DELIVERABLE 7

OPERATIONAL MATERIALS PASSPORTS

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Authors:

EPEA Nederland BV

SundaHus i Linköping AB

Deliverable 7 lead partner: EPEA Nederland BV

Report development: EPEA Nederland BV and SundaHus i Linköping AB

Authors:

EPEA: Lars Luscuere, Rafaela Zanatta, Douglas Mulhall

SundaHus: Jan Boström, Lisa Elfström

Contribution: Drees & Sommer and BAMB Work Package Leaders.

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EXECUTIVE SUMMARY

Deliverable 7 'Operational Materials Passports' (D7) represents the more than 300 materials passports (MP) implemented in the materials passports platform (MPP). D7 was mainly developed by the WP2 partners EPEA and SundaHus.

The WP2 deliverables 5 'Framework for materials passports' (D5) and 6 'Software platform' (D6) serve as background for D7 by describing MP and the MPP. The MPP contains passports for products, buildings and instances. Instances represent occurrences of products that can be linked to a building.

Passports were initially created as prototypes with the BAMB pilot leaders. Later on, stakeholders of the building industry were also invited to create passports for products, buildings and instances. The third main source of data in the MPP was the SundaHus Material Data system from which data was imported into the MPP to demonstrate data sharing between platforms.

The MP creation process in the MPP generated the following results:

345 passports for products, representing 345 products from 94 manufactures in 14 countries;

7 passports for buildings, representing 7 buildings from 7 owners;

76 passports for instances, representing 62 products from 53 manufacturers.

Adding up to a **total of 428 passports**.

The reader can view the passports by accessing the MPP using the following information:

Website: https://passports.bamb2020.eu

Name: Guest

Password: bambplatform

Videos demonstrating the MPP and the MP are available through the following links:

https://vimeo.com/238909741

https://vimeo.com/238910718

https://vimeo.com/307279299

Feedback on MP and the MPP was collected throughout the project and processed by adapting the documents that were set up initially to guide the MPP development. In addition, basic adaptations to the MPP were made, such as improving the stability, restoring data when dropped by the platform, and establishing a back-up.

Efforts have been made to relate the MP work to the Circular Building Assessment tool (CBA), as developed in WP5A1. The CBA was developed to compare and assess building, element, product and material resource scenarios during the life time of a built asset and beyond. A material health section[1] of the Workbook 2.0 was developed as an initial input for the CBA to support data on circularity of products, essential for a full building assessment.

In conclusion of the 30 months project report, clarifications and evidence in relation to the validation approach of MP was requested. To clarify the subject, the report discusses the current situation of validation in the MPP, possible validation on platforms, and validation of data sets.

Among the main lessons learned from the work on MP and the MPP is the need for a standardized data format for products regarding circularity and health. This will help manufactures not to have to provide information on products to different platforms in different formats and help product specifiers to collect data in a standardized way. This development has started and several initiatives outside of the BAMB project are ongoing including the 'Luxembourg CE Dataset Initiative' in collaboration with the Ministry of the Economy of

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[1] Also based on the Cradle to Cradle® concept. For information see: https://www.epea.com/de/vision-prinzipien/

Luxembourg and the DOEN Foundation's Healthy Printing initiative, to develop a standardised approach to materials passport datasets. At the time of writing, 43 initiatives related to MP, from the list presented in D5 (EPEA & SundaHus, 2017), have been identified and scanned for parameters used to generate information about the circularity of products. Most of the initiatives use very distinct parameters. This underlines the need for standardization. A lot of platforms are dealing with composition inventorying and screening, while very few contain information on circularity. Moreover, additional work on the Workbook 2.0 has been carried out to optimize the MP data for standardization.

Following the conclusion of D7, continued work is planned for the creation and standardization of a data format for products regarding material health and circularity.

After the end of the project, the MPP data is planned to be made available in an online repository for free access. It will serve as a valuable data set for researchers and stakeholders of the building industry regarding materials health and circularity of products.

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1 INTRODUCTION

1.1 Deliverable description

On the report

This report on operational materials passports describes the fact that more than 300 materials passports that have been implemented on the MPP. They have been generated based on data collection as well as data import from existing databases and they have been made for amongst others various types of products. They can be accessed by parties that have a free user account. They are presented on the platform and accompanied by this report, which includes a link to a video demonstration (BAMB, Consortium, 2016).
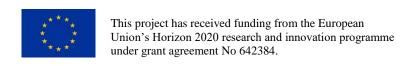
On the authors

The deliverable contains contributions from WP2 partners and BAMB work package leaders, and it was mainly developed by EPEA and SundaHus. A brief description of these two companies is included in annex 7.3.

1.2   Background

This report and the operational materials passports are the result of a rich background coming from research, discussions within the WP2 team, contributions from BAMB partners, workshops with stakeholders for input and feedback, and work based on the team's expertise. Also, two previous WP2 deliverables were essential background for the D7 development:

- **Deliverable 5 Framework for Materials Passports (D5)** (EPEA & SundaHus, 2017)**:** This deliverable is the foundation for the creation of materials passports (MP)[2] and the materials passports platform (MPP)[3] in the project. It describes MP and an MPP.

- **Deliverable 6 Software Platform (D6)** (IBM, EPEA, & SundaHus, 2017) : The software and linked database, as a whole named MPP, were developed based on D5 as a Proof of Concept (PoC) to be the prototype platform for passport creation. This technology was later adapted by the WP2 team (see section 4.3).

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[2] Materials passports are (digital) sets of data describing defined characteristics of materials and components in products and systems that give them value for present use, recovery, and reuse. They are an information and education tool that asks questions often not covered by other documents or certifications related to building products, especially in relation to the circularity of products.

[3] In the D5 report the MPP was referred to as 'PoC' as we were making a distinction between it and a conceptual vision of a platform. In this report the MPP refers to the platform created in D6 unless stated otherwise.

