Design for Disassembly as Support Trend towards Extended Producer Responsibility Policy in Malaysia

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Abstract

The Extended Producer Responsibility (EPR) policy has been implemented in numerous developed countries across the world, for the purpose of the recycling and disposal of solid waste. In Malaysia, the EPR policy has not yet been implemented as a full policy, but there exist some elements in the existing national solid waste management policy that have similarities with the EPR policy, since the 1980s. Currently, the trend towards implementing this policy is becoming stronger with the introduction of the Solid Waste and Public Cleansing Management Act (SWPCMA) in 2007, and the 10th Malaysian Plan (10MP) in 2010, which clearly incorporate elements of the EPR policy. Moreover, the Malaysian Government has recently cooperated with the Japanese Government to draft a new framework to manage e-waste (i.e. electrical and electronic equipment waste), which include provisions of the EPR policy. With this scenario, it is highly important for both the manufacturing and construction industries to consider incorporating the Design for Disassembly (DFD) into their processes. The DFD is needed to support the EPR policy, since the DFD provides design and technical support that contributes to the successful implementation of the policy. Unfortunately, although the EPR policy is expected to be implemented in the near future, the majority of industries involved are not yet equipped with the skills and knowledge to integrate the DFD in their processes. This study aims to address this issue, and elaborate on how industries should take into consideration the incorporation of the DFD into their processes, in order to support the implementation of the EPR in the near future.

Keywords: Design for disassembly; Design for environment; Recycling; Extended producer responsibility; Manufacturing, construction

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1.0 INTRODUCTION

Design for Disassembly (DFD) is a comprehensive concept in product design that considers the manner in which products may be disassembled for future upgrade, repair, recycle, or remanufacture or redevelopment (U4R; Sustainable Consumption, 2016). This design concept is part of the provision for Design for Environment, which places a high priority to protect the environment and public health in its processes.

The product range discussed in this study covers products as small as consumer electronic devices, to those as large as multi-storey buildings reaching the end of their life, and may have an adverse effect on the environment if not managed properly. The term ‘product’ here is applicable to, not only the area of manufacturing, but the construction industry as well.

The advancement of technology has made products, especially consumer products, have a relatively shorter life-cycle (Ward, J. et al., 2016). Therefore, it is critical for a product to be designed with the consideration of how it may be disassembled for future upgrading, repairing, recycling, or remanufacturing or redeveloping (U4R). Failure to do so will result in the product to end up in a landfill site, with the possibility to contaminate the environment. The community as a whole should attempt to minimize as much as possible the disposal of solid waste to landfill sites. The cost of operating a landfill site is increasing, and the cost of having a new site is even most costly. Furthermore, having waste products at a landfill site may potentially have adverse environmental effects on the environment; especially if the product contains hazardous components (Yang, Y. et. Al., 2016) Therefore, the consideration to include DFD from the beginning stage of product design, to the end of its life, is crucial for the safety of the environment.

There is a growing concern throughout the world about protecting the environment. Trends are moving towards designing a product with sustainability in mind (Schöggel, J. P., 2017). With DFD, the resources needed to perform U4R can be increased significantly, thus reducing the amount of utilising raw and scarce materials for manufacturing and construction, and in turn reducing the amount of wastage involved (Priyono, A., et al., 2016).

According to the US Environmental Protection Agency (EPA), an estimated 91.5% of overall construction-related waste is generated annually in the US alone, mainly due to renovation and deconstruction; while only 8.5% is produced from new construction. The
volume of this construction-waste is significant, because it constitutes to 30% of all waste produced in the US (Accociates, F., 1998). This massive volume of construction-waste will be among the largest sources of solid waste in the next generation, after 2020.

In the manufacturing industry, the United Nations Environment Programme (UNEP) reported that the large volume of household e-waste (i.e. waste from electrical and electronic products) produced around the world is increasing by 40 million tonnes per year (Huisman et al., 2008). In Malaysia, as shown in Figure 1, the production of household e-waste is also expected to increase in the near future. These figures are significant, especially for products such as personal computers (PCs), mobile phones and rechargeable batteries. The amount of e-waste in terms of volume is not as high as compared to construction-waste, since the former is potentially hazardous in nature. If this waste is not treated properly, e-waste will have a negative impact on the environment and public health in the future (Asia E-waste Project, 2009).

