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TÜRK YAPI MALZEMESİ SEKTÖRÜNÜN ÇEVRESEL ÜRÜN BİLDİRİMİ İLE DENEYİMLERİ [1]

THE EXPERIENCES WITH ENVIRONMENTAL PRODUCT DECLARATION IN TURKISH BUILDING MATERIAL SECTOR

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Öz: Amaç: Bu çalışma, uluslararası bağımsız programlar tarafından onaylanan çevresel ürün bildirimleri (EPD) hakkında Türk yapı malzemesi üreticilerinin görüş ve deneyimlerini, ulusal çevresel ürün bildirimi sistemine yaklaşımlarını belirlemeyi amaçlamıştır. **Yöntem**: Çalışmada çevresel ürün bildirimi sertifikalarına sahip Türk yapı malzemeleri üreticileri için bir anket tasarlanmıştır. Yapı malzeme üreticilerinin bünyesinde yer alan çevre konularından sorumlu uzman kişiler ile "survey monkey" anket programı, sosyal ağ (Linkedln) ve yüz yüze görüşme gibi farklı iletişim araçlarıyla bağlantı kurulmuştur. **Bulgular**: Türkiye'de çevresel ürün bildirimi sayısı oldukça sınırlıdır. 42 yapı malzeme üreticisinden 36'sı ankete cevap vermeyi kabul etmiştir. Türk yapı malzemeleri üreticilerine göre çevresel ürün bildirimlerinin temel güçlü yönleri, kurumsal marka kimliğini geliştirmesi ve yeni pazar fırsatları sağlaması iken; bu bildirimlerin temel zayıflıkları, tüketicilerin çevresel ürün bildirimi hakkındaki bilgi eksikliği ve bu bildirimlerin kayıt ve yenilemelerindeki yüksek maliyetleridir. Üreticilerin %43'ü ulusal çevresel ürün bildirimine olumlu yaklaşırken, %7'si olumsuz yaklaşmakta ve üreticilerin %50'si ise bu konuda kararsız kaldığını belirtmektedir. **Sonuç**: Kararsız kalan üreticilerin ve EPD almayan diğer yapı malzeme üreticilerin görüşleri, EPD'lerin güçlü yönleri konusunda farkındalığın artırılması ve EPD'lerin zayıflıklarının ortadan kaldırılmasıyla değiştirilebilir. Ulusal çevresel ürün bildirimi sistemi, çevresel sonuçların doğruluğuna, yapı ürünlerinin çevresel etkilerinin karşılaştırılabilirliğine ve ulusal envanter veri tabanının geliştirilmesine katkıda bulunarak çevresel ürün bildirimi ile ilgili problemler için bir çözüm olabilir.

Anahtar Kelimeler: Çevresel Sertifika, Sürdürülebilirlik, Yaşam Döngüsü Değerlendirmesi

Abstract: Aim: This study aimed to identify Turkish building material manufacturers' opinion and experiences on Environmental Product Declarations (EPDs) approved by the international independent programs and their approaches to a national EPD system. **Method**: In the study, a questionnaire was designed for the building material manufacturers with EPD certificates in Turkey. It was contacted with specialists responsible for environmental issues in building material firms through different connections such as "survey monkey" questionnaire program, social network (Linkedln) and face to face interviews. **Results**: The number of EPDs in Turkey is very limited. 36 of the 42 manufacturers agreed to answer the questionnaire. According to the manufacturers, the main strengths of EPDs are developing corporate-brand identity and providing new market opportunities, while the main weaknesses of EPDs are the consumer's lack of knowledge about EPD and high costs of EPD registration and renewal. 43% of the manufacturers have a positive approach, while 7 % of them have negative approach and 50 % of them remained undecided for local EPD. **Conclusion**: The opinions of the undecided and non-certified manufacturers can be modified by increasing awareness of EPDs' strengths and by eliminating EPDs' weaknesses. National EPD system can be a solution by contributing to the accurate environmental results, the comparability of the environmental impacts of the building materials and the development of local inventory database for the EPD problems.

Key Words: Environmental Certification, Sustainability, Life Cycle Assessment

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INTRODUCTION

Environmental Product Declaration (EPD) quantifies the environmental impacts of the building materials by using Life Cycle Assessment (LCA) methodology and helps contractors, constructors and planners to better understand the related environmental issues. LCA is internationally acknowledged as a science-based, standardized environmental assessment methodology that evaluates impacts of a product or a service in the entire life cycle defined as “cradle to grave” or “cradle to cradle”. “Cradle to grave” is the system boundary of an LCA which covers all activities from raw material supply up to the end of life phase, while “cradle to cradle” is the system boundary of an LCA which provides a closed loop cycle of the materials thanks to reduce, reuse and recycle. The LCA methodology described in the ISO 14040 (2006) standard series consists of goal and scope definition, Life Cycle Inventory Analysis (LCI), Life Cycle Impact Assessment (LCIA) and interpretation phases. While LCI is a phase where the inputs and outputs are calculated, LCIA is a phase aimed at understanding and evaluating the magnitude and significance of the potential environmental impacts for a product system.

EPD process includes Product Category Rules (PCRs) development, EPD draft, verification and publication of the EPDs according to ISO 14025 (2006: 21-22) (Figure 1). In this context, the standard provides the principles and procedures for Type III EPDs. One of the objectives of Type III EPDs is to provide LCA based and additional information on the environmental aspects of products to enable comparisons among products fulfilling the same function.