2 MATERIALS PASSPORT CREATION

2.1 Methodology

MP were initially created as prototypes using an adaptation of the input workbook developed in D5 for data collection. When the MPP became available, the passports made with the workbook were manually transferred and BAMB stakeholders were invited to test the MPP. They reported bugs and provided feedback. Lastly, passports were also created by importing data from an external database.

2.2 BAMB pilot projects

MP were made in collaboration with all pilots. Together with each pilot leader products were selected for this purpose. This input was used for the D5 report.

At the time D5 was delivered however, the MPP was not ready for use. This led to several risks including delays on the creation of MP, the ability to generate more than 300 MP, and the integration of the MPP with operational MP in the Reversible Experience Modules (REMs) exhibition. As a measure to mitigate these risks, a separate process was set up in order to collect data before the platform was ready. Excel files were developed specifically for this purpose and used together with the pilot leaders to collect and store data on selected products. Later on, when the platform was online, the data was transferred to the platform. One of the parties outside of the BAMB pilots that generated passports on the platform is the consortium partner TUM, who developed passports for the Nexus solar house, introducing it as an external pilot to the project. The TUM also supported extensively in data collection for the other pilots.

The passports developed with the pilots generated feedback about the questions and pointed out the need for guidance in general and clarification on terminology. The manual addition of the data in the platform demanded more time than expected, confirming the importance of automated data sharing between the MPP and external systems as well as a user friendly platform. Feedback received from the pilot leaders notably included the lack of functionality of

the platform, together with the lack of user-friendly interaction and of the ability to update the platform.

Reversible experience modules (REMs)

The EPEA pilot project REMs makes extensive use of MP. The REMs pilot is a traveling exhibition of around 70 construction products, each with their own MP, which during the BAMB project visited six locations throughout Europe. The MP in the REMs are accessible directly from the exhibition by scanning a products' QR code or NFC (near field communication) chip. In addition to the MP, visuals have been developed to help visitors understand passports and to provide a much needed 'dashboard'. See Figure 1 below for an example of a visualisation that is part of the REMs exhibition. Further information on this pilot is provided in the D14 report, which describes results from interviews with manufacturers that have worked on MP for products in the REMs.

MANUFACTURER: THOMA
PRODUCT: HOLZ100

SOLID WOODEN HOUSE CONSTRUCTION SYSTEM

Product features
+ solid construction
+ no glues or metals

Reuse potentials

The Holz100 construction system can be disassembled and reused in new applications, recycled and finally composted in a bio-cascade, returning nutrients to the biosphere. Holz100 wood is FSC certified.

Product story

Layers of wood connected with wooden pegs are assembled into solid wood panels designed for interior walls, floors and ceilings, roof structures and exterior walls. The resulting indestructible solid wooden blocks are highly water resistant and perform better than other construction methods in heat insulation, fire security, radiation shielding, earthquake safety and have 100% protection against condensation and mould growth.

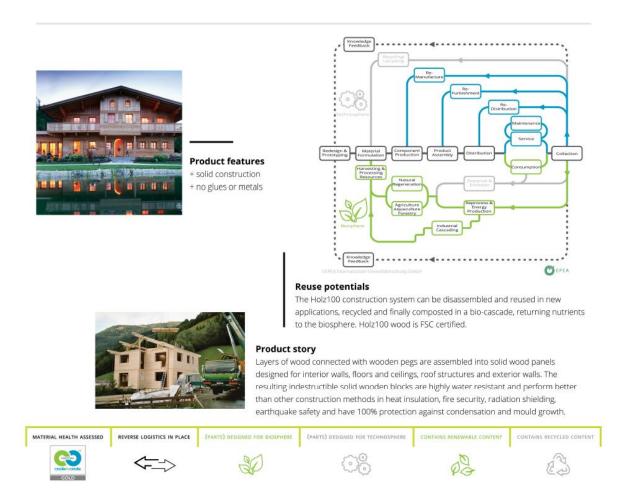| MATERIAL HEALTH ASSESSED	REVERSE LOGISTICS IN PLACE	(PARTS) DESIGNED FOR BIOSPHERE	(PARTS) DESIGNED FOR TECHNOSPHERE	CONTAINS RENEWABLE CONTENT	CONTAINS RECYCLED CONTENT

Figure 1. REMs dashboard type collection of summarised information.

2.3　Stakeholders

Workshops were held with the Stakeholder Network Special Interest Group on materials passports during the consortium events, as well as Circular supplier community workshops with other possible users of MP. Communication and dissemination happened continuously throughout the project including during conferences and presentations. These meetings focused on the dissemination of the project and on involving stakeholders in MP creation. The concept and value propositions for MP and the MPP were presented, the MPP was demonstrated and participants were invited to test it.

Stakeholders could receive a free user account and were able to create passports. Guidance in generating the passports was provided when needed.

2.4　External systems

One of the basic requirements for the MPP was that it should be able to communicate with other systems. Hence, an API (application programming interface) that enabled this was included in the MPP. The API was used to create over 200 MP by transferring data from the SundaHus Material Data system (SHMD) (for details, see section 4.1).

It took considerable time to set up the supporting infrastructure for the data transfer due to the status of the MPP. A lot of transforming of data had to be set up, as well as specific software for communicating with both the source (SHMD) and the target (MPP) systems. However, once this was concluded, the actual import was performed in minutes.

3 ANALYSIS

3.1 Overview of created materials passports

As described, the goal to be reached is the creation of 300 MP. There are three types of MP on the MPP: One for products, one for buildings and one for instances. At the moment of writing there are **345 MP for products**, **7 MP for buildings** and **76 MP for instances.** Adding up to a **total of 428 MP**. Well beyond the stated goal.

The following sections provide additional information on MP created per type.

