Remanufacturing policies have been gradually introduced in Asian countries, such as China, Japan, Malaysia, Singapore, and Thailand. This paper reviews the process of diffusion of remanufacturing policy in Asia. The mechanism of this diffusion is also discussed. The United States began to promote the idea of remanufacturing around the year 2000 through bilateral free trade agreements with Asian countries and international forums such as G8 and the Asia-Pacific Economic Cooperation (APEC). This paper reviews the various efforts on remanufacturing in Asian countries and discusses policy options for promoting remanufacturing. It is crucial to identify the ways to promote remanufacturing in each country in the region to improve resource efficacy and strengthen the circular economy in Asia.

Keywords: remanufacturing, circular economy, policy diffusion, Asia

1. Introduction

Remanufacturing is an important component of the circular economy. The International Resource Panel defines remanufacturing as “a standardized industrial process that takes place within industrial or factory settings, in which cores are restored to original as-new condition and performance, or better” [1]. Some studies have proposed some sets of Rs for circular economies, including reduce, reuse, recycle, and remanufacture. For example, Kirchherr et al. [2] listed 10R strategies for circular economies, including remanufacturing, by reviewing 114 circular economy definitions. Reike et al. [3] also adopted remanufacturing as one of the 10R value retention options for the circular economy.

The concept of remanufacturing has also spread throughout Asia. However, there are few studies on remanufacturing policy in Asia. This paper aims to present the current status of remanufacturing policies and the process of diffusion in Asia. The challenges and prospects of remanufacturing in Asia are also discussed. Various environmental policies have been disseminated from pioneer countries to other countries. Gilardi [4] claimed an emerging consensus regarding the mechanism of transnational diffusion of environmental policies, which can be grouped into “coercion,” “competition,” “learning,” and “emulation.” Some studies focused on the diffusion of environmental policies such as emission trading and energy efficiency to Asian countries [5].

Some Asian countries have included “remanufacturing” in their laws or circular economy action plans. But the United States (U.S.) and the European Union (EU) have put more emphasis on remanufacturing than Japan [6]. Based on the review of remanufacturing policies in Asia, elements of policies to promote remanufacturing have been identified.

This paper consists of the following sections. Following this introduction, Section 2 reviews the national laws and action plans to promote remanufacturing in Asian countries. Section 3 discusses regional initiatives to promote remanufacturing, which are likely to disseminate the concept of remanufacturing throughout the region. In addition, the mechanism of diffusion of remanufacturing policies into Asia is discussed. Section 4 concludes with the policy recommendations to promote remanufacturing.

2. Remanufacturing in National Laws and Action Plans in Asia

Remanufacturing is an important pillar for establishing a circular economy. Some Asian countries have adopted regulations and action plans for their circular economies.

2.1. Japan

Japan developed the standard on retreaded tires in 1954, which have been used especially for trucks and buses. With the exception of retreaded tires, the Japanese government did not take the initiative to promote remanufactured goods until 2001.

In 1991, the Act for the Promotion of Utilization of Recycled Resources was enacted. The law, which focused on recycling, was revised and renamed the Act on the Promotion of Effective Utilization of Resources in 2001. It covers the 3Rs, namely, reduce, reuse, and recycle. Remanufacturing was not mentioned in the act, but remanufacturing is regarded as an inherent part of “reuse.” Based on the law, the government is able to specify products for which producers should utilize parts for reuse, refurbishing, or remanufacturing.
The ministerial order of the law listed the products that producers should design and produce products and parts for easy reuse, in addition to recycling. Products listed for reuse include automobiles and home appliances (TVs, air conditioners, refrigerators, washing machines, microwave ovens, personal computers, and copy machines).

Matsumoto et al. [7] described the history of remanufactured auto parts in Japan based on an interview with the CEO of a company that produced remanufactured alternators and starters. The company was established in 1967. From the 1970s to the mid-1980s, the major market was the U.S. The domestic markets started to grow in the early 2000s.

In 2017, the Ministry of Health, Labour and Welfare revised the ministerial ordinance on the standards for remanufactured single-use medical devices. Before the ministerial ordinance, it was reported that the number of hospitals operated by national universities using remanufactured single-use medical devices decreased from 2007 to 2013. The reason behind the decrease was the nonexistence of official standards to regulate the practice.

