

Drivers and Challenges for the Practice of Material Efficiency Strategy in the Wire and Cable Industry: A Malaysian Case Perspective

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The importance of the wire and cable industry to serve this modern society can be seen through the application of wire and cable in many industrial devices and products. The manufacture of wire and cable is sound as a simple process compared to other types of manufacturing industry, such as the electrical and electronics industry. Nevertheless, the wire and cable industry does generate unnecessary waste during its manufacturing process. Practicing material efficiency is an effective solution to reduce material waste during cable manufacturing. It is for this reason that this study is conducted to investigate the drivers and challenges faced by the wire and cable manufacturer to practice material efficiency strategy. A semi-structured interview was conducted with one of the foremost Malaysian wire and cable companies. The findings demonstrate that the main drivers to motivate the wire and cable manufacturer to practice material efficiency strategy is the economic advantage, followed by market competitiveness concerns, and, finally, compliance with environmental requirements; while the challenges faced are mainly technical issues, such as unskilled workers, poor management and planning. In addition, limitations in technology and restrictions of legislation on the product design are identified as barriers for cable manufacturing. Providing these findings, can be a reference point for other cable companies or other companies to enhance material utilization in order to reduce waste generation.

Keywords—challenges, drivers, material efficiency, sustainable manufacturing, wire and cable industry.

I. Introduction

The wire and cable industry plays an important role in serving the different manufacturing industries and the construction sector, e.g. supplying power and communication cables. Similar to many industries, the manufacture of wire and cable

products generate solid waste and other by-products. For many manufacturers, including the wire and cable manufacturer, practicing a material efficiency strategy is seen as an effective solution to minimize the material used and waste generation; however, sometimes, these solutions are not clearly presented due to many unclear factors. For example the drivers and challenges faced by the manufacturer. Most of the time, a lack of consideration of these factors in the manufacturing industry can lead to a high volume of material waste generation. While, in less severe conditions, the manufacturing industry may fail to compete with other competitors and incur economic losses by consuming unnecessary raw materials.

Very seldom does the wire and cable industry report generating industrial solid waste to the environment. To understand the factors that might help or influence the wire and cable industry to use the material efficiently, it is important to study the factors influencing their drivers and challenges. This link, however, has not been researched in past studies, and recent literature on material efficiency practices show that there is no study that discusses the efforts to use less materials in the wire and cable industry [1-3]. Hence, it is apparent that there is a need to explore the factors relating to the drivers and challenges of the wire and cable manufacturers to practice material efficiency strategies. This information is useful to the manufacturer, especially in gaining a clearer understanding of the critical factors pertaining to the efficient use of material.

Forming a framework to understand the drivers and challenges for practicing environmental strategy can serve as a useful reference model to aid the manufacturer in understanding the need for continuous improvement of their product manufacturing, especially in a specific discipline [4]. Nevertheless, no specific material efficiency framework has yet been designed for the wire and cable industry. For that reason, there is a need for an integrated framework to clarify the information concerning the drivers and challenges to use the material efficiently within the wire and cable industry.

Understanding the drivers and challenges for practising a material efficiency strategy can serve to better improve the use of material in the wire and cable industry. Therefore, a study is needed to explore the real case for generating an insight into the drivers and challenges faced by the wire and cable industry. The data gathered from this study will be useful as a starting point to aid the wire and cable industry concerning practicing a material efficiency strategy. In addition, it will provide important information to other cable related industries about the factors that influence the efficient use of material. Perhaps, with the inputs from this study, it can be used as an

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important source to support the Malaysian wire and cable manufacturers in practicing material efficiency strategies.

II. Literature Review

Raw material is the core element to enable the manufacturing process. However, to use the raw material efficiently has become a challenging issue to many manufacturers, especially to understand the factors that influence the material efficiency practices [3][5]. Therefore, to investigate material efficiency practices, it is essential to analyse and determine the firm's drivers and challenges [2][3]. Understanding these factors can aid the manufacturer to formulate appropriate material efficiency practices that suit their company, product, as well as their production lines [2][3]. From previous studies relating to material efficiency practices, the frequently seen drivers can be categorized as economic, legislation, stakeholder pressure, and also self-responsibility. Examples of material efficiency drivers are shown below:

- Reduce energy consumption [2]
- Reduce the material waste [3][5][6]
- Reduce the manufacturing cost [1][2][5]
- Reduce the waste or waste management cost [2][3][6]
- Business opportunities to global market [2][3][7]
- Comply with the environmental legislation [2][3]
- Increase market competitiveness [2][3][5][6]
- Stakeholder requirements [3][5]
- Self-awareness and responsibility [2][5][6]

In the context of challenges, Peck and Chipman [5] stated that most of the material efficiency practices challenges are due to the limitations of technology, restriction on product design, and unwillingness of manufacturer to practice. According to Pajunen et al. [3], challenges to practising material efficiency are due to rapid market competitiveness, restrictions arising from the industry culture, difficulty in complying with the environmental standards and legislation, lack of knowledge and data, relying on the end of pipe thinking, the challenges relating to poor management and planning, and lack of support from the other industrial stakeholders, such as the subcontractors and consultants.

There is a growing trend in the literature on material efficiency related research. Nevertheless, the available literature indicates that more new literature is needed, particularly the data from various industries. Therefore, a new study of various industry cases is important to bridge the gap and support a comprehensive database for practicing material efficiency strategy, e.g. investigation of drivers and challenges to practicing material efficiency strategies of cable manufacturers.

III. Research Methods

Few studies have been conducted to understand how the manufacturing companies practice material efficiency strategies. For this particular reason, an exploration study of a real industrial case is the most appropriate approach to understand the perspective of the industry in practicing material efficiency strategy [8]. In addition to the limited number of wire and cable companies in Malaysia, only one wire and cable company agreed to be interviewed. The selected case study company is one of the foremost wire and cable companies. See Table 1 for company details. The semi-structured interview method was used to gain an insight into the company's practices. A 90 minute interview was conducted with the Quality Manager from the Product Quality Department, and the interview data were audio recorded.

To explore and gather the information concerning the drivers and challenges for practicing material efficiency strategy, "what" and "how" questions were mainly asked to the key-informant. The purpose of "what" questions is to understand important criteria relating to material saving or material use, e.g. "What is the driver to encourage material saving?"; "What are the challenges faced by your company to deal with material saving and material waste?" In addition, "how" questions are also asked to the key informant to clarify "what" answers relating to the influence of practicing material efficiency strategies. For example, "How the mentioned drivers influence the material efficiency practices?"; "How the challenges faced affect the material saving?"

Table 1: Details of the wire and cable company

Company origin	Italian-based multinational corporation headquartered in Milan.
Number of employees	300 (Malaysia) 12,350 (International)
Activities involved	Manufacturing and laying cables for the energy and telecommunications sectors, commercial industry plant, building construction.
Interviewee	Quality Manager
Example of product:	Control and Instrumentation Cables, Fire Performance Cables, Marine Cables (Ships/Offshore Platform), Data Communication Cables, Industrial Wire and Cable

IV. Data Analysis

For the purpose of data analysis, the interview was transcribed verbatim resulting in 11 pages of transcript. This transcript makes it possible for researchers to undertake a thorough qualitative data analysis. Qualitative thematic

analysis is used to perform data sorting, coding, theme building, and also reporting the findings [9]. Careful analysis and studies are important to identify the highly related quotes. Several rounds of checking were conducted with other research members to ensure the derived data are consistent in terms of the interpretation. The list of drivers to practice material efficiency and selected quotes are shown in Table 2. The list of drivers to practice material efficiency strategy and selected quotes are shown in Table 3. Fig. 1 presents the developed framework of drivers and challenges to practice material efficiency strategy based on the company's study production structure. This framework could provide useful guidance to other cable manufacturers as it indicates the potential material waste generation along the cable manufacturing. Furthermore, in the figure it does show the drivers and challenges addressed by the wire and cable company.

Table 2: Drivers to practice material efficiency

Driver(s)	Sample Quotes
Material waste reduction	...off course to achieve minimum cost, the factors for us is to be a good quality of cable to produce with less reject and the highest output.
Manufacturing cost reduction	I think the driver, from the opinion is the cost because in the cable industry, the market is also quite competitive, but the product is standard. What we can improve actually is to bring down the cost, the cost of the manufacturing, I think the main factor is still the operation cost.
Waste management cost reduction	... because high cost was due to high rejection, less output, and all these rejection handling also quite costly, so when looking at the cost.
Environmental legislation compliance	What we have now is the ISO14001, we fully comply with the environmental requirements, so the way we manufacture, the way we process, the way we handle and manage our company is actually based on the requirements of the ISO14001.