Materials passports for products:

A passport for a product is a data set describing a product. This data set is specific to a certain product from a certain manufacturer, but it does not include what we refer to as instance data, such as the condition of one product in particular. This data set is often largely based on the manufacturer's information about a product. To qualify as a MP for the purposes of this report, a product passport contains data in at least all fields that are denoted as 'mandatory' in the MPP.

A total of 345 products were added in the MPP at the time of writing this report. They represent building products with information mainly provided, or made available, by manufacturers. The passports represent a great variety of products such as ceiling systems, wall paint, furniture, flooring, ceramic tiles and ventilation systems made by numerous manufacturers spread out over 14 countries (Austria, Bosnia and Herzegovina, Belgium, Switzerland, Germany, Denmark, Spain, France, Great Britain, Israel, the Netherlands, Norway, Sweden and the USA). Notably, many of the passports contain information on material health assessment results, while little information is provided on topics such as actively beneficial qualities and next use potential. This is where the role of MP as an educational tool is relevant, pointing users towards topics where data is still missing, or where understanding is still lacking. See Figure 2 below for key figures on product passports, and Figure 3 for an overview of entries of products in the MPP by product category.
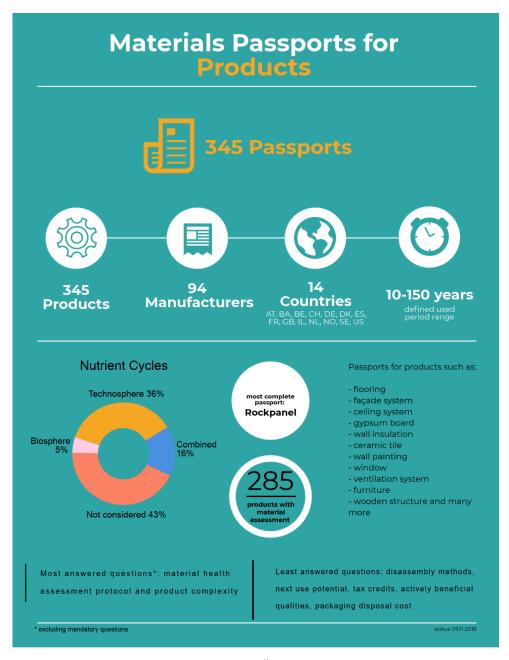
Figure 2. MP for products infographic
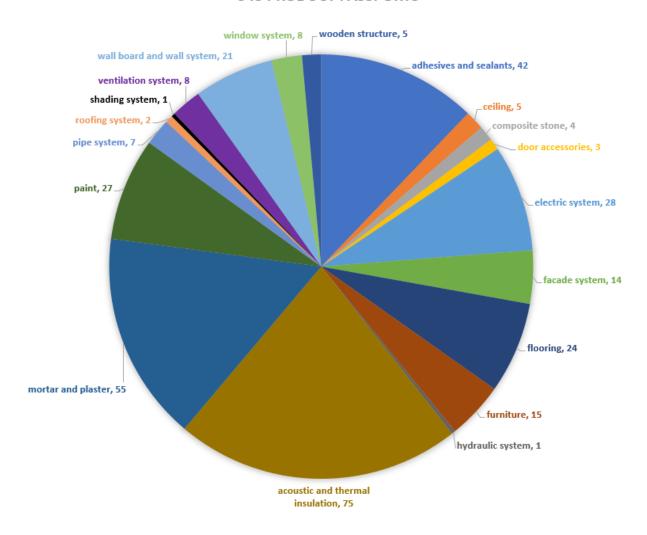
345 PRODUCT PASSPORTS

window system, 8 — wooden structure, 5 — adhesives and sealants, 42 — ceiling, 5 — composite stone, 4 — door accessories, 3 — electric system, 28 — facade system, 14 — flooring, 24 — furniture, 15 — hydraulic system, 1 — acoustic and thermal insulation, 75 — mortar and plaster, 55 — paint, 27 — pipe system, 7 — roofing system, 2 — shading system, 1 — ventilation system, 8 — wall board and wall system, 21

Figure 3. Product types registered on the MPP.

Materials passports for buildings:

MP for buildings are concise. They are data sets containing information related to a specific building/project. After creation, they act as a hub to which instances of products can be connected. In other words; a building passport on the MPP represents the set of products in that building that have an MP, rather than being a complete building level data set. Information about the building´s name, owner and location were usually present. More specific contacts such as building's contractor and database operator were not provided in many building data sets. This might be due to the lack of information available to the user that entered data in the platform. To qualify as an MP for buildings, a criterion was set that a building should have at least 3 instances connected to it. Seven buildings have met this criterion. See Figure 4 below for key figures on building passports:
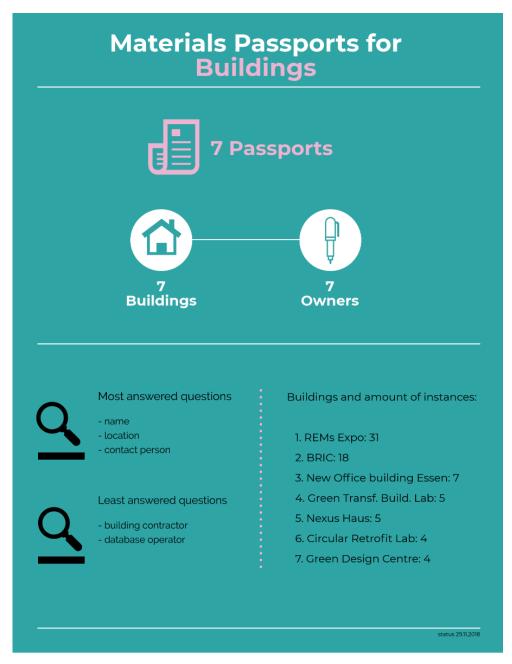
Figure 4. MP for buildings infographic

Materials passports for instances:

An MP for an instance is a data set describing an occurrence of a product, often connected to a building. This passport supports context and location data of products. Instances are different from products in that an instance might tell you something about the location of a product, maintenance that has been carried out, or the state of the product.

