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DATA REQUIREMENTS FOR A MATERIAL PASSPORT IN THE SRI LANKAN CONSTRUCTION INDUSTRY

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ABSTRACT

Material Passports have emerged as an effective digital tool enabling systematic documentation of material information throughout the building lifecycle, supporting Circular Economy principles in the Built Environment. However, the concept of Material Passport is relatively new to the Sri Lankan context, and there is currently a lack of a standardized template specifying the data requirements necessary for their implementation. Therefore, this study aims to identify the data requirements needed to develop a standardized MP template for the Sri Lankan BE. A qualitative research approach was adopted for this study. Initially, a comprehensive literature review was conducted to identify commonly used MP data categories reported in previous studies. Subsequently, semi-structured interviews were conducted with key stakeholders in the building lifecycle. The collected data were analysed using thematic analysis with predefined coding categories. The findings revealed that while categories like product features, composition, and maintenance are applicable, environmental impact and end-of-life deconstruction details are currently lacking in local practice. As an intermediate solution, it is proposed to retain these as descriptive open fields accompanied by guidance notes. Structuring these fields requires careful consideration to ensure backward compatibility and support a future transition toward dynamic material passports, with green building rating systems potentially serving as market-based catalysts to incentivize their use. This study provides a foundation for developing a context-specific MP template for Sri Lanka, which can enhance material traceability, improve lifecycle information management, and support gradual transition towards CE practices within the BE in Sri Lanka.

Keywords: *Built Environment; Circular Economy; Data Requirements; Material Passport; Sri Lanka.*

1. INTRODUCTION

The construction industry is a major contributor to global material consumption and environmental impact throughout a building's lifecycle (Lokuge et al., 2025). Notably, more than 30% of natural resources extraction and 25% of global solid waste generation are attributable to the construction sector. This is largely due to the fact that the

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construction industry still adopts a linear economic model based on "take-make-dispose" approach (Benachio et al., 2020). Therefore, the Circular Economy (CE) model is increasingly recognized as a feasible solution to the problems associated with these linear economic models (Blomsma et al., 2023). By adopting CE practices, the industry can reduce waste, enhance the utilization of recycled materials and create markets for recycled and repurposed resources (Lakshan et al., 2025).

Furthermore, the integration of digital technologies into the CE concept aims to ensure better use of fewer resources, reduce energy consumption, utilize capacity and logistics routes more effectively, and enable open access to information about the resources used by products. This enables optimization of product life cycles (Antikainen et al., 2018; Chi et al., 2023). Consequently, the Material Passport (MP) is considered an essential and reliable technology to identify the circular and sustainability values of systems and materials within the Built Environment (BE) (Blomsma et al., 2023). MP encourages the use of sustainable, circular, and healthful building materials by enabling project stakeholders to systematically evaluate material performance and lifecycle considerations when making design and construction decisions (Cagno et al., 2021).

As a developing country, Sri Lanka is increasingly suffering from environmental challenges resulting from unsustainable development practices, high material usage, and high waste generation (Athapaththu et al., 2016). This occurs as the Sri Lankan BE predominantly follows the "take-make-dispose" linear economic paradigm, promoting a necessary shift towards CE practices to mitigate these impacts (Weerakoon et al., 2023). As a solution for this significant environmental impact, the Sri Lankan construction industry is leaning away from linear economy practices towards CE (Weerakoon et al., 2023). While international studies advocate for comprehensive MP frameworks, their direct implementation in the local context is hindered by distinct differences in industry practices, regulatory maturity, digital infrastructure and availability of lifecycle data (Jayawardane et al., 2023). Specially, Jayawardane et al. (2023) identified that a lack of continuous information flows, insufficient experimental applications, and widespread ambiguity regarding how to define and implement MP acts as primary barriers within the Sri Lankan industry. Furthermore, limited stakeholder awareness, and the absence of standardised lifecycle information management systems severely restrict the adoption of internationally developed MP templates (Hernandez, 2024). Building directly upon these findings, this study addresses the implementation barrier by defining the foundational data requirements necessary to establish these missing information flows. Because international templates often rely on advanced digital integration and established circular supply chains that do not yet exist locally, a context-specific, standardized data template is essential to bridge the gap between theoretical CE concepts and practical local application.

Accordingly, this research aims to identify the key data requirements necessary to develop a standardized MP suitable for the Sri Lankan BE. The primary objectives are:

01. Identify the key requirements for a comprehensive MP.
02. Develop a standardized MP data template based on these requirements for the Sri Lankan context.