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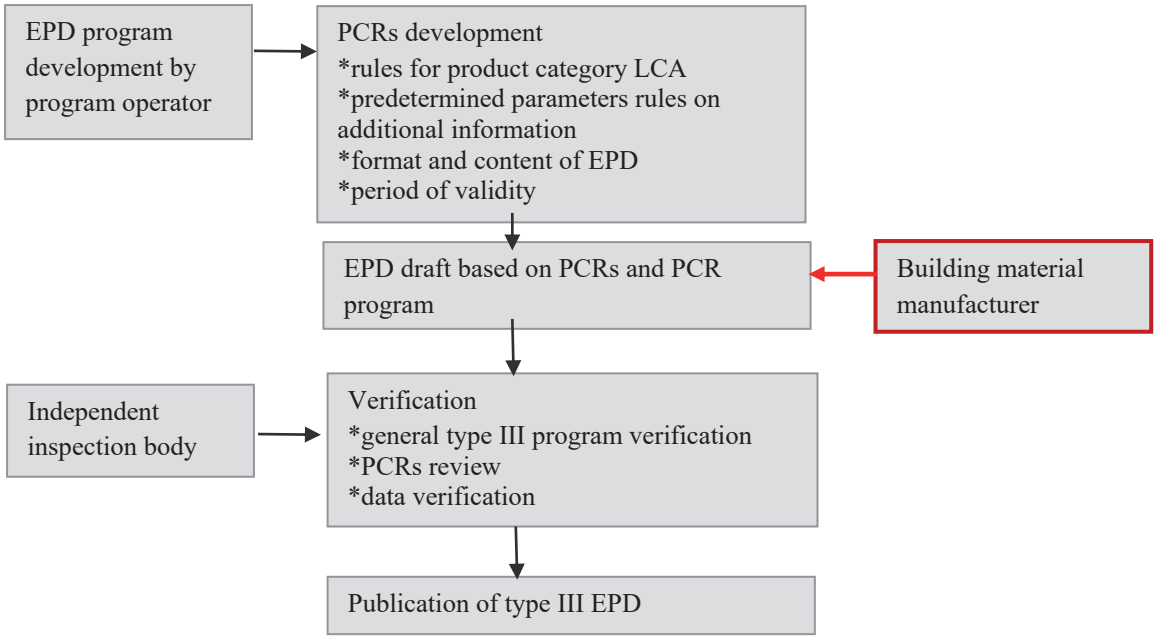

Figure 1. Type III EPD Process for The Building Materials

EPDs according to the EN 15804 (2012: 12-15) are voluntary, transparent and well-established way to present fundamental and verified environmental information based on LCA about the impacts of a product or product group. The standard provides PCRs for Type III environmental declarations in the construction sector. The PCRs set the functional unit, the scope, the boundaries, the life cycle inventory data and the environmental impact categories and shall be performed in accordance with ISO 14040 (2006: 11-12-13-14), ISO 14025 (2006: 8-9-10-11), EN 15804 (2012: 16-17-18) and ISO 21930 (2017: 24-25-26). ISO 21930 (2017) cancels and replaces the first edition (ISO 21930- 2007) that has been revised and changed technically. This standard provides the principles, specifications and requirements to develop an EPD for the building materials and services. The standard also complements ISO 14025 (2006) for the specific requirements. The standards about EPD are displayed below (Figure 2).

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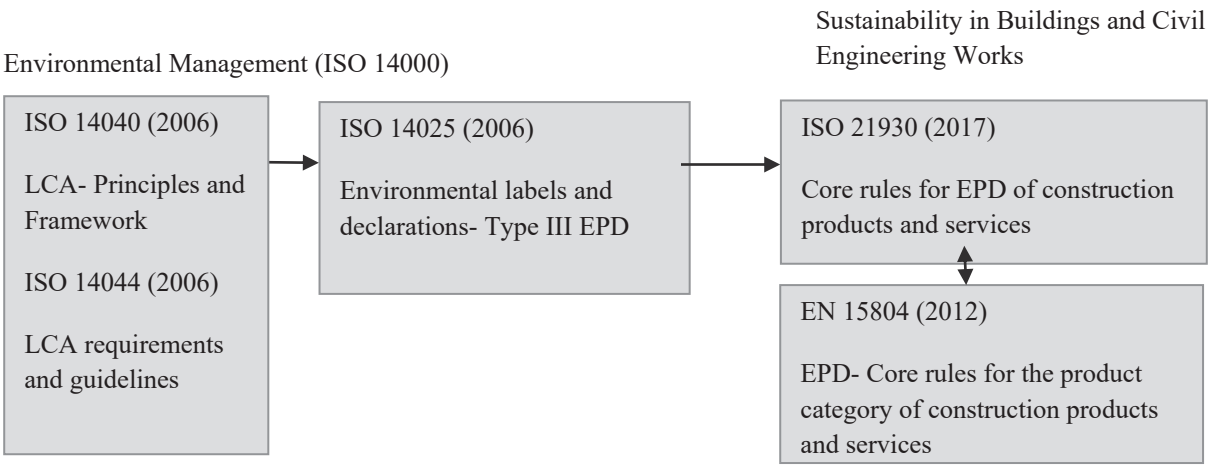

Figure 2. Standards for Type III EPD of Building Materials, Source: Modified from [6].

The environmental information of an EPD including all life cycle phases shall be subdivided into the module groups. According to EN 15804 (2012: 14) and ISO 21930 (2017:18), modules A1-3 (raw material supply, transport to manufacturing site and manufacturing) include product phase of the building materials, A4-5 (transportation from gate to the construction site and assembly) include construction phase, B1-7 (use phase, maintenance, repair, replacement, refurbishment, operational energy use and operational water use) include use phase, C1-4 (deconstruction-demolition, transport, waste processing and disposal) include end of life phase, while D includes supplementary information beyond the building life cycle such as reuse, recovery and recycling potential. Modules A1-3 are mandatory while the declaration of the other modules is optional for cradle to gate (life cycle phases from raw material supply up to the factory gate) EPD. Modules A, B and C are mandatory for cradle to grave EPD.

