanotechnology Plastics Cleaner Concentrate	75 ml bottle with sprayer		DE	Home	Cleaning products
Percenta	Nanotechnology Window Cleaner	30 ml bottle with sprayer		DE	Home	Cleaning products
Percenta	Percenta AG brutally reiniger	1.000 ml bottle with sprayer		DE	Home	Construction materials
Percenta	Percenta Chroom & Edelstaal (RVS) Reiniger	20.000 ml Can		DE	Home	Cleaning products
Percenta	Percenta Nano Airco Clean	200ml		DE	Motor	Maintenance and accessories (air purification)
Percenta	Percenta Nano Chroom & RVS coating	50 ml bottle with sprayer		DE	Home	Cleaning products

Percenta	Percenta Nano Kunststoffverzegeling	15 ml bottle with sprayer	DE	Home	Cleaning products
Percenta	Percenta Nano Lakcoating	400 ml	DE	Motor	Coating/cleaning
Percenta	Percenta Nano glas- en keramiek-coating	20.000 ml Can	DE	Home	Coating
Percenta	Percenta Nano glascoating ZR	15 ml bottle with sprayer	DE	Home	Cleaning products
Percenta	Percenta Nano rim-coating	50 ml bottle with sprayer	DE	Motor	Coating/cleaning
Percenta	Percenta Nano textiel- & leer coating	1.000 ml bottle with sprayer	DE	Home	Furnishing (pillows, etc.)
Percenta	Percenta nano hout & steen	100 ml bottle with sprayer	DE	Home	Construction materials
Philips	200°C Nano-silver Straightener		NL	Care	Hair care (shampoo, gel, hair dyes, etc.)
Philips	220°C Nano-Diamond Ceramic Straightener		NL	Care	Hair care (shampoo, gel, hair dyes, etc.)
Proldee	Ladies Nano Walking Cane Umbrella		DE	Textile	Other textiles (sheets, etc.)
Proldee	Men's Nano Pocket Umbrella		GI	Textile	Other textiles (sheets, etc.)
Proldee	Nano All Purpose Apron		DE	Textile	Clothing (incl. prof clothing)
Proldee	Nano Rain Hat		DE	Textile	Clothing (incl. prof clothing)
Proldee	Nano Trousers		DE	Textile	Clothing (incl. prof clothing)
Proldee	Nanoflex Cotton Suit		DE	Textile	Clothing (incl. prof clothing)
Samsung	RL44ECPS 2m Fridge Freezer		KR	Appli	Large appliances (refrigerators)
Samsung	RL44ECTB 2m Fridge Freezer		GB	Appli	Large appliances (refrigerators)
Samsung	Samsung Forte	AQ09NSD-N	DE	Appli	Air Conditioning
Samsung	silencio vacuum cleaner		KR	Appli	Large appliances (refrigerators)
Sharp	SJ-RM323TWH		JP	Appli	Large appliances (refrigerators)
Soap and Glory	Sexy Mother Pucker XL Extreme-Plump	Collagen Lip Shine	GB	Care	Make-up and nail care (lipstick, eye shadow, etc.)
Sonax	SONAX Nano Polish 1ltr.	1 ltr.	DE	Motor	Coating/cleaning
Sonax	SONAX Velgenverzegeling NanoPro	Aerosol spray can	DE	Motor	Coating/cleaning
Sonax	SONAX Xtreme Liquid wax nr. 1	500 ml	DE	Motor	Coating/cleaning
Sonax	SONAX Xtreme Ruitenreiniger	500 ML	DE	Motor	Coating/cleaning
Sonax	Sonax Xtreme Polish & Wax2 Nano Pro	250 ml	DE	Motor	Coating/cleaning
Sonax	Sonax Xtreme Velgenverzegeling Nano Pro		DE	Motor	Coating/cleaning