2. LITERATURE REVIEW

Digitalization can boost the transformation from linear economy to the CE by providing accurate product information, enabling efficient processes, minimizing waste, promoting product longevity, and reducing transaction costs, thus closing the material loop and enhancing resource efficiency (Antikainen et al., 2018). Consequently, MP serves as essential enablers of the CE acting as digital repositories that track and record the circularity characteristics of materials to systematically support end-of-life recovery, recycling, refurbishment, and reuse (Qazi et al., 2026). Therefore, the MP can be defined as a critical digital technology that enables circularity throughout the life cycle of the building in the BE (Çetin et al., 2022; Markou et al., 2025).

2.1 OVERVIEW OF MATERIAL PASSPORT

A MP is a tool that can be used for material information management (Munaro et al., 2019; KC et al., 2025). According to the Markou et al. (2025), a MP can be defined as digital records that provide details about the physical characteristics of the materials and the components that are utilized in various products or systems. Some other authors emphasize that an MP can be identified as a digital tool that encompasses details related to materials and their environmental impact (Atta et al., 2021; Göswein et al., 2022; Honic et al., 2019). Çetin et al. (2023) mentioned that few purposes of having MP in CE such as recovering value through recycling and reuse, calculate the economic value of products, optimisation of design, measure the circularity level of a building, and management of life cycle data. However, some similar terminologies can be identified alongside the MP such as Digital Product Passports (DPPs) and Digital Building Logbooks (DBLs) (Markou et al., 2025). These passport instruments vary according to the industries in which they are implemented, the scope and backbone principles on which they are established, yet these passport instruments are all designed to enable circularity (Çetin et al., 2023).

	Digital Product Passports	Material Passports	Digital Building Logbooks
Scale	Product	Area; Complex; Building; Element; Product; Material; Raw material	Building
Industry	Cross-industry	(Mainly) Built environment	Built environment
Regulation	EU Ecodesign Directive	-	EU-wide Framework for a Digital Building Logbook

Figure 1: Differences and similarities between digital product passports, material passports, and digital building logbooks (Source çetin et al., 2023)

Considering that the MP and DPP both provide details regarding material quantities, capabilities of reuse, and the potential to dissemble products, the main difference is their scope: MP is tailored for the BE, whereas DPP is cross-industry tools applied across a wide range of sectors, including textiles, electronics, and industrial batteries, under regulations like the EU's Eco-design for Sustainable Products Regulations (Ahmadi et al., 2026; Qazi et al., 2026). Furthermore, considering the MP and DBL, while both are involved in digital information management, DBL is primarily utilised as centralised

repositories for activities, energy efficiency, and emission tracking during a building's operational and renovation stages (Ahmadi et al., 2026; Qazi et al., 2026). In contrast, the MP encompassed detailed material data covering the entire life cycle of a building (Markou et al., 2025; Çetin et al., 2023).

These distinctions are particularly impactful for the Sri Lankan context. Because the local industry predominantly struggles with high material waste and the linear "take-make-dispose" paradigm rather than advanced operational energy tracking, the MP, with its specific focus on material recovery and lifecycle traceability, is the most urgent and contextually appropriate tool to introduce first, as summarised in Figure 1.

2.2 KEY REQUIREMENTS FOR A COMPREHENSIVE MATERIAL PASSPORT

Some studies have identified key requirements that should be included in a comprehensive MP template. Initially, there should be general information regarding the building such as the name, type, and location of the building, the year the building was constructed, the gross floor area, and the number of floors (Çetin et al., 2023; Markou et al., 2025; Göswein et al., 2022; Çetin et al., 2022). Moreover, product features such as details of the manufacturer, the product registration number, the unique ID of the materials, and a material photo must be included in the MP (Çetin et al., 2023; Markou et al., 2025; Göswein et al., 2022). Çetin et al. (2023) and Markou et al. (2025) explained that there should be product composition details in the MP, under this category, detailed information on materials and components used should be included by mentioning quantities, weight, volume, physical properties and the composition of materials.

Additionally, there should be quality standards for materials including performance characteristics, the durability status of the materials, and relevant certifications (Markou et al., 2025). Çetin et al. (2023) mentioned that there must be a quality assessment as an essential data requirement in the MP. On the other hand, Marsh et al. (2022) argued that omitting the quality of material category from the MP will undermine the effectiveness of the tool. Moreover, without incorporating quality standards into the MP, it would not be possible to enable the reuse of reclaimed materials efficiently or secure the cradle-to-cradle concept in the BE (Honic et al., 2021).