AIM

Inventory database for the building materials in Turkey has not been developed yet and lack of environmental data is the main problem for the challenges of assessing the environmental impacts of the building materials. EPDs provide quantitative environmental data and comparison of the environmental impacts caused by the building materials. In this context, participation of the building material manufacturers is important in obtaining environmental data. Therefore, it was aimed to identify local building material manufacturers' opinion on the strengths and weaknesses

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of EPDs, communication tools that provide to know EPD and their approach to a national EPD system in this study. It is thought that the experiences and opinions of the manufacturers can be reference for the future studies on a national EPD system.

SCOPE

While participation of government and academia is important in terms of taking environmental decisions and contributing to sustainable development; participation of the building materials sector plays an active role in the acquisition and evaluation of environmental data especially in developing countries such as Turkey. Therefore, the building material sector was the focus in the study. Experiences of the Turkish building material manufacturers that have applied for an EPD certificate from international programs were evaluated.

RESEARCH METHODOLOGY

In the study's first part, the recent literature on EPD of the building materials was presented. In the second part, environmental initiatives and studies conducted on the building materials sector in Turkey were examined. In the study's last part, a questionnaire was designed to distribute to the building material manufacturers with EPD certificates. It was contacted with the environmental specialists on EPD of the building material manufacturers through different connections such as "survey monkey" questionnaire program, social network (Linkedln) and face to face interviews. 36 of the manufacturers agreed to report their opinions and to answer the questionnaire on EPD. The factors that led the manufacturers to choose EPD program, their experiences and opinions on a national EPD system, the strengths and weaknesses of EPDs, and the advantages of local EPD were evaluated.

RESEARCH LIMITATIONS

In this study, it was difficult to communicate with the environmental specialists of the building material manufacturers. Firstly, the questionnaire was prepared in the "survey monkey" program. Although the questionnaire was short in length and quick to complete (<15 minute), only four manufacturers answered the questions. Therefore, the study was mostly completed by face-to-face interviews and social communication tools such as Linkedln. It is thought that inadequacy of sector- academia cooperation, intensive work processes and reluctance to share the environmental information about their firms may have been effective in not responding to questions promptly.

One of the other limitations of the study is that there are very few manufacturers with

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EPD in Turkey. Unfortunately, this study only reflects the opinions of 36 manufacturers.

RESEARCH PROBLEMS

The main problems that have led to the research,

- Non-comparable environmental impacts in Turkey

Although EPDs can provide collection of environmental information for the local database, all data used for EPDs are not local due to the lack of environmental data. Both foreground (primary) data such as industry-based data and background (secondary) data such as Ecoinvent data are used for EPDs. Building material manufacturers have taken EPDs from different declaration holders in Turkey and it is seen that different background data that can cause incorrect environmental results in the comparison have been used (Oztas and Tanacan, 2016: 3-4). While inventory studies are new in Turkey, developing a standardized way that provides to allow comparison of the building materials' environmental impacts is an urgent need.

- Limited EPD certification

In Turkey, there are over 6400 building material manufacturers in large, medium and small-scale. Unfortunately, it was found that only 42 manufacturers have had EPD certificate. For future studies, experiences of the very few manufacturers may be useful to encourage the remaining manufacturers to the consideration of green certificates.

By contemplating these problems, the question of the research is if a national EPD system may be accepted by the Turkish building manufacturers. The other question of the research is what the advantages and disadvantages of the EPD system are.

RESEARCH SUBPROBLEMS

One of the most important factors limiting the use of the LCA methodology that is necessary for EPD is the lack of environmental data in developing countries such as Turkey. Besides this, environmental awareness of the building material manufacturers and consumers is not high enough in Turkey.

RESEARCH HYPOTHESIS

Considering the strengths and weaknesses of the EPD, it is thought that the national EPD system may be accepted for Turkish building material manufacturers and may be solution to increase awareness of EPD and to compare environmental impacts correctly.

THEORETICAL FRAMEWORK

EPDs can be used by designers to select environmental friendly material (Gelowitz and McArthur, 2016: 63-64). EPD is an important tool for voluntary declaration of environmen-

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tal impacts and too many materials manufacturers will apply for the EPD certificate (Almeida, et.al, 2013: 5). There are many Type III EPD program around the world. Each program develops its own PCRs and classifies PCRs differently. Distribution of EPD programs are different between the regions. While Europe has highest share with 56 %, EPD programs of North America has a share of 28% and Asia has a share of 8% (Minkov, et al., 2015: 241).

There are several factors that may increase EPD use. EPDs can be used by designers, manufacturers, end users and used for purchasing and procurement. The use of EPDs can be extend by the public procurement to ask for goods and services to have registered EPD (Bovea, et al., 2014: 149). Certification programs are also effective in increasing EPD use. LEED v4 provides two points for products having EPD. One point requires the use of at least 20 different permanently installed products sourced from at least five different manufacturers which have EPDs, while a second point requires the use of products which demonstrates impact reduction below industry average in at least three of the six impact categories: global warming potential, ozone depletion, acidification, eutrophication, ozone formation and non- renewable energy depletion[1]. The LEED credit provides incentives both for manufacturers to create EPDs and practitioners to implement it in construction projects (Gelowitz and McArthur, 2016: 65).