An instance MP is only counted as one MP even if it has several context and location records i.e. it has been in multiple buildings. A total of 76 instances have met this criterion. They are based on 62 generic products in the MPP, representing products made by 53 manufacturers. Data for value recovery and next use options were the least provided in the instance data sets. See figure 4 below for key figures on instance MPs:
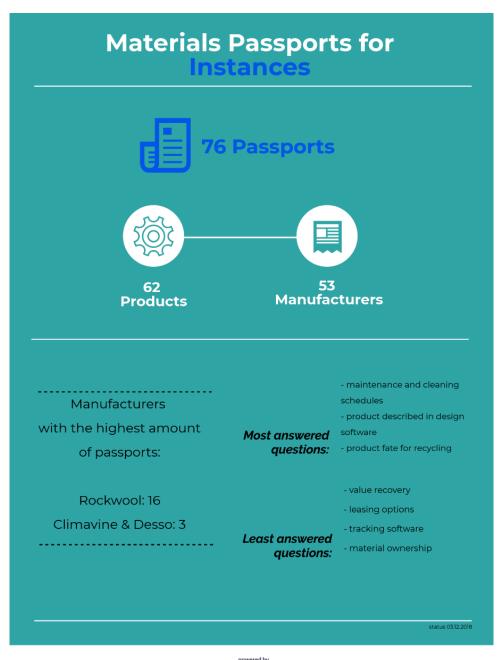
Figure 5. MP for instances infographic

3.2 Data sources

The MPP contains a cloud-based database able to support data about products and buildings. It does not contain confidential information and it is openly available to anyone with a user account. The absence of data in some areas is not necessarily a negative sign, as it was not intended that users fill out all fields. The main data sources for the MPP are manual users who enter data and external systems that can communicate with the MPP through its API. Both use groups can retrieve information as well.

3.3 MPP users

Interested stakeholders can request a user account to access the MPP through the following email address:

materialspassports@bamb2020.eu

Following this, an account is set up with the appropriate user rights. Users can have read-only access, or in addition to that write access connected to certain manufacturers or buildings.

The reader can access the MPP directly using the following access information:

Website: https://passports.bamb2020.eu

Name: Guest

Password: bambplatform

By using this account, it is possible to access the platform features without being able to add or edit data.

Platform users have access to a customer service with guidance for the platform´s features, how to create passports, and input field descriptions. It is possible to access it through the platform or through the link below:

https://passports.atlassian.net/wiki/spaces/MPPCS/overview

3.4   Supporting videos

Videos about the MPP and the operational passports are available through the link below:

MPP overview

https://vimeo.com/238909741

How to add a product

https://vimeo.com/238910718

300+ Materials passports

https://vimeo.com/307279299

4 MATERIALS PASSPORT DEVELOPMENTS

4.1 Connection with external systems

An important feature for the future scalability of the MP concept is the possibility to transfer data between systems efficiently. To facilitate that, an API was included in the MPP. This API opened the possibility for other systems to communicate "machine-to-machine" with the MPP. Since there are hundreds of thousands of products used in the construction industry, automatic communication of the needed data is a requirement for a broad implementation of a more circular building industry.

The SundaHus Material Data system (SHMD) contains a significant amount of data that is relevant for MP. To test the MPP's capacity to communicate with an external system, the MPP's API was used to create over 200 MP with data from the SHMD. The data transferred from the SHMD to the MPP relate to the following input fields (depending on the availability in SHMD for each product imported):

- Basic information identifying the manufacturer
- Brand name
- Product name and description
- Product complexity
- Documents such as:
    - General reference documents
    - EPD (environmental product declaration)
    - MSDS (material safety data sheet)
    - Certificates
    - Building product declaration
- Information about material health assessment according to the SHMD criteria
- Emission information according to several systems
- Information about renewable sourcing

The data transfer test was a five-step process:

1. Using the list of input fields available through the MPP API as a base, a mapping between the fields available in SHMD and MPP was created. Since the data types were not always the same, some transformations also had to be defined.

2. An export program for SHMD was written that pulled the relevant data from SHMD and created a "snapshot" of it in an intermediate transport file. This program also handled the needed transformations.

3. An import program that read the intermediate transport file and inserted the data into the MPP via the API was written.

4. The process was tested on a single product to make sure everything worked correctly. I.e. that data was exported with the export program, the intermediate transport file was manually checked for correctness, and then the data was transferred to the MPP via the import program. Effectively creating a new MP in the MPP. This MP was then accessed through the MPP's GUI (graphical user interface) and manually checked to validate the whole chain.

5. When the process had been validated, 200+ MP were created in the MPP in a single 'go'[4].

In theory, there could have been one program that read the information from the SHMD and directly inserted it in the MPP through the API. However, since this was the first test, every step was validated separately.

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[4] Certain fields including "other emissions per product" are not visible on the MPP even if data is available in the system.

During the process, several things that must be considered for the future development of platforms were noted:

1. **Globally unique article identifiers are crucial.** It was known that the data transferred did not include products that were already on the MPP, so there was no risk of duplication. In a future scenario, a product might already exist in the MPP and should only be partially updated, which means that there would be a risk of creating duplicates. Therefore, a globally unique identity is crucial.

2. *A standardized data format for communicating product information.* This would make the implementation much safer and faster. The transfer test included a lot of mapping and transformation work that would be avoided if both systems were adhering to a common standardized data format.

4.2   Circular building assessment

The Circular Building Assessment (CBA) is a methodology that compares and assesses product and material resource flows during the life time of a built asset and beyond. This method is being developed into a prototype online platform/tool that can quantify and compare design approaches and highlight corresponding environmental and economic net benefits, focussing on the difference between 'business as usual' versus circular building scenarios. Circular building scenarios include; reuse of material from the previous built environment, design for future reuse via reversible building design and design for transformation potential (BRE, Circular Building Assessment Prototype, 2017).