Both the construction and manufacturing industries should bear the responsibility for the adverse effects towards the environment, if these issues are not resolved. The application of DFD offers an alternative and effective approach to increase the application of U4R in these industries.

Hereafter, we will investigate the trends towards implementing the Extended Producer Responsibility (EPR) policy in Malaysia, and its relation to DFD, before sharing the details and benefits of DFD in both the manufacturing and construction industries.

Figure 1 Future Projection for e-waste in Unit Quantity in Malaysia in 1981 - 2020
(Source: Asia E-Waste Project, 2009)

2.0 EXTENDED PRODUCER RESPONSIBILITY (EPR)

Extended Producer Responsibility (EPR) is an approach towards environmental policies for manufacturers’ responsibilities of their products being extended to the post-consumer stage of a product's life cycle (OECD, 2001). EPR is considered a novel method in managing waste in developing countries such as Malaysia. EPR requires the producer, manufacturer or developer of the product to provide a collection service, or what is commonly referred to as a take-back service, to collect products that near the end of their lives. The take-back service is carried out to allow the product to undergo U4R processes in order to recover valuable materials, and prevent the product from being directly disposed to landfill sites.

In European countries, for example, EPR has become a policy that is widely implemented. They enforce electronic products manufacturers to use DFD related processes in order to manage their schedule waste (such as e-waste) (Reagan, 2015).

The main aim of this policy is to manage and promote U4R activities related to schedule waste, so that the recovery of useful materials can be implemented, and the amount of solid waste disposed in landfill sites is decreased. The EPR policy has also been implemented in many OECD countries. The same policy has also been implemented, even though at certain state levels, a different approach has been used to manage e-waste.

Having implemented this policy, manufacturers and developers in these countries have to carefully plan and strategize their processes in order to fulfil the objectives of EPR. This has resulted in implementing the use of modern DFD techniques in order to comply with EPR requirements.

After successfully implementing EPR, the results have been encouraging, where they are able to reduce or totally eliminate waste materials from being disposed at landfill sites, or to perform the U4R processes for future utilisation in the industry (Triguero, A., 2016).
The methods in the take-back system are carried out with the cooperation from third party vendors, such as public collections centres in public malls, community recycling centres, as well as companies that provide recycling services (Mmereki, 2016).

In Malaysia, the EPR policy has not yet been implemented, but there exist some elements in Malaysia's national solid waste management policy and legislation that generally have similarities with the EPR policy in general. However, the Malaysian Government did not proceed to develop and implement the EPR policy, although new solid waste management policies have been introduced to the country, including the National Strategic Plan for Solid Waste Management (NSP) in 2005; the Master Plan on National Waste Minimization (MWM) in 2006; and the National Solid Waste Management Policy (NSWMP) in 2006.

Nevertheless, in 2007, with the growing concern for environmental management in the country, the government has proposed the Solid Waste and Public Cleansing Management Act (SWPCMA) in 2007, and the 10th Malaysian Plan (10MP) in 2010, which clearly incorporated elements of the EPR policy. In general, SWPCMA provides detailed elements of the EPR policy that include requirements, such as take-back systems, deposit refund systems, and minimum volume for recycled content (Agamuthu et al., 2011). Figure 2 depicts the Malaysian Waste Policy and Legislation timeline.

![Timeline for Malaysian Waste Policy and Legislation](image)

Figure 2 Timeline for Malaysian Waste Policy and Legislation (Source: Agamuthu et al., 2011)

This trend suggests that the Malaysian Government does have the intention to implement a full EPR policy in the future, even though the current focus is towards basic necessities such as solid waste collection, recycle and disposal including schedule, as well as construction waste.

The Department of Environment (DOE), Malaysia is currently working with the Japan International Cooperation Agency (JICA) to develop a policy framework to manage e-waste. The objective of this framework is generally similar to an EPR policy that has been implemented in other developed countries. The framework plans to make it compulsory for producers and manufacturers to design their products to meet EPR requirements, as previously mentioned.

The Director of Malaysia's DOE Hazardous Waste Unit, Dr. Abdul Rahman Awang, made a statement in the press mentioning that the industry in Malaysia should be responsible for the products that they produce, and should consider how the product could be designed using methods that involve the production of less waste (Tan, 2010).