The use of local data is important in obtaining accurate environmental data and for also EPDs. In a study in Europe, it was emphasized that the weakness of EPD use is the lack of information about EPD (Fores, et al., 2016: 157-165). In the other study, the importance of local factors was emphasized, and it was mentioned that more efforts are needed to develop regional and sector specific databases (Silvestre, et.al., 2015). The study about an EPD of ready mix and precast concrete in Qatar applied Gulf Green Mark – Type III EPD (GGM-EPD) and related PCRs were developed. It was aimed to identify environmental information gap for local database besides the reduction and comparison of the environmental impacts (Biswas, et al., 2017: 36-37). In Finland, environmental PCRs for a local EPD certification named with RTS were identified by a committee. In addition to EN 15804 standard, RTS includes more information modules such as A4, C1, C2, C3, C4 and D in accordance with some provisions (Sariola and Ilomaki, 2016: 77-79).

Comparability and harmonization between EPDs are the largest concerns in EPD studies.

1 https://www.usgbc.org/credits/new-construction-core-and-shell-schools-new-construction-retail-new-construction-healthca-22

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In the study focused on the EPD experiences in five European countries, it was indicated that the high number of EPD programs point to the demand for environmental assessment of building materials. Austria, Belgium, Germany and France among five countries have their EPD program. It is evident that EPDs are used in national database and building labeling/certification schemes in these countries. Their programs also have national appendix of EN 15804. The need on harmonization and clarification related to system boundaries, service life of products and buildings, data quality requirements, allocation rules, impact categories and assessment methods, scenarios, end of life approach and biogenic carbon emissions were also highlighted for EPD programs (Passer, et al., 2015: 1206-1208). Alignment of PCRs to compare the environmental performance of products was the focus for another study. It was mentioned that there is no single international body that oversees the program operators. Challenges were stated as definition and classification of product category, data requirements, geographic scope of PCRs and the format of the claim for aligned PCRs (Ingwersen and Stevenson, 2012: 102-105-106). In the study of Gelowitz and McArthur (2016: 65), it was emphasized a strong need for harmonization in PCRs to compare EPDs. Their study in 2017, three keys barriers to EPD adoption were identified as overuse of generic data sets, poor data quality, data availability and the cost of EPD development according to the literature. 50 EPDs and their underlying 13 PCRs were studied to identify the issues that prevent product comparison. Therefore, an EPD comparison matrix was developed to compare EPDs. The lack of harmonization among EPDs and PCRs, poor quality of PCRs and inability to comparison among EPDs were the focus. As a result of the study, it was indicated that 38 % of EPDs were missing information required by ISO standard and 8% of EPDs had self-contradictory information. Oversight for program operator and their PCR committee, consistent functional units and characterization factors, more transparency for EPD data and a movement towards the treatment of cut off and allocation rules were recommended (Gelowitz and McArthur, 2017: 131-132).

One of the factors that affects EPD use is the cost of EPDs and LCA application. The results of the study about the costs of EPD assessment have displayed that the costs of PCRs and EPDs are between 13,000 and 41,000 dollars and the workload to be between 22 and 44/ person- day. It was indicated that comprehensive research on how to reduce the costs while maintaining reliability of EPDs is required (Tasaki, et.al., 2017: 727-730).

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ENVIRONMENTAL INITIATIVES and STUDIES in TURKEY

Some standards related to the environment and the building materials in Turkey are formed by the result of the harmonization of ISO and EU standards. These standards in Turkey are developed in the context of ISO 14000 series. The environmental impacts of the building materials are controlled by the TS EN ISO 14001 standard (2015), while the principles and framework for LCA are described by TS EN ISO 14040 (2007). In addition to the standards, performance declarations on basic characteristics of the building materials, the rules for the CE (Conformité Européene) marking of the materials are indicated in the regulation on the criteria of the building materials of the Ministry of Environment and Urban Planning. Environmental requirements in of the building materials as referred to in the regulation are hygiene- health and environment, energy savings, heat conservation and sustainable use of natural resources[2].

One of the most crucial reasons for not using LCA methodology is the lack of environmental data and a local inventory database in Turkey. In November of 2017, the Republic of Turkey- Ministry of Science, Industry and Technology, The Scientific and Technological Research Council of Turkey and Sustainable Development and Cleaner Production Center- Boğaziçi University have been initiated the project named with “Development of National Life Cycle Assessment Database”. It is aimed to develop a core data set for energy production, domestic and industrial water production in the promising project. It is the first initiative supported by the government for the development of LCA database.

Green certificate regulation for settlements and buildings has been published by the Ministry of Environment and Urban Planning in December 2017. The certification is optional, and this assessing process is controlled by national green building information system named with YeS-TR. Besides, Green Building Association in Turkey has developed a local certification system (ÇEDBIK- housing) for new housing projects. One of the assessment criteria is the material and resource use.

Academic studies about LCA of the buildings in Turkey have increased since the early 2000s Unfortunately, it is evident that the researchers often use non-local secondary database using some LCA programs such as SimaPro and GaBi due to the lack of local data in Turkey (Banar and Çokaygil, 2011: 204, Mangan and Oral, 2015: 845, Ölmez, et.al., 2016:196, Atmaca and Atmaca, 2015: 423, Mangan and Oral, 2016: 368).

2 http://sgb.csb.gov.tr/mevzuat/dosfolmezyalar/r_20131004041501885_5620f1bc-9042-41bc-9ccf-6bcc4587b194.pdf

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One of the important stakeholders for EPD development and implementation is construction sector. There are over 6400 building material manufacturers in large, medium and small-scale in Turkey. Approximately 140 manufacturers in the sector are large, the rest are small and medium-scale. Building materials industry is grouped under 30 sub-sectors such as prefabricate elements, bricks, aerated concrete, ceramic, iron and steel[3]. The environmental friendly material production is limited in Turkey and should be supported to reduce the cost of procurement (Cengiz, et.al., 2014:11).