In an update of the workbook (see section 4.3) a subset of criteria was developed on material health as input for the CBA. At the time of writing, attributes specific to MP, specifically information related to emissions, are implemented in the CBA prototype online platform but not defined within the CBA BIM attributes. Collaboration is ongoing, and three steps are defined to take this further (BRE & SundaHus, D16. Task 6: Development of a BIM Compliant Resource Productivity Prototype (add-on) in accordance with existing BIM software, 2018):

- Comparison/mapping between CBA and selected MP attributes.
- Review of IFC schema for any attributes that are already defined.
- Development of a list of attributes required to cover (selected attributes of) MP within CBA

4.3 Adaptations/updates

Below, a summary of adaptations on some results of D5 and D6 after their conclusion that are directly connected to D7.

Workbook 2.0

One of the issues with the MPP has been that it is not possible to make adaptations to criteria over time, hindering the iterative use and adaptation of the platform based on what has been learnt from usage and feedback. As a result, the feedback about the platform became repetitive after some time. Still, lessons were learned and there was a wish to document suggested improvements. In the end, the medium used for this was a redevelopment of the input workbook created in D5.

This was called 'Workbook 2.0', based on the D5 document originally meant for the MPP development and thoroughly revised. The redevelopment encompassed structural modifications, such as changes in data sets, many changes to the criteria, their description and related meta-data. This adapted workbook was developed as a goal on its own, to ensure that feedback, lessons learned, and further research could be positively processed. It also proved to be useful in several work topics, including the development of a summarised property set for the standardisation of a data format (see section 4.5), and the development of a property set focused on materials health as input for the CBA (see section 4.2).

MPP updates since D6 completion

The platform delivered in D6 did not meet minimal requirements for use, and both EPEA and SundaHus were not equipped to repair these. This posed risks for any work that depended on the platform being operational and accessible. As a measure to deal with this risk, an external ICT party has been hired to solve high priority issues. While the intention was to move on to further adaptations and improvements to the platform after the high priority issues were dealt with, this was eventually decided against. Due to design and stability issues with the platform,

seemingly simple changes such as adding a 'Terms of Use' and privacy policy check while logging in proved difficult, time consuming and expensive. Because of this, the support was limited to fixing the most pressing issues such as making sure the platform was running and stayed online, restoring data when dropped by the platform, and establishing a back-up. A short report on code quality was provided to allow some insight in the difficulties of working with the platform, and eventually the conclusion was drawn that it is not feasible to extend or scale up the MPP to a commercially usable platform.

4.4 Validation

In conclusion of the 30 months project report, the following is requested: "*Some further clarifications and evidence are needed within the upcoming deliverables, in relation to: Validation approach, which is put in place to secure the credibility of Material Passports*".

The above question relates to validation that would allow a user to trust the data that is presented to them to be correct, rather than data validation that ensures consistency of data with a technical format.

First the situation of MPP validation is described, followed by a discussion on how validation could be covered by a platform or for a data file.

Current situation

Validation is not implemented on the MPP developed in D6. The D5 report however includes a description of validation as this relates to MPP requirements. D5 describes how one of the value propositions for MP is to support transparency and validation of claims about products. It describes third-party data validation to achieve this on the MPP, and that this could be optional. It continues to describe how data validation should happen when data enters the system, happening only once, instead of every time the data is used. Data validation is also described as a possible service connected to platforms in the MP ecosystem (EPEA & SundaHus, 2017).

In the work on Cradle to Cradle® Certification, for example. EPEA comes across a large amount of data that requires validation. This is done in several ways such as:

- Onsite audits
- Collecting supporting documentation including certificates, standards, technical documents and financial documents
- Expert evaluation

- Checking consistency of data throughout the supply chain
- Performing analytics

Validation on platforms

It is relevant to note that the specific type of data that is required by MP is often new in terms of standardization efforts, or in terms of users handling it. This notion adds to the importance of data validation for MP, as users may be unfamiliar with some requested information. Also important, is the feedback received by WP2 regarding the concern of product manufacturers which agree that data validation is essential, but this will put the load on them to finance it.

Several ways are identified in which data validation could occur:

- Platform linked (optional) third party validation

This allows users to have their data stand out by being validated. Appointed auditors can verify the correctness of data, and successfully validated data receives a 'stamp' to show this. Validation being optional keeps the threshold low for users to enter data, while allowing validation services to be offered. This approach is not uncommon on digital platforms. Sampling is a way to lower costs.

Disadvantages for this approach are the fact that it is platform bound, it is likely costly for users to validate their data and, in relation to the manufacturers´ concern mentioned above, it is likely that much of the financial burden would be carried by them.

- Open data validation

This approach can be used on its own or in combination with optional third-party validation described above. Essentially validation is crowd sourced to the users of the platform and this is enabled by having data openly available. For example, when a data point is questioned by a critical number of users, this can prompt a request for additional evidence for the data provider

and/or show this status on the platform. For such a system one can envisage additional functionalities such as benefits for validators and trust inheritance from recognized sources.

A disadvantage of this system is that its success depends on the users of the system and their active involvement. It also relies more on sampling of data rather than systematic validation.

Validation of a data file

The current work which is exploring the development of a data format in relation to standardization and harmonization of MP, to enable improved collaboration between MP type platforms and data providers (see section 4.5), contains its own challenges and opportunities for validation, as it would not be bound to a specific platform. Below an initial exploration of options for validation of data sets based on such a data format:

- Digitally signed documents. Validation in this case is the responsibility of the party making the data file. It could be self-signed or signed by a third-party. The trust associated with a signed document would relate to the signature used.
- Block chain provides a way to describe data transparently and immutable. This is being explored as a vehicle for standardized MP data files.