In addition, there should be details about the quantity of the materials in the MP and under this category, there is a need to include quantitative data on the amounts of material used expressed in weight (Markou et al., 2025). Çetin et al. (2023) and Göswein et al. (2022) also emphasized that the quantity of materials must be included in the MP as a data requirement category. The ability to deconstruct is another category to be included in the MP, under this category, it should be mentioned how a product can be dismantled easily for recycling or reuse purposes at the end of its life (Çetin et al., 2023; Markou et al., 2025; Göswein et al., 2022). However, Çetin et al. (2023) argued that ability to deconstruct data is not always readily available and requires an effort to obtain.

On the other hand, there should be an environmental impact category in the MP (Markou et al., 2025). Çetin et al. (2023) emphasized that under this category, there should be details about recycled or reused materials, the renewable or non-renewable content of the materials, details about whether materials are untreated or treated, and life cycle assessment details. These environmental impact details facilitate the CE concept by offering a systematic framework for evaluating material circularity performance in the BE (Senarathne et al., 2025). Furthermore, there should be details regarding product

safety features (Markou et al., 2025). Under this category, one should identify the hazardous substances used in the product, provide guidelines for the handling and disposal of those substances, and include the product safety data sheet (Çetin et al., 2023).

Moreover, there should be a category regarding product operational aspects. Under this category, this includes maintenance instructions, the maintenance log, maintenance contractor information, the availability of spare parts, and the expected service life (Çetin et al., 2023; Senarathne et al., 2025). Markou et al. (2025) expressed that under this category, proper recommendations for maintenance and care should be provided. Under the expected life data point, details of the duration for which the materials can be used under the normal conditions should be provided. Table 1 illustrates the summary of data requirements for a comprehensive MP.

Table 1: Summary table of required data to create MP template

Data Requirement Category	Sub Category	Illustrative Reference(s)
Building General Information	Name of the building	
	Type of the building	
	Location of the building	[A], [B], [E], [F]
	Year of building constructed	
	Gross Floor Area	
	Number of floors	
Product Features	Details of manufacturer	
	Product registration number	[A], [B], [E]
	Unique ID of the materials	
	Material photo	
Product Composition	Weight	
	Quantity	
	Volume	[A], [B]
	Physical properties	
	Composition of materials	
Quality of Materials	Durability	
	Performance characteristics	[A], [B], [C], [D]
	Certifications	
Quantity of Materials	Quantity of each material type	[A], [B], [E]
Ability to Deconstruct	Details of dismantle process	
	Details of recycling process	[A], [B], [E]
	Details of reusing process	
Environmental Impact	Details of recycle & reuse materials	
	Renewable or non-renewable content of materials	[A], [B], [G]

Data Requirement Category	Sub Category	Illustrative Reference(s)
	Details about untreated or treated materials	
	Life cycle assessment details	
Product safety features	Hazardous substances	
	Manuals for hazardous substances	[A], [B]
	Product safety data sheet	
Product operations aspects	Maintenance aspects	
	Maintenance log	
	Maintenance contractor information	[A], [B], [G]
	Availability of spare parts	
	Expected service life time	

[A]-Çetin et al., 2023; [B]- Markou et al., 2025; [C]- Marsh et al., 2022; [D]- Honic et al., 2021; [E]- Göswein et al., 2022; [F]- Çetin et al., 2022; [G]- Senarathne et al., 2025

3. RESEARCH METHODOLOGY

A literature review was conducted to identify the key data requirements needed for the MP. The MP is a very new concept to the Sri Lankan BE. Consequently, a quantitative approach was deemed unsuitable to collect data due to the lack of awareness of the concept within the BE, making it challenging to select a reliable and large sample. Qualitative research focuses on the quality of the data and aims to comprehend the explanations and motivations behind acts, as well as the way people perceive their experience and the environment around them (Ghanad, 2023), while facilitating the active participation of researchers in data collection (Creswell, 2017). Hence, a qualitative research approach was selected for this study to collect data using semi-structured interviews with stakeholders of the BE having knowledge of material specification and potential future users of MP.