Sonax	SONAX Nano Lak Protect		DE	Motor	Coating/cleaning
Swissdent	Swissdent Nanowhiting Sweet Mint Toothpaste	100ml	CH	Care	Oral hygiene (toothpaste, mouth wash)
Swissdent	Swissdent Extreme Toothpaste	50 ml	CH	Care	Oral hygiene (toothpaste, mouth wash)
TSP	TSP Socke Nano		SI	Textile	Clothing (incl. prof clothing)
Tenzi	Antypara Nano Silver		PL	Motor	Interior
Tenzi	Boberex Nano Silver		PL	Home	Cleaning products
Tenzi	Gran Di-Cl Nano Silver		PL	Home	Cleaning products
Tenzi	Gran Diw Nano Silver		PL	Home	Cleaning products
Tenzi	Gran Glass Nano Silver		PL	Home	Cleaning products
Tenzi	Gran Oil Nano Silver		PL	Home	Cleaning products
Tenzi	Gran Shine Nano Silver		PL	Home	Cleaning products
Tenzi	Odor Off Nano Silver		PL	Home	Cleaning products
Tenzi	Office Clean Nano Silver		PL	Home	Cleaning products
Tenzi	Rollex Nano Silver		PL	Motor	Coating/cleaning
Tenzi	Sani Plus Nano Silver		PL	Home	Cleaning products
Tenzi	Shampo Neutro Nano Silver		PL	Motor	Coating/cleaning
Tenzi	Textil PROT Nano Silver		PL	Textile	Coating
Tenzi	Top Clear Nano Silver		PL	Motor	Coating/cleaning
Tenzi	Top Fresh Nano Silver		PL	Home	Cleaning products
Tenzi	Top Glass Nano Silver		PL	Home	Cleaning products
Tenzi	TopEfekt CITRO Nano Silver		PL	Home	Cleaning products
Tenzi	TopEfekt DIAM Nano Silver		PL	Home	Cleaning products
Tenzi	TopEfekt EXTRA Nano Silver		PL	Home	Cleaning products
Tenzi	TopEfekt KOK NANO		PL	Motor	Interior
Tenzi	TopEfekt MAX Nano Silver		PL	Home	Cleaning products
Tenzi	TopEfekt NORMAL Nano Silver		PL	Home	Cleaning products
Tenzi	TopEfekt ORANĹ Nano Silver		PL	Home	Cleaning products
Tenzi	TopEfekt SANIT Nano Silver		PL	Home	Cleaning products

Tenzi	TopEfekt SET Nano Silver		PL	Home	Cleaning products
Tip Top	Tip Top Nano Clean & Polish		DE	Motor	Coating/cleaning
Tip Top	Tip Top Nano Diamant Kettenspray		DE	Motor	Coating/cleaning
Turtle Wax	Extreme Cockpit-Bumper-Tyre Shine	500 ml	GB	Motor	Coating/cleaning
Turtle Wax	Extreme Glass Clean	500 ml	GB	Motor	Coating/cleaning
Turtle Wax	Extreme Wash en Wax	500 ml	GB	Motor	Coating/cleaning
Turtle Wax	Extreme Wheel Clean	500 ml	GB	Motor	Coating/cleaning
Turtle Wax	Extreme polishing liquid wax	500 ml	GB	Motor	Coating/cleaning
Turtle Wax	extreme tyre gel	500 ml	GB	Motor	Coating/cleaning
Whirlpool	Origami Stainless Steel Hob with iXelium	75 cm.	US	Appli	Large appliances (refrigerators)
Yonex	Ezone	Tennisracket 300 gr. average weight	JP	Sport	Rackets, bats, golf clubs, etc.
Yonex	Fairway Wood	golf club	JP	Sport	Rackets, bats, golf clubs, etc.
Yonex	Nanospeed 9900	badminton racket	JP	Sport	Rackets, bats, golf clubs, etc.
Yonex	VOLTRIC 70	Badminton racket	JP	Sport	Rackets, bats, golf clubs, etc.
crystal	Colloidaal Koper	food supplement	NL	Health	Other health products
nanolex	Nanolex premium Spray Sealant		DE	Motor	Coating/cleaning
nanonordisk	BILRUDEFORSEGLING		DK	Motor	Coating/cleaning
neosino	Sun Protect LSF 15		AT	Care	Sun cosmetics
percenta	Percenta Autoruitcoating	1x Nano-coatingdoek (10ml)	DE	Motor	Coating/cleaning
sephora	Nano Eyeliner	Glitter Black	US	Care	Make-up and nail care (lipstick, eye shadow, etc.)
sephora	Nano Lip Liner	Pretty Praline	US	Care	Make-up and nail care (lipstick, eye shadow, etc.)
turtle wax	Extreme speed wax	500 ml	GB	Motor	Coating/cleaning
whirlpool	Origami Stainless Steel Hob with iXelium	60 cm.	US	Appli	Large appliances (refrigerators)
	Stone Color		DK	Home	Paint