4.5 Standardization

There is a rapid proliferation of passport-type mechanisms (called building-, material- and product-passports). Many of these were summarized for the BAMB WP1 deliverable on the state of the art, and this list has been continuously updated. Proliferation is good because it reflects demand and provides diverse insights. The platforms offer diverse services. Some are materials marketplaces while others aim to calculate the overall circularity of a building or compare certification compliance.

Due to the demand of those platforms to make data available, there is confusion in the market. Product manufacturers have to provide information about their products to different sources in different levels of detail and in different formats. Stakeholders in the building industry need information, but do not know where to find it and which platform to trust for accuracy. Time for providing and searching for information is also key.

Moreover, if there is no consistency in standards and passport mechanisms, the risk of discrediting the overall approach is high. Data credibility, data gathering costs and data duplication are essential aspects that relate to this.

Diversification of the marketplace at early stages of a new concept or service is not unusual, and not necessarily bad, but it does pose practical barriers to scaling up, until industry standards are developed, or one player becomes dominant in the marketplace.

In the interests of promoting fair competition on a level playing field, an industry standard rather than monopoly is often the most productive and cost-effective solution for users.

The research and development of MP generated valuable content to move forward with the exploitation of the MP concept. As part of the Workbook 2.0 (see section 4.3), a section on product material health and a MP light version were created, and in the exploitation work the development of a data format was identified as an exploitable result.

Some benefits for standardized data formats are:

- Save costs and work load of manufacturers who deal with diverse platforms, by saving them time providing similar data in different ways to different platforms.

- Improving collaboration and communication between manufacturers and materials passport type platforms as well as between these platforms.

- Establishing among a wider group of stakeholders including industry, MP type platforms, and key MP players a shared view on MP based on the results of the Horizon 2020 BAMB project.

- Harmonisation. The goal is to provide standardisation on data aspects relating to materials health and a circular economy, to enable platforms to speak the same language when using these data. The goal is not to make platforms that use MP uniform. Different questions from the market require different solutions, different insights and different platform services to tackle them. These various objectives can be met by a diversity of platforms.

- Uptake of MP. Making MP more appealing to manufacturers and users. These platforms in turn are expected to help developers and building owners to contribute to the movement towards circular economy.

There are numerous efforts across the building industry related to the effort to standardize formats:

- Scandinavia. The Coclass (Svensk Byggtjänst, 2019) project and eBVD (Byggmaterialindustrierna, 2019) aim at standardisation of data for buildings. Aspects of those relate to circularity of products, but it is not their focus.

- Netherlands. The CB23 (CB23, 2019) project is aiming to standardize MP in The Netherlands.

- ISO/CEN (CEN, 2019). Product Data Template methodology is being developed as a tool to standardise data for products in the construction industry.

- UL Spot (ULSpot, 2019) Circularity and Circularity Facts Report. The Underwriters Lab UL standard is used globally for electrical and other products. It has recently introduced a circularity component.
- BAMB templates created to standardise data inputs and Outputs to the CBA platform.
- Environmental Product Declarations (EPDs) (EPD International AB, 2019). Machine readable EPDs are introduced to make the standardized data more easily available. Again, this data is largely Life Cycle Assessment (LCA) based and although there are overlaps with circularity, some key aspects are missing.

However, none of those efforts have so far developed a broadly accepted and narrowly defined dataset for circularity that reflects core criteria like those identified in the BAMB MP workbook. As a result, the following initiative was started recently.

The Luxembourg CE dataset initiative

A pathway to harmonization of circularity and health data for products through a standardized data format is being explored. In keeping with the aims of the dissemination and exploitation aspects of BAMB as well as the continued development of MP, work is ongoing in this project initiated in collaboration with the Ministry of the Economy of Luxembourg and the DOEN Foundation's Healthy Printing initiative. The outcome of this project is at the time of writing still a work in progress.

The early practical objective of the Luxembourg CE Dataset Initiative is to bring leading players together to demonstrate demand. The main vehicle is a Dataset Working Group (DWG) with selected candidates including manufacturers, building owners, auditors, standardization organizations, CE data platforms and others. A webinar and a first working session with the working group were held in December and February respectively, and a first data format for circularity data as well as a display component which will be piloted as part of the initiative is being worked out at the time of writing the report.

Updates to the 'passport light'

Additional work has been done on the Workbook 2.0 in relation to standardization. Especially with regards to the passport light section. The focus was on; emissions from products, restricted lists, compositional data, green building certification schemes, extraction and disassembly, reverse logistics and next use potential.

Circularity parameter review

For the standardization of circularity parameters, it is crucial to know which kind of data is already processed in the marketplace. Therefore, platforms, standards and certifications that deal with circularity were continuously reviewed and analyzed.

The list of initiatives related to MP presented in D5, and updated since the end of this delivery, was used as a basis. These initiatives were scanned for parameters used to generate information about the circularity of products. A summary sheet was created for every analyzed platform to have an overview about the following:

- Relevance of the platform for the given project
- On which layer does the initiative operate (whole building level, product level or other supporting level)?
- Is the platform openly accessible or exclusively accessible for customers?
- What is its regional distribution?
- Brief explanation of the initiative;
- Input parameters (product-related data that must be supplied);
- Output parameters (product-related data that can be generated through the initiative).

43 initiatives have been analyzed. If a low relevance was identified, the documented information was kept superficial. If a high relevance was identified, the analysis was carried out as detailed as possible.

In summary, most of the initiatives use parameters that are very distinct from each other. This underlines the need for standardization. A lot of platforms are dealing with composition inventorying and screening, while very few contain information on circularity. The Circularity Indicators by the Ellen MacArthur Foundation[5] have so far been identified as the most relevant existing scheme for this type of information. Many others lack a clear definition of their criteria. It is relevant to mention that also those indicator sets that are widely used have certain shortcomings when it comes to describing circularity as they often lack a mechanism for dealing with; renewable material, composition, and health aspects.