RESULTS

In the study, it was contacted with the specialists on EPD of the building material manufacturers through different connections such as "survey monkey" questionnaire program, social network (Linkedln) and face to face interviews. 42 manufacturers have EPD certification in Turkey. 36 of them agreed to report their opinions and to respond to the questionnaire on EPD. The factors that led the manufacturers to choose EPD program, the strengths and weaknesses of EPDs, the manufacturers' opinion on national EPD system and the advantages of local EPD were evaluated.

In this study, some data were obtained by researching EPDs of 42 manufacturers even though all of them have not responded to the questionnaire. Turkish building material manufacturers have had EPD certifications since 2011. IBU (Institut Bauen and Umwelt) and the international EPD system are the most preferred programs among 42 manufacturers (Figure 3). All manufacturers applying for IBU, the international EPD system and UL Environment program have had EPD certificate for five years, while nine manufacturers applying for BRE Global certification program have had EPD for the periods between one and three years. The manufacturers in the scope of the study apply the environmental management systems such as ISO 14001 and ISO TR 14025. Some of the manufacturers also have different environmental certifications such as ecolabel, water label and carbon footprint.

3 http://www.imsad.org/Uploads/Files/tisdkar_ana.pdf

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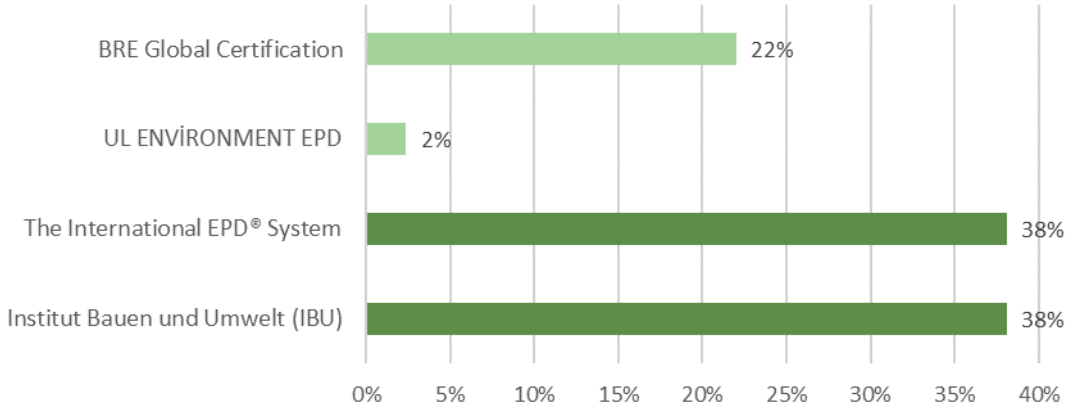

Figure 3. EPD Programs Received By 42 Building Material Manufacturers in Turkey

In Turkey, mostly large- scale and well-known manufacturers have received EPD certificate while medium and small-scale manufacturers have not initiated EPD certificate yet. Figure 4 displays that mostly manufacturers that produce metallic materials and ancillaries such as structural steels, steel profiles and accessories, steel reinforcing bar have had EPD certificate. EPDs for some building material groups such as bricks and wood-based products have not been found (Figure 4).

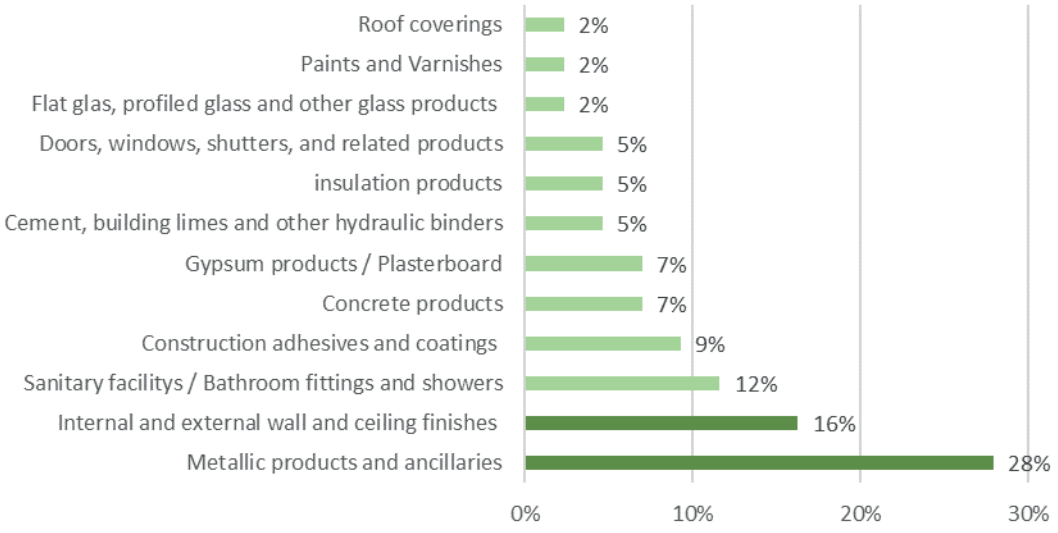

Figure 4. Number of Manufacturers Having EPD by Product Category in Turkey

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In the scope of EPDs, it is evident that the environmental impacts of the building materials have been assessed under different system boundaries such as cradle to gate, cradle to gate with options and cradle to grave. In addition to the mandatory information modules (A1-3) for all EPDs, disposal phase (C4) is mostly included in the scope of EPDs. Unfortunately, the environmental impacts during the use phase including use, maintenance and repair of the building materials have mostly been neglected (Figure 5).