Given that MP is a relatively new concept in the Sri Lankan BE, a specific interview protocol was established to ensure validity and reliability of the data. Initially, each interviewee's baseline understanding of MP was assessed. Subsequently, the interviewer, having extensively researched the domain, provided a comprehensive briefing on MP concepts, data structure, and lifecycle applications. During this briefing, literature-based MP data categories and explanatory examples from studies conducted in other countries were used to guide the semi-structured interview discussions, assisting respondents in evaluating the relevance of the MP requirements in the Sri Lankan context. This ensured that all respondents possessed a clear, unified understanding before providing their expert evaluations.

The interviewees were selected based on purposive sampling focusing on various stakeholders who would ideally be responsible for maintaining the MP throughout a building life cycle, such as civil engineers, quantity surveyors, architects, project managers, and facility managers(Senarathne et al., 2025). (refer Table 2). These participants were explicitly chosen because they have considerable knowledge of material

specifications, project coordination, construction documentation, facility management, and decision making in the context of a material's lifecycle. Given its qualitative exploratory nature and data collection continued until data saturation was achieved.

Table 2: Selection criteria of interviewed experts

Code	R1	R2	R3	R4	R5	R6	R7	R8
Designation	Civil Engineer	Quantity Surveyor	Architect	Civil Engineer	Project Manager	Facility Manager	Quantity Surveyor	Architect
Having more than 5-year experience	✓	✓	✓	✓	✓	✓	✓	✓
Involvement in building projects	✓	✓	✓	✓	✓	✓	✓	✓
Exposure to Material Specifications	✓	✓	✓	✓	✓	✓	✓	✓
Lifecycle phase experience	✓	✓	✓	✓	✓	✓	✓	✓

Thematic analysis was employed to systematically identify and analyse patterns within the interview responses. The process followed a structured deductive approach (Braun & Clarke, 2008), utilising predefined codes derived from the literature review. Interview transcripts were first carefully reviewed for familiarisation. Subsequently, data segments were manually coded using text-based software and transferred into a spreadsheet matrix. This matrix allowed the data to be systematically filtered and cross-referenced according to the predefined MP data requirement categories, ensuring a rigorous synthesis of the insights of practitioners. Findings from the literature and data analysis were then discussed to achieve the research aim and objectives.

4. RESEARCH FINDINGS AND DISCUSSION

Initially, pre-defined codes were developed based on the findings of the literature review and date collected from the respondents. These codes encompassed categories such as building and element identification, material specifications, composition, quality and durability, design parameters, sources, manufacturer details, installation records, maintenance and operation, environmental impact, recycle ability, and-end-of life deconstruction. Each interview transcript was carefully reviewed and statements from respondents were assigned to the appropriate codes to identify the most critical MP data requirements for the Sri Lankan context.

Table 3: Respondents summary

Category	R1	R2	R3	R4	R5	R6	R7	R8
Building and element identification data	✓		✓	✓	✓	✓	✓	✓
Material identification and specifications		✓		✓	✓	✓		
Material composition and quantities		✓	✓	✓	✓	✓	✓	✓

Category	R1	R2	R3	R4	R5	R6	R7	R8
Quality and durability data	✓		✓	✓	✓	✓	✓	✓
Design related parameters	✓							✓
Details of sources	✓							
Manufacturer details	✓	✓		✓	✓			
Installation records	✓			✓		✓		✓
Maintenance and operational data		✓	✓	✓	✓	✓	✓	✓
Environmental impact indicators	✓		✓	✓	✓	✓	✓	✓
Recycling ability			✓					
End of life deconstruction	✓	✓	✓	✓	✓	✓	✓	✓

4.1 BUILDING AND ELEMENT IDENTIFICATION DATA

According to Çetin et al. (2023), Markou et al. (2025), Göswein et al. (2022) and Çetin et al. (2022b), there should be general information about the building in an MP. This includes the name of the building, type of building, location, year constructed, gross floor area, and the number of floors. By including this data category, one can easily identify basic project details, and stakeholders can get an idea about project information. Additionally, R1, R3, R4, R5, R6, R7, and R8 commented that there should be building and element identification data. Specifically, R7 mentioned that "*it should include general building information, such as project name, location, building type, and construction year. It helps users understand the context of the project and identify the building easily*". These kinds of data requirements are highly accessible through the internal database of the relevant project.