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[5] https://www.ellenmacarthurfoundation.org/resources/apply/circularity-indicators

5 CONCLUSION & OUTLOOK

5.1 Conclusions

- After more than three years of research and development on MP and the MPP, valuable lessons have been gathered for the continuation of the work on MP and dissemination of the concept.

- It was possible to create well over 300 passports in the MPP for products, buildings and instances despite various setbacks.

- A large increase in awareness about circularity in the building sector has been identified, including many platforms and governmental initiatives mentioning passports as a tool for implementing circular economy in the building industry. This shows the significance of the project and suggests its success in disseminating the concept and influencing market development. Interest and enthusiasm for passports was also noticed during the various workshops with stakeholders.

- MP prototypes made for the pilot projects provided important feedback in the data gathering process. It was possible to identify which inputs are easily available and which data is essential to be added by specific users such as products' suppliers/manufacturers. It was also a valuable test for understanding the input fields, leading to their update later on, and creating user guidance and demonstration videos for the platform. In addition, the importing of product data from an external system (SHMD) proved to be a great alternative for the success of MP and the MPP concept moving forward.

- As noticed already in the development of D5, many challenges would have to be solved for the MPP to be commercially viable, such as quality assurance and validation of data, as well as administration, governance and revenues generated in the platform. Possible commercial services to be offered in the MPP are described in D5.

- A great financial investment beyond BAMB budget would be necessary to build a passports platform that aligns with similar platforms available in the market, and it will be necessary from a programming viewpoint to start a new platform development rather than build upon the current MPP.

- The added value and differentiator for the MPP is the content developed as a result of co-working between partners who are very present and experienced in product circularity and health data assessment and consultancy[6]. The 'Workbook' as presented in D5, and improved throughout the project, is a valuable outcome of the project.

- There are increasing demands in the marketplace for a consistent, transparent and thorough approach to materials health as a foundation for healthy buildings, as well as assuring safe next use of materials so they are 'fit for purpose'. The Workbook has been a significant guide to addressing this and raising awareness among BAMB members.

- In addition, gathering data about circularity of building products has proved to be challenging. This type of information is not commonly present in the marketplace. It is usually either not available or of insufficient quality.

- Fragmentation of datasets for circularity is resulting in an undue burden on manufacturers to meet diverse demands for similar types of information from diverse platforms. This points to a need for standardisation of circularity related datasets.

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[6] Also based on the Cradle to Cradle® concept. For more information see: https://www.epea.com/cradle-to-cradle/

5.2 Outlook

Following the conclusion of D7, work is planned to continue on a standardized data format for sharing data on products regarding circularity and health as a possible BAMB key exploitation result.

After the end of the project, the MPP data is planned to be made available on an online repository for free access. This will be a valuable source for researchers and building materials specifiers.

6 GLOSSARY

API - The MPP Application Programming Interface (API) is a series of definitions and protocols which enable other systems to communicate with the MPP.

CBA - The Circular Building Assessment (CBA) is a methodology that compares and assesses product and material resource flows during the life time of a built asset and beyond. This method is being developed into a prototype online platform/tool that can quantify and compare design approaches and highlight corresponding environmental and economic net benefits.

Open data format - An open data format is a format for storing and transferring digital data in files or through APIs, defined by a published specification, and which can be used and implemented by anyone.

Material - Material is used mainly to describe raw and/or generic materials such as metals (copper, aluminium, etc.), wood, earth, clay, stones (granite, marble, basalt, etc.) and substances that are content of products available in the market, such as additives, pigments, and polymers, but which are anonymous and not considered specific products themselves. In this sense of the term, materials can be represented in MP through the description of the composition of products and systems, but they do not have their own passports.

Materials passport (MP) - Materials passports are (digital) sets of data describing defined characteristics of materials and components in products and systems that give them value for present use, recovery, and reuse. They are an information and education tool that asks questions often not covered by other documents or certifications related to building products, especially in relation to the circularity of products. They provide information that supports assessments and certifications by other parties and allows existing assessments and certifications to be entered into the passport as uploaded documents

Materials passport platform (MPP) - The software and linked database developed by BAMB WP2 in deliverable 6, as a prototype for the creation of MP. This IT solution enables multiple stakeholders to generate and view MP.

Product - Product refers to an item that is manufactured or refined for sale. A product is offered in the market by a responsible producer and has certain properties such as a commercial name, a producer ID and a serial number. A product is not an anonymous material. Examples of products for which MP can be made are building related products such as; wall or floor tiles, flooring, gypsum walls, office furniture, paint, windows, connectors, steel or wooden beams, railing and framing, roof tiles, bricks, insulation, doors, coatings, piping, hardware, electronic equipment, and lighting fixtures.

Proof of concept (PoC) - A realization of a certain method or idea to demonstrate its feasibility, or a demonstration in principle, whose purpose is to verify that some concept or theory has the potential of being used. In the present report, PoC refers to the software platform developed by BAMB WP2 on D6.

SHMD - The SundaHus Material Data system (SHMD) contains a significant amount of data that is relevant for MP. To test the MPP's capacity to communicate with an external system, the MPP's API was used to create over 200 MP with data from the SHMD.

Value proposition - A value proposition is a business or marketing statement that a company uses to summarize why a consumer should buy a product or use a service. This statement convinces a potential consumer that one particular product or service will add more value or better solve a problem than other similar offerings. Companies use this statement to target customers who will benefit most from using the company's products, and this helps maintain an economic moat (Investopedia, LLC, 2016).

7 ANNEXES

7.1 Circular supplier community workshops

Circular supplier community workshops were organized by EPEA with support from Drees & Sommer on 16.10.2018 in Hamburg and on 22.11.18 in Stuttgart.

The project, the value propositions of passports, the materials passports platform, other platforms and projects linked to the ongoing work, and future possibilities for passport usage were presented and discussed.