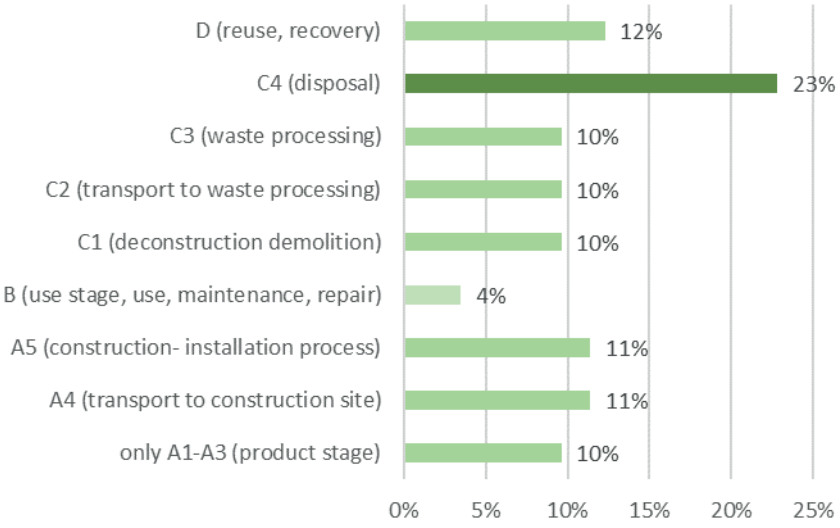

Figure 5. Information Module Groups Within the System Boundary of EPDs

The same or convertible functional units are necessary for the comparison of environmental impacts. When EPDs belonging to the same product group are evaluated in terms of functional units, it is seen that the same or convertible functional units for EPDs have been used in Turkey.

The answers of the manufacturers display that commercial market and technical consulting are the most effective communication tools that provide to know EPD for the Turkish building material sector (Figure 6).

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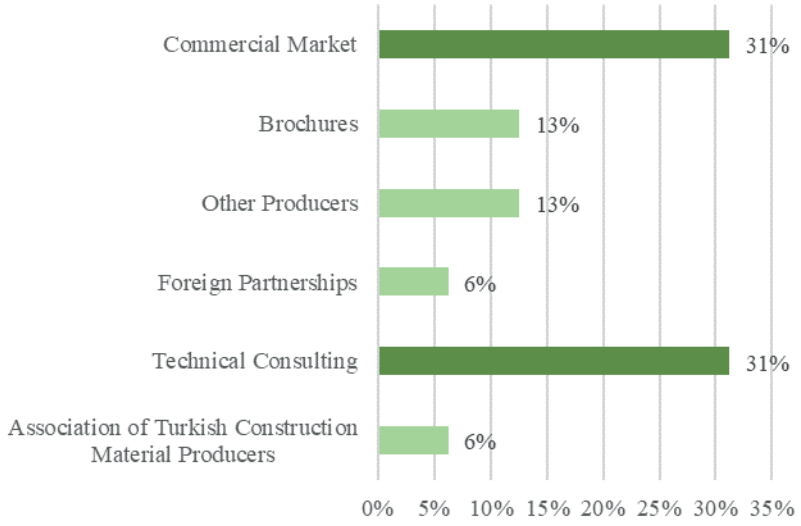

Figure 6. Communication Tools That Provide to Know EPD

It is seen that the main strengths of EPDs are developing corporate-brand identity and providing new market opportunities according to the manufacturers (Figure 7).

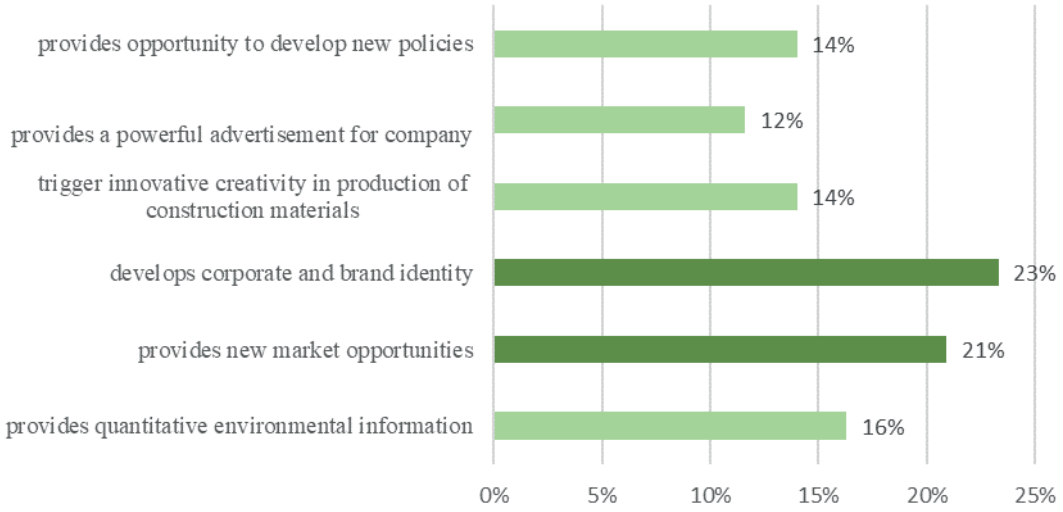

Figure 7. Strengths of EPDs According to The Manufacturers

The main weaknesses of EPDs is the consumer's lack of knowledge about EPD according to the manufacturers. High cost of registration and renewal of EPDs and re-

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quirement a long period and intensive study program are the other important weaknesses of EPDs (Figure 8). In addition to the questions of the survey, the obligation to become a member of association that operates an EPD program such as IBU is the other weaknesses.