4.2 PRODUCT FEATURES/MATERIAL IDENTIFICATION AND SPECIFICATIONS

Existing literature strongly supports the inclusion of product features such as manufacturer information, product registration numbers, unique material IDs, and material photos to ensure the traceability and transparency of building materials (Çetin et al., 2023; Markou et al., 2025; Göswein et al., 2022). The responses obtained from the industry practitioners further validate this requirement within the Sri Lankan BE. Specifically, respondents R1, R2, R4, and R5 emphasised the importance of manufacturer details in the MP template. The suggestion made by R1 regarding code-based manufacturer identification, *"code-based manufacturer details. For example, when we are going to use concrete if we can code the batching plant as a reference, then we can track the quality of the concrete"* highlights the potential for integrating systematic tracking mechanisms within MPs to monitor material quality and performance.

Furthermore, several respondents commented on the importance of having material identification and specifications data for the MP template when considering the Sri Lankan context. In this context, this requirement becomes important due to the diversity

of materials used in construction and the need for reliable documentation of specifications that are often dispersed across different project documents.

4.3 MATERIAL COMPOSITION AND QUANTITIES

Çetin et al. (2023) and Markou et al. (2025) emphasized that there should be product composition details in the MP. Under the product composition data requirement category, there should be included detailed material information and components used by mentioning quantities, weight, volume, physical properties and the composition of materials. Such information enables a comprehensive understanding of material traceability and lifecycle management within the BE. The responses from the industry practitioners in the study strongly support these arguments, as the majority of respondents (except R1) commented on the importance of including material composition and quantity details when developing an MP template tailored to the Sri Lankan context.

The practical implementation of this data category may present challenges within the Sri Lankan BE. This is because in many construction projects, detailed information regarding material composition and quantities is often dispersed across various documents such as BOQs, material specifications, and supplier records rather than being systematically centralized. R4 specifically mentioned that *"there should be material composition and quantities details. Quantities can be tracked with the BOQ but composition details tracking may be limited by supplier transparency".* Therefore, it will be critical to collect data for the MP template under this data requirement category.

4.4 QUALITY AND DURABILITY DATA

The inclusion of quality standards for materials, including durability, performance characteristics, and relevant certifications is considered an essential requirement for the development of an MP template (Çetin et al., 2023; Markou et al., 2025; Marsh et al., 2022; Honic et al., 2021). These types of information enable stakeholders to evaluate the reliability and long-term performance of materials utilized in construction projects. Consistent with existing literature, the data collection findings indicated that almost all respondents (except R2) highlighted the necessity of integrating quality-related information into the Sri Lankan MP template. Among them R7 explicitly emphasized the importance of documenting detailed quality verification information, stating *"There should be details to evaluate the quality of the material or product including warranties, inspection reports or test reports".* Consequently, systematically incorporating this quality-related data into the MP can significantly enhance reliability, transparency, and lifecycle management of building materials in the local BE.

4.5 END OF LIFE DECONSTRUCTION

According to Çetin et al. (2023), Markou et al. (2025), and Göswein et al. (2022) MPs should include details regarding the deconstruction ability of the construction project at the end of its expected lifetime, encompassing. The disassembly process, recoverability, and the feasibility of reusing or recycling building elements. However, findings indicate that the inclusion of end-of-life data currently has limited practical applicability within the Sri Lankan context. During the interview process, all respondents indicated that end-of-life deconstruction details are rarely considered in the current construction process in Sri Lanka. In particular, R8 commented that such details are not valid for Sri Lanka, most of the projects don't consider the end-of-life part. A sentiment echoed by R2.

Therefore, while deconstruction-related data are frequently suggested in international MPs, they are not yet mainstream in the local BE.

4.6 MAINTENANCE AND OPERATIONAL DATA

An MP should also incorporate product operation aspects including maintenance instructions, logs, contractor details, and availability of spare parts (Çetin et al., 2023; Markou et al., 2025; Senarathne et al., 2025). Such information enables building owners and facility managers to efficiently maintain building components and ensure their best performance over their service life. Except for R1, all respondents agreed that the inclusion of maintenance and operational data is highly applicable to the Sri Lankan context. R6 provided a detailed explanation, stating, "*there should be details regarding the maintenance and operational data including maintenance procedures, inspection schedules, repair guidelines, and previous maintenance history*". Furthermore, R1, R4, R6, and R8 recommended incorporating installation records under this category. R6 emphasized recording installation dates, responsible contractors, and installation methods because installation conditions may affect performance. Therefore, recording installation-related information within the MP can support improved lifecycle management of materials.