2.2. China


In the same year, China enacted the Circular Economy Law, which also mentions remanufacturing in Article 2 on the definition of reuse. Reuse means the direct use of waste as a product, including the restoration, remanufacturing, and refurbishment of waste. Article 40 mentions government responsibility for remanufacturing, including the development and enforcement of standards and labeling of remanufactured goods. Article 40 requires the government to support enterprises that remanufacture components and parts of motor vehicles, construction machinery and machine tools, and retreaded tires. The quality of the remanufactured products must meet the standards established by the state and be labeled as such in obvious places.

In addition, remanufactured goods are also mentioned as one of the target items of the government’s procurement policy in Article 45. Other sectoral ministries should join the initiative to promote remanufacturing. The Ministry of Industry and Information Technology issued “Notice of Electromechanical Products Remanufacturing Pilot Units List (the first batch)” and “Requirements for the Pilot Work of Mechanical and Electrical Products Remanufacturing” in 2009. The list of remanufacturing pilot units covers construction machinery, industrial electromechanical equipment, machine tools, mining machinery, railway locomotive equipment, ships, office information equipment, and remanufacturing industrial zones.

The government also put effort into controlling the quality of remanufactured products. The Ministry of Industry and Information Technology issued Interim Measures for Remanufacturing Product Certification Management in 2010. Article 3 of the interim measures specifies that the ministry is responsible for the management and supervision of the certification of remanufactured products, formulating relevant systems, standards, and implementation plans, organizing and carrying out certification, and publishing the “Remanufactured Products Catalog.” The first Remanufactured Products Catalog was issued in 2011, and the eighth was published in October 2019.

In 2012, the Ministry of Industry and Information Technology issued “Entry Conditions for Comprehensive Utilization of Waste Tire,” which covers retreading tires in addition to recycling tires.

In 2013, the Ministry of Industry and Information Technology, along with other ministries, initiated the “Swap the Old for Remanufactured Products” program, in which consumers are subsidized for buying remanufactured parts and returning old parts. The old collected parts are then sent to remanufactured companies. In 2017, the Ministry of Industry and Information Technology issued the “High-End Smart Remanufacturing Plan (2018–2020),” which placed priority on the remanufacturing of key equipment, such as tunnel boring machines, aer engines and gas turbines, medical imaging equipment, heavy machine tools, and oil and gas field equipment.

In 2021, the NDRC and other ministries jointly issued “Interim Administrative Measures on Auto Parts Remanufacturing” to guarantee the quality of remanufactured goods and promote high-quality remanufactured parts [8]. The Chinese government has actively promoted remanufacturing based on the Circular Economy Promotion Law.

2.3. Singapore

In partnership with Nanyang Technological University, the Agency for Science, Technology and Research in Singapore established the Advanced Remanufacturing and Technology Centre in 2012. The center has facilitated collaboration among companies and researchers in the field of remanufacturing and other technologies, such as repair and restoration technologies, automated fabrication, intelligent machining and fixturing, adaptive robotic welding, and laser metal repair technologies.

2.4. Malaysia

The Centre for Remanufacturing and Reuse for Nathan Associates Inc. [9] estimated that the four remanufacturing sectors in Malaysia, namely vehicle components, printer cartridges, information and communication technology, and aerospace, generate Malaysian ringgit (RM) 3.8 to 4.0 billion (USD 1.2 billion).

The Malaysian government has pushed the development of the remanufacturing industry, especially in the automobile sector. The Malaysian Standard on “Retreaded Pneumatic Rubber Tyres of Passengers Cars and Commercial Vehicles – Specification” (MS 224) was developed in 2005 and has since been revised twice. The stan-
2.6. Indonesia

The Indonesian government does not have a specific policy to promote a remanufacturing industry or to improve the quality of remanufactured products. The Indonesian Department of Transportation promulgated a notice to prohibit the use of retreaded tires on public roads due to safety problems in 2015 [15]. Indonesia issued a set of standards on the retreading of passenger and commercial vehicles (SNI 3768-2013) in 2013. However, the standard is not mandatory but voluntary. The objective of the ban on retreaded tires is to improve safety.

As a result, the export of retreaded tires increased dramatically from two thousand units in 2014 to more than 356 thousand units in 2015. The Indonesian Tire Association announced its opposition and requested that the Government apply Indonesian National Standards (SNI) to retreaded tires instead of accepting a total ban on the use of retreaded tires. In March 2017, the National Planning Agency of Indonesia enacted a policy to expand the scope of domestic standards for retreaded tires from commercial vehicles to passenger cars.