The participants were suppliers of the building industry, which are also suppliers of data in the materials passports, such as architects, designers, engineers, manufactures, facility managers, construction companies and building owners. There were also circular economy consultants, students and university researchers. The speakers were consortium members, building product manufacturers, building owner, construction company and BIM software designer. There were approximately 45 participants.

There were valuable discussions about the challenges of implementing circular economy in the building industry, the importance of maintenance and governance of data sharing, and the acceptance of BAMB concepts by national governments. Participants were invited to test the MPP, to create passports and to register in the stakeholder network for a closer involvement in the project.

Agenda

Topic Description
Welcome and registration
The BAMB project *Background information, partners, milestones, planned projects, working together, value for stakeholders*
Materials Passports *What are they? Benefits and outlook*
Circular Buildings *Opportunities of circular building design for manufacturers and retailers*
Redesigning products and systems challenges and implementation in practice *Opportunities of circular building design for manufacturers and retailers*
Building Information Modeling *Digital planning process based on databases to connect information in a single network*
Podium discussion *Questions & Answers*
Materials Passports Platform Prototype and other related platforms *What are they? The industry demands*
REMs: Workshop Session *Transforming buildings from demolition cost and liabilities into material banks*
Wrap-Up & Get involved! *Questions & Answers, discussion of what's next and how to engage*

Pictures workshop Hamburg

Pictures workshop Stuttgart

Marketing material

News Mailing: EPEA, BAMB, Drees & Sommer

Social Media: EPEA, BAMB, Drees & Sommer

Personal contact: via EPEA staff
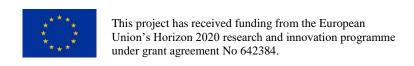
Flyers:

Outcome

The great majority of participants decided to engage in the project and register in the BAMB Stakeholders Network. Through this network, they are not only involved in the project development in general, but also in the standardisation work running until the end of the project (see section 4.5). The workshops were considered successful because they reached the goal of engaging the building industry community on providing input about the work in progress and feedback on the results presented.

7.2 WP2 publications

Several publications relevant to MP have been developed in the scope of WP2. At the time D7 was concluded, the publications were not ready to be included in the body of this report. The following material is at the time of writing planned to be made available on Zenodo[7] and the BAMB website[8]:

- A publication on materials passports best practices by TUM, based on the lessons learned and experiences during the MP creation with the MPP.

- A report on the metals value chain by EPEA, presenting the impact of surface treatments for metal on human health and the environment, reuse and recycling potential.

- A publication on creating buildings with positive impacts by EPEA, discussing the value propositions of healthy materials and materials passports in buildings to improve the occupants´ well-being and productivity.

- Lars Marten Luscuere. (2016). Materials Passports: Optimising value recovery from materials. ICE, 170(1), 25–28. http://doi.org/10.1680/jwarm.16.00016 https://www.zenodo.org/record/1145784

- Luscuere, L.M. Mulhall, D. (2019). Circularity information management for buildings: the example of materials passports. In M. Charter (Ed), Designing for the Circular Economy (pp. 369-380) Abingdon, Oxon, Routeledge.

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[7] https://zenodo.org/

[8] https://www.bamb2020.eu/library

7.3   Deliverable 7 partners

A brief description of the two partners mainly involved in D7 is included below:

EPEA Nederland B.V.

EPEA supports companies, institutions and local authorities to analyse and optimize materials, products, and systems so that they are of human, environmental, and economic benefit based on the Cradle to Cradle® design concept. By material flow management, it is possible to identify and positively define beneficial resources for biological and technical nutrient cycles. Examples of previous EPEA projects related to the topic of this report include, but are not limited to:

- o Mid-1990s. Dow Chemicals starts Safechem based on the EPEA concept of leasing chemicals. Safechem uses criteria from EPEA for identifying high quality safe chemicals which can be effectively recovered and reused.
- o 2011. Turntoo, a C2C-based concept for products leasing is launched. EPEA NL is a founding member of the group.
- o 2012 Delta Developments and Park 2020 request EPEA NL to describe criteria for MP in Buildings.
- o 2013 The first Maersk Triple E ship piloting C2C MP is launched.
- o 2013 Rijkswaterstaat requests and receives from EPEA NL a study on the potential for designs for disassembly relating to MP in ships (EASME).
- o 2014 EPEA launches the Environmental and Health Statement (EHS). It is based on the positive Cradle to Cradle® approach and integrates statements on product safety during use, material productiveness after use, post-use management, good raw materials, and progress planning.

SundaHus i Linköping AB

SundaHus i Linköping AB (publ) is an SME registered in Sweden as a public limited liability company. SundaHus has an extensive experience from over a decade of structuring, normalizing, and providing easy access to information similar to the one in the BAMB project and for the same context that the project is targeting. The company has been doing that in well over 1,700 real-world construction projects which have resulted in a system with documentation, assessment, and in depth information about products, chemical content and other quantifiable and environmental properties of over 37,000 unique construction products available in just short of 110,000 "flavors", i.e. sizes, colors and so on. The "easy access" provided includes web interfaces, but also Application Programming Interfaces (APIs) for linking to external systems, such as other database and BIM tools. SundaHus' services, projects and experience that relate but are not limited to the report topic:

o SundaHus Miljödata (SundaHus Material Data) - The main, web-accessible information platform that handles construction product and project information. Used by all stakeholders in design- and construction phase as well as in property management.

o BlackList - The customizable automatic assessment system that allows customer's specific environmental requirements to be encoded into the system and automatically applied to every product in the database.

o An assessment service that consists of an in-house staff of qualified chemists with an extensive experience of assessing construction materials on a daily basis.

o A Revit plugin that allows easy access to information in SundaHus Miljödata from within a BIM model.

o Methodology for conscious material choices who does what and when, based on the concept of "plan, do, check, act".

o Counselling services about the methodology and system SundaHus Material Data.

o Knowledge and experience in structuring and standardising data and to develop tools, software platforms and functions to make data easily accessible for all users.

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