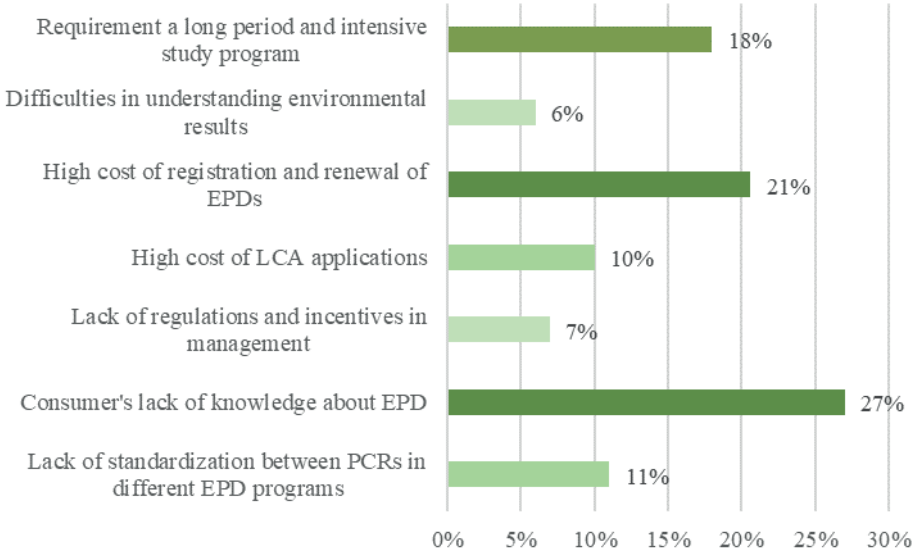

Figure 8. Weaknesses of EPDs According to The Manufacturers

43 % of the manufacturers have a positive approach for a national EPD system, while 7 % of them have negative approach and 50 % of them remained undecided in this regard. It is stated that a national EPD system may reduce the costs of EPD and may be better known by the consumers (Figure 9).

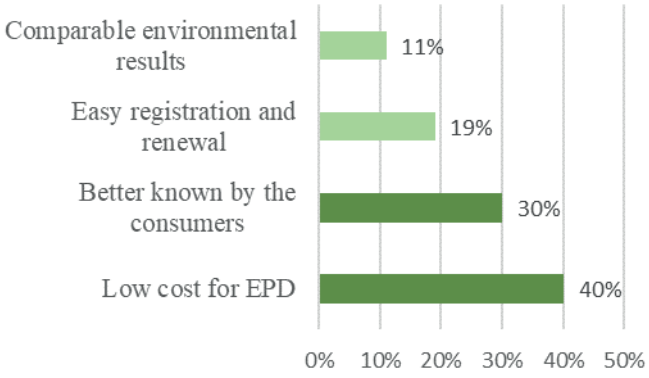

Figure 9. Answers for A National EPD System

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DISCUSSIONS

The building material manufacturers having EPD are very limited in Turkey. A study that was aimed to determine the promoters and barriers for green building applications in public sector displays that it is difficult to find certified building materials in Turkey (Yıldız, et.al.,2016: 257). It is seen that the manufacturers have applied for different EPD programs that use different background data and PCRs in Turkey (Oztas and Tanacan, 2016: 3-4). Appropriate LCA data for the building materials are a prerequisite for the assessment. Thus, building LCA might be more sensitive to background data selection (Takano et al. 2014:21). Yokoo et al. (2013:315) indicated that the use of different databases causes numerical differences in LCA of the buildings. In addition to the database, comparability is further dependent on the PCRs used. Therefore, it is thought that a national EPD system could provide comparability of the building materials by using local inventory data and the same PCRs. A standardized way to allow comparison of the environmental impacts of the building materials is needed.

The number of EPDs varies among building materials groups. It is seen that metal and wall- ceiling finishes manufacturers are more concerned with the EPD certificates. No manufacturer in the brick and wood-based product industry has received an EPD certificate. Recognition of EPD and LCA methodology should be provided for the manufacturers of different building material groups. A manufacturer having EPD may increase environmental awareness for the other manufacturers of the same product group.

In addition to mandatory information modules (A1-3) for EPD according to EN 15804 standard, the environmental impacts of disposal phase have been mostly declared by the Turkish material manufacturers. It displays that the manufacturers have environmental data about this phase. However, data for use phase are very few and studies about use phase of the building materials should be increased.

The communication tools are useful for the manufacturers to know EPD. When it is considered that the numbers of EPD manufacturers in Turkey are very few, the effectiveness of the communication tools should be improved. In Turkey, Association of Turkish Construction Material Manufacturers as a non-governmental organization that have a large member consists of the building material manufacturers may provide more benefits to increase the awareness of the sustainability among the manufacturers. Increasing the building materials sector and academia cooperation, government incentives and development of the legal regulations can be useful in this regard.

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Developing corporate-brand identity and providing new market opportunities are the main strengths of EPDs. In addition to these strengths, EPDs are very useful for the innovative product and process development when assessing the environmental impacts of each process. EPDs also provide quantitative environmental information that is useful to develop an inventory database of the materials.

The main weakness of EPD according to the manufacturers is having little demand to environmentally sensitive products by the consumers. The consideration of environmental labels of the building materials such as EPD in green building certifications may increase the use of the labels. The incentives such as EPD points in LEED certificate are mostly used in the developed countries. Selection of the environmental friendly materials using EPDs in architectural design phase also may increase the use and recognition of EPDs. Increasing the environmental awareness of the consumers is the main solution to increase the demand to the environmental friendly materials. A national EPD system may be better known by the consumers to be supported by regulations and incentives of the government when compared to an international system.