Table 3: Challenges for practising material efficiency strategy

Challenge(s)	Sample Quotes
Technology limitation	The only thing that the process requires more concern for during the manufacture of the cable is the insulation process and the inner jacketing and outer jacketing, because these processes are using the extrusion machine where when once you start the process, you can't stop the process, you cannot easily stop the process, once the process stops, it is considered a product failure.
Lack of knowledge	For me, a must is to improve the process, the worker skills, and the ability to handle the machinery of the process. Because our industry is nearly 100% manual work.
Restriction of product design	So, when replacing materials, the material must be replaced with the same material, but an improved of grade materials. We are not doing material replacing.
Environmental legislation	During design with the cable, when something happens with the legislation, our design also needs to comply with the international standards.

v. Results and Discussion

Similar to other manufacturing industries, cable manufacturing does generate material waste. For example, generation of copper dust during the copper drawing process, by-products of cable during the machine setup and changing of the raw materials, product failure during the extrusion process, and also cable scrap during the final inspection and testing.

From this study, it can be seen that the major drivers to enhance material use in the wire and cable company is to produce a cost efficient cable. This can be achieved by reducing the raw material waste, reducing manufacturing cost, and reducing waste management cost. Most of the time, the wire and cable company is trying to generate less scrap during the manufacturing as this has a direct impact on the extra material used, e.g. continuous monitoring of the extrusion process, especially for cable jacketing. In addition, less rejection of the end product does encourage the cable manufacturer to practice material efficiency strategy. If these activities can be achieved, it will probably decrease the waste management cost and increase the company productivity. However, less concern is given to the waste, such as copper dust and the by-products during processes and machine setup. These solid wastes are normally treated as scheduled waste that can be sold to the recyclers. Thus, the allowance of raw materials to be wasted during the machine setup, such as

copper dust and by-products are not significant for the wire and cable company. Meanwhile, the studied company is also certified to the ISO 14001 standards in order to ensure their manufacturing processes are fulfilling the environmental requirements with less waste generation. With this certification, it can be used to increase the company's competitiveness, especially concerning the awareness of environmental benign manufacturing. Furthermore, the ISO certification is to ensure that the manufacturing process and waste management follow the right environmental procedures.

Through the interview session, it was gleaned that the machinery used to manufacture cable is mostly outdated. Therefore, practicing a material efficiency strategy with these technology limitations has created a big challenge to the wire and cable company. Among these challenges, the reliability of machines to produce the same dimension of cable is noticed as being the most addressed issue. The manager also clarified that not many technological innovations are developed for the wire and cable industry. Consequently, the Malaysian wire and cable industry is still unable to propose and use the high-tech technology to assist the cable manufacturing processes. Therefore, the use of new technology to assist in reducing the waste is not happening in the wire and cable industry.

From this study, it was found that many operational tasks are handled manually by the skilled workers. In some of the tasks, such as drawing and the extrusion process, manual jobs play an important role in ensuring the processes flow is smooth and controlled within the stated dimension allowances. However, as we understand that not all the workers are skilful, lacking technical knowledge can cause more waste generation, especially from the unskilled workers. Although this problem is unavoidable and frequently happens in other industries, it has been raised as one of the major issues faced by the wire and cable company. In addition, this situation will become severe when the wire and cable company needs to process various types of cable at one time by the unskilled workers.

In the aspect of product design challenge, wire and cable design is limited and not many changes can be made. This is due to the requirements that have been set by the product standards and engineering requirements. Therefore, changes to the cable design rarely happen and are strictly not allowed to ensure the product fulfils the safety aspect. According to the interviewee, the cable design specifications are controlled by authorized bodies whereby changes cannot simply be made by the manufacturer. By understanding the restriction of the product design in wire and cable manufacturing, it can be presumed that cable product design is considered rigid and not advisable to be changed. However, improvement in terms of adding more protection layers to the cable is still allowed. Therefore, material substitution in the wire and cable company is not an option at this moment.

VI. Conclusion

The concern of sustainable manufacturing has forced many industries to use the raw material efficiently, including the wire and cable industry. This study was conducted using

qualitative methodology to explore the drivers and challenges of Malaysia's foremost wire and cable manufacturer to practice material efficiency strategy. From the study, wire and cable companies are acknowledged as a low tech industry with simple manufacturing processes. To achieve material efficiency, this company is greatly influenced by the economic drivers, followed by legislation and self-responsibility factors. However, the influence of stakeholder pressure was the least significant to the company under investigation.