With this scenario, it is thus crucial for the industry in Malaysia to start planning, strategizing and developing their human capital to implement the DFD, before the EPR policy is fully implemented in Malaysia in the near future. Hereafter, we further discuss the necessities and benefits of the application of DFD in the manufacturing and construction industries.

### 3.0 BENEFITS OF DESIGN FOR DISASSEMBLY (DFD)

Among the latest trends in product life cycle (PLC) design is to consider incorporating the DFD in the manufacturing or construction processes (Akhtar, F., 2016). Industries in Malaysia should investigate the necessity of adopting DFD technology into their product design processes, especially if the government decides to implement the EPR policy in the future.
The products that are designed with DFD can easily implement U4R, and thus enable the majority or all of the components to be reused. This feature should be considered, even if the product is not recycled once the product has reached its end of life.

There are many practical reasons for incorporating DFD in industrial processes, including:

- Reducing the number of components to be used, thus having fewer components to be disassembled in the future;
- making compulsory dismantling and using U4R in product design and construction, since DFD has taken place;
- using fewer and similar fasteners or design fasteners that can easily allow the components to be dismantled;
- avoiding the use of adhesives to easily dismantle products, or using adhesives that can be removed easily, with environmental friendly substances such as water;
- creating disassembly instructions with the product to help users understand how to dismantle it;
- reducing hazardous materials used in product design and construction;
- using coding standards for all components and materials so that it can be easily be traced and referred to when the disassembly process is required; and
- setting measurable targets of the average amount of materials by weight per product to be recovered, and using them as general guidelines in product design, to gauge the success in waste recovery.

These practical applications are referenced from various resources, including Autodesk Sustainability Workshop modules and Design for Disassembly for Built Environment (Disassembly and Recycling, 2016; Sustainable Consumption, 2016).

4.0 ADOPTION OF DFD AND EPR IN THE MALAYSIAN INDUSTRY

Innovation As previously mentioned, due to the constant increase of solid waste, such as e-waste and construction waste, several developed countries have implemented waste management policies that require manufacturers and contractors to be responsible for the products that they build (Gui, L., 2016). This is done by setting up a system to take back the products to implement U4R; this policy is known as EPR. Besides taking back the products directly themselves, producers, manufacturers or developers may also partially finance the collection of the end of life products by incorporating them into the cost of the product, especially during the design stage (Pires, 2015). This can be implemented if the take-back system has not been implemented, or is inadequate, and thus requires the public to cooperate with a third party vendor to manage the collection of the waste.

DFD can play an important role in solving this issue by ensuring that the product is designed with recycling and resource recovery in mind (Kibert, C. J., 2016). The EPR policy could play a significant role in ensuring that DFD is implemented by creating incentives for companies to redesign their products to suit EPR requirements, as discussed in the previous section.

The technology to incorporate DFD into industrial processes would require a significant amount of investment to produce skilled personnel to use DFD. Therefore, the government should provide incentives to the industry to start developing their human resources to adapt to future requirements of the EPR policy (De los Rios et al., 2016).

With this scenario human resource development institutions in Malaysia should also address this issue. Skill development institutions and universities that are currently involved in training skilled manpower in PLC design should incorporate DFD in their syllabus as soon as possible to support the industry in the future. If they do not have the knowledge and skills required, then they should immediately prepare their trainers and lecturers, before the demand for these skills becomes mandatory.

The implementation of DFD can also be further strengthened if society supports the idea of having their products easily disassembled for U4R. This can be achieved through promoting awareness about the importance of DFD for the environment. Activities such as educating the younger generation during their school years about the importance of protecting the environment, are crucial for the implementation of the DFD, and in turn the EPR policy.

5.0 CONCLUSION

In conclusion, implementing Design for Recycling (DFD) is in line with the trend towards the EPR policy implementation in Malaysia. With DFD, the product being manufactured or constructed can be redesigned to be more environment-friendly, and have the capacity to recover resourceful materials for future usage. The government of Malaysia can play a significant role in ensuring the protection of the environment by implementing the EPR policy in the future, as well as supporting activities that ensure the success of the policy’s implementation. The application of DFD offers opportunities for the manufacturing and construction industries to move upward by protecting the environment and achieving economic sustainability, for a better Malaysia.

REFERENCES