The other important weakness of EPD is the costs of LCA applications, registration and renewal of EPDs. In Turkey, LCA methodology is applied by specialized firms. Having specialists responsible for environmental issues in building material firms and a national EPD system may reduce LCA costs. In addition to the strengths and weaknesses of EPD, collection of the environmental data in developing countries is an opportunity to EPD. However, increase in number of programs and the lack of formal oversight of program operators are threats to EPD.

Developing a local inventory database is time-consuming for the processed based LCA. Instead of this, adaptation of existing database such as Ecoinvent for Turkey may be a solution for the lack of data. Increasing environmental awareness of the manufacturers and a systematic data collection method may be useful in eliminating data incompleteness.

There is no need for a national EPD system according to 7% of the Turkish manufacturers with EPD, while a national system can be useful according to 43% of the manufacturers. Most of the manufacturers think that a national EPD system can reduce the costs of EPDs and provide to better known by the consumers. The opinions of the undecided manufacturers can be modified by increasing awareness of the strengths of the EPDs and eliminating the weaknesses of the EPDs.

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CONCLUSION

It is thought that EPDs will be inevitable for the building materials to be able to take part in the international market in the future. A standardized way to allow comparison of the building materials' environmental impacts should be developed for Turkey. National PCRs should be created in addition to the rules in related standards with the participation of different stakeholders such as building materials sector, government and academy. And a national EPD system should be developed.

The following contributions can be provided with a national EPD system;

- contribution to develop local inventory database
- contribution to the correctness of the environmental results
- the low cost of EPD registration and renewal
- providing better known by the consumers
- contribution to increase environmental awareness of the local manufacturers and consumers

The problems and the proposals about EPD for Turkey are shown below. The problems indicated by red are the main problems indicated by the manufacturers (Figure 10).

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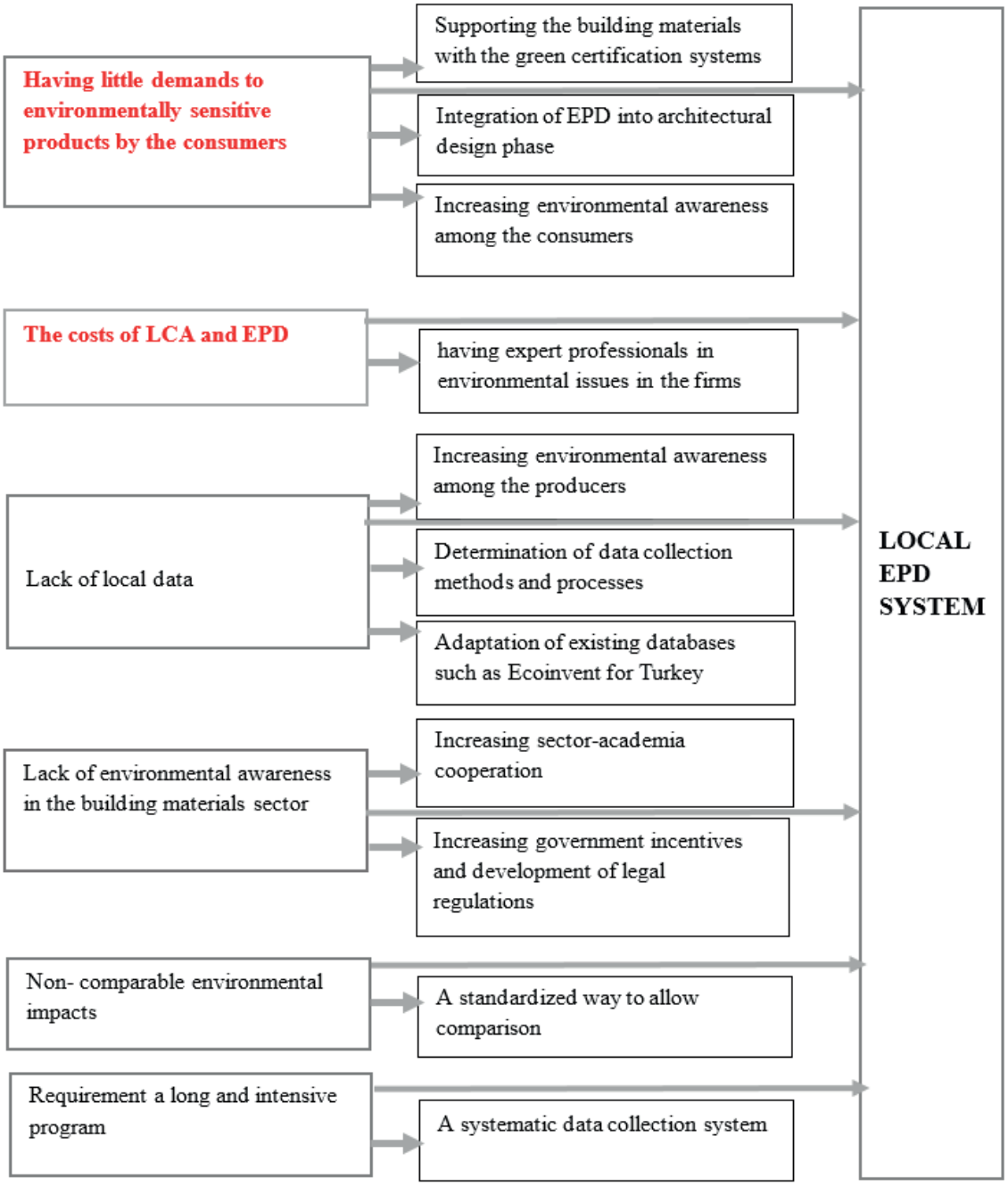

Figure 10. Problems and Proposals about EPD for Turkey

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