4.7 ENVIRONMENTAL IMPACT INDICATORS

Previous studies emphasized the importance of including environmental impact data within the MP template, such as renewable content, treatment details, lifecycle assessments, and recycled material usage (Çetin et al., 2023; Markou et al., 2025; Senarathne et al., 2025). These indicators are crucial for evaluating the sustainability and promoting CE practices in the BE.

During the data collection, all other respondents except for R2 commented on these indicators. Agreeing they could enhance sustainable practices; however, they noted that practical implementation remains limited locally. R1 highlighted this stating, *"in Sri Lanka we do not strictly focus on the environmental impact data such as the renewable or non-renewable ability of materials, and Life cycle assessment details"*. This suggests that while widely recommended in international MPs, the practical integration of environmental indicators into the Sri Lankan BE is currently constrained due to limited awareness, data unavailability, and insufficient regulatory requirements.

4.8 CONTEXTUAL ADAPTATION AND FINALIZATION OF MP DATA REQUIREMENTS FOR THE SRI LANKAN BE

Comparing the literature review insights with practitioners data, Figure 2 summarises the finalise MP data requirements for the Sri Lankan context categories such as building general information, product features, product composition, quality of materials, maintenance and operational details, and design related parameters were found to be highly applicable and ready for immediate implementation (Çetin et al., 2023; Markou et al., 2025; Göswein et al., 2022). Conversely, while end-of-life/deconstruction and environmental impact details are critical components of international MP template (Çetin et al., 2023; Markou et al., 2025; Göswein et al., 2022; Senarathne et al., 2025), respondents indicated these are rarely practiced in Sri Lanka. In the Figure 2 red color text indicated the collected data categories during the data collection process and black color text indicated the collected data categories through literature review. However,

completely excluding these categories would undermine the MP's primary objective of facilitating the transition from a linear to a circular economy. As an intermediate solution, these categories should be retained in the template as descriptive open fields accompanied by guidance notes.

Defining the MP structure requires careful consideration because buildings have long lifecycles; maintaining these open fields alongside strictly structured data points ensures the template's backward compatibility and support the eventual transition from static data models to dynamic MPs that can be continuously updated across all lifecycle stages (Ahmadi et al., 2026; Qazi et al., 2026). To address the current lack of utilisation, explanatory notes can provide an initial incentive for practitioners to continually improve their data recording practices as awareness grows. Ultimately, realising the full benefits of material passports requires supportive regulations and policy incentives (Senarathne et al., 2025). Furthermore, private sector initiatives, such as green building rating systems and certifications, can drive this adoption by introducing scoring criteria that reward projects for documenting end-of-life material pathways and environmental impacts (Ahmadi et al., 2026). This actively incentivises practitioners to populate these open fields, encouraging a market-based approach to broader CE adoption much like green building certifications did for energy efficiency (Ahmadi et al., 2026).

Ultimately, standardizing these data formats from the outset will enable the development of structured decision support systems, facilitating better material selection, maintenance planning, and long-term resource management among project stakeholders.