Despite the limited innovations and changes found in the cable design, the need for new technologies for cable processing still appeared unnecessary. For that reason, the cable manufacturing process still relies on manual jobs from skilled workers. Other challenges, such as employee lack of knowledge, poor management and planning do prevent the materials from being used efficiently in the company. In short, the awareness level of the wire and cable manufacturer towards the sustainable use of materials is still at the initial stage because non-critical industrial waste issues are found in this industry.

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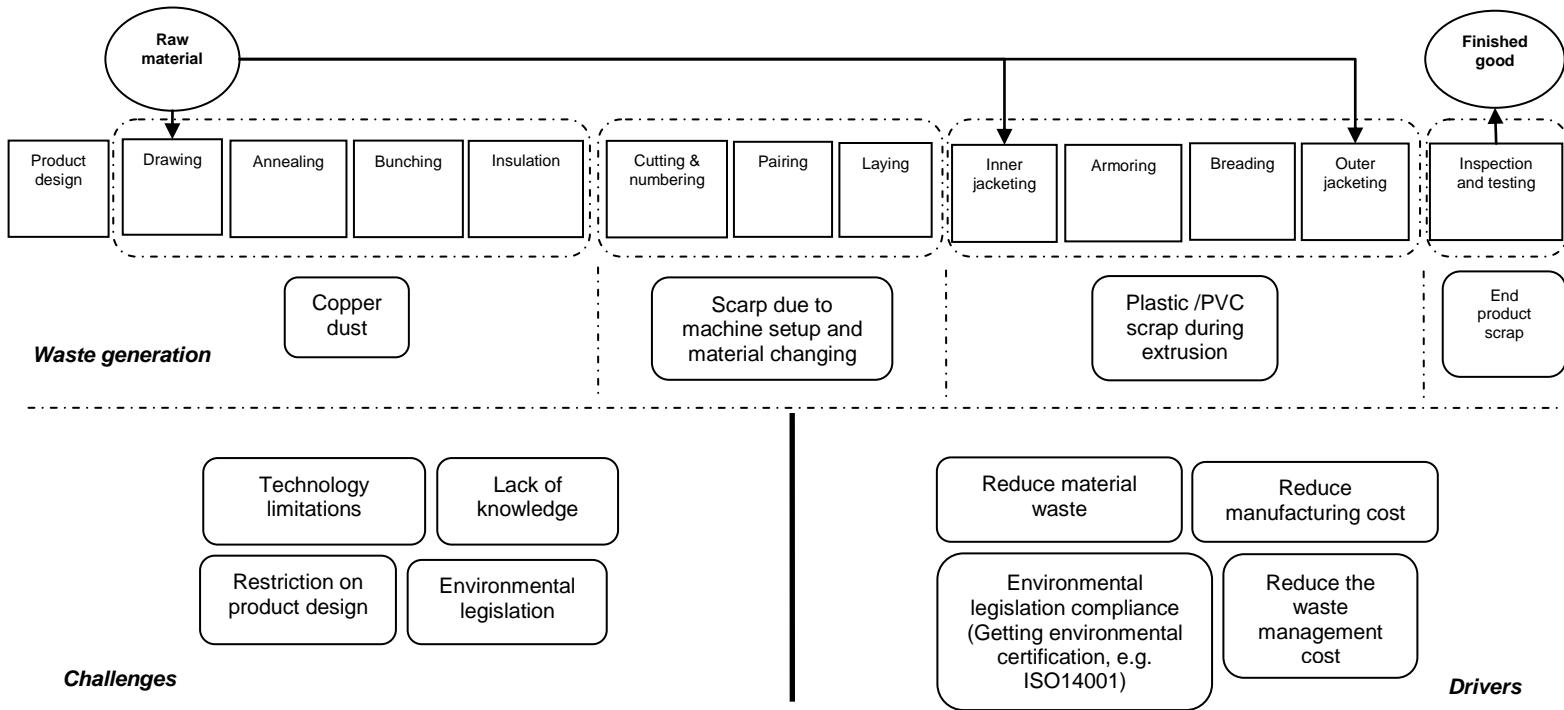


Figure 1. Framework of drivers and challenges to practice material efficiency for Wire and Cable Company.

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