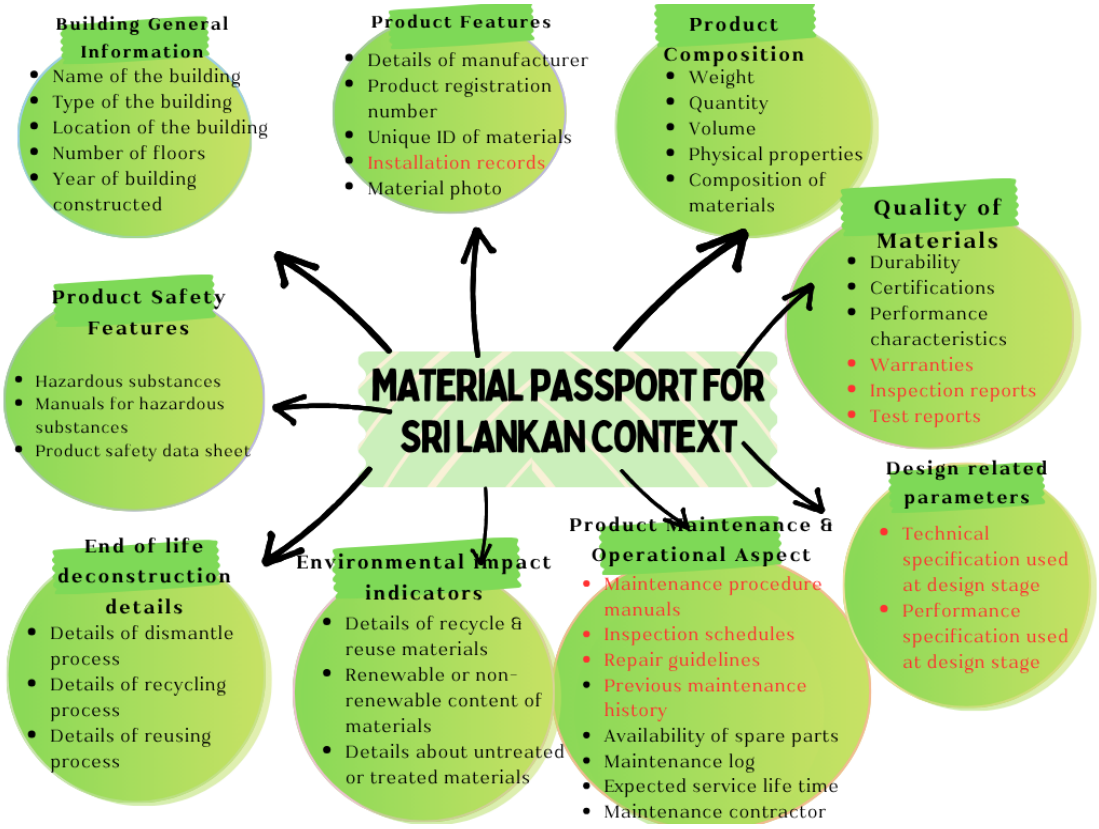

Figure 2:MP summary diagram for the Sri Lankan context

4.9 IMPLICATION OF THE RESEARCH

The findings provide a practical foundation for developing a standardized MP template suitable for the Sri Lankan BE. The identified data requirements can help construction stakeholders systematically document material information throughout the building lifecycle. Consequently, the adoption of MP could enhance material traceability, quality verification, and the lifecycle management of building components. The inclusion of information such as manufacturer details, material specifications, installation records, and maintenance data can enhance the more efficiency facility management and decision-making regarding maintenance aspects. Therefore, findings of this research study support industry practitioners, policymakers, and project stakeholders in developing a more transparent and information driven construction practice.

Additionally, this study contributes to the growing body of knowledge on MP and circular construction. It provides context-specific insights for the Sri Lankan BE, which is currently underrepresented in existing MP research. On the other hand, these findings contribute to the theoretical development of an MP template by illustrating the importance of adapting internationally proposed models to suit local industry practices and conditions.

5. CONCLUSIONS

This study concludes that the development of MP is a valuable strategy for enhancing the representation of material information in the BE. MP enhances the efficiency of tracking and assessing material attributes by enabling clearer communication between stakeholders. Accordingly, this research highlights MP as a practical tool for a border information management system. To develop a standardized MP template suitable for the Sri Lankan context, this research identified key data requirements including building general information, product features, material composition, quality, and maintenance aspects. Due to its qualitative exploratory nature, with eight industry practitioners, the findings may not be generalizable to the entire Sri Lankan BE. Data collection, however, continued until saturation was reached, that is, no new substantial insights arose from further interviews, to ensure the reliability and depth of the findings within the scope of the study.

However, because end-of-life deconstruction and environmental impact data are currently lacking in local practice, it is recommended to leave these as descriptive open fields for the moment. Consequently, an intermediate guidance note should be provided to allow stakeholders to include whatever data they currently have regarding material circularity. Moreover, defining the current MP must be done very carefully because buildings have a long lifecycle and the same MP will be used many years later. Because of this, the structure of the other defined fields must also be carefully chosen for consistency in revisions for backward compatibility. Once environmental and deconstruction data become practical, revised versions of the MP can be issued with proper revision notes, while maintaining the other fields to ensure no data is lost over time. By structuring material data, MP supports evidence-based decision-making. This illustrates how a structured MP template can enable the effective assessment mechanisms by facilitating CE practices and enhancing sustainability outcomes. As a qualitative research study conducted with stakeholders in the BE, the findings may have limited generalizability. Based on the findings of this paper, further studies can adopt the development of a fully

operational MP template for the Sri Lankan BE and explore the integration of MPs with digital platforms such as Building Information Modelling to facilitate more effective material data management and support the transition towards a circular and digitally enabled BE in Sri Lanka.

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