There are several remanufacturing industries in Indonesia, such as copying machines, mining equipment parts, and automobile parts. Kamigaki et al. [16] reported that about 70% of black and white photocopiers are refurbished products, which are remanufactured by independent remanufacturers. Additionally, according to a Japanese automobile parts remanufacturer in Indonesia, there is a limited market for remanufactured automobile parts in Indonesia. As a result, remanufactured parts are exported to other countries (interview by Kojima in April 2015).

Matsumoto et al. [17] indicated that arbitrary import permit regulations on secondhand goods had created uncertainty in securing cores for remanufacturing. To invest in the remanufacturing sector, it is necessary for remanufacturers to ensure the supply of cores for the remanufacturing process, including a supply of cores from other countries.

3. Some International Initiatives

As mentioned in the previous section, some Asian countries have initiated the promotion of remanufacturing. Such actions have been influenced by some international initiatives, which shared good practices on remanufacturing and facilitated the reduction of trade barriers on remanufactured products.

3.1. 3R Initiative

The “3R Initiative” was proposed by Japanese Prime Minister Junichiro Koizumi at the G8 Sea Island Summit in 2004. The 3R Initiative was an additional program to the activities of the “Science and Technology for Sustainable Development” program that was originally developed at the G8 Evian Summit in 2002.

The “3R” Action Plan and Progress on Implementation,” part of the outcomes of the G8 Sea Island Summit, stated that “G8 will seek through the 3R initiative to reduce barriers to the international flow of goods and materials for recycling and remanufacturing [emphasis added], recycled and remanufactured products [emphasis added], and cleaner, more efficient technologies, consistent with existing environmental and trade obligations and frameworks” [18]. The initiative focused on the reduction of trade barriers to remanufactured goods as well as recycled products and more efficient resource-use technologies.

In 2005, Japan hosted the Ministerial Conference of the 3R Initiative in Tokyo. The European Commission
and 18 countries, including China, Japan, the Republic of Korea, Indonesia, Malaysia, Philippines, Singapore, Thailand, and Vietnam, submitted 3R portfolios [19]. Among the 19 portfolio documents submitted, only that of the U.S. touched on remanufacturing. “Promoting Remanufacture as well as Reuse and Refurbishment” is described as one of 10 major activities of the U.S. Suppliers Partnership for the Environment, an association of auto manufacturers and suppliers, that was formulated to examine opportunities for the remanufacturing and reuse of products and vehicle components.

3.2. Asia-Pacific Economic Cooperation (APEC)

The APEC Ministerial Meeting in 2011 agreed to facilitate trade in remanufactured goods. The ministerial meeting also welcomed the APEC Pathfinder Initiative on Facilitating Trade in Remanufactured Goods. 11 economies participated in the initiative, including Japan, Chinese Taipei, Singapore, and the Republic of Korea. They agreed to refrain from applying import prohibitions against remanufactured products or against remanufactured goods in specific industries.

APEC also published a resource guidebook on remanufacturing in 2013 [20] with support from the U.S. Agency for International Development (USAID). The guidebook listed global information resources, research institutions, and industrial remanufacture associations in the region, among others. The initiative also organized many pieces of training and workshops to promote the trade of remanufactured goods in the region.

In 2021, APEC, with support of USAID, also published the report titled “Trade in Remanufactured Goods in APEC: The Case of Refurbished Medical Imaging Devices” [21]. The report overviewed the value chain of refurbished medical devices and identified potential challenges to trade in refurbished medical devices. The report recommended that medical imaging devices were a good starting point for using refurbished medical devices beyond national borders, because the International Electrotechnical Commission had issued the standard on the Process of Refurbishment of Used Medical Imaging Equipment in 2019.

3.3. Free Trade Agreement (FTA) of the United States

The U.S. started to promote remanufacturing around the year 2000. In 1998, the U.S. Federal Trade Commission allowed remanufacturers to label their products as “recycled” and “remanufactured.” Furthermore, the State of New York passed regulations prohibiting state agencies from purchasing commodities from original equipment manufacturers (OEM) that restricted remanufacturing. Other states, namely Texas, Connecticut, and California, also passed similar legislation. New York State even legislated to give a tax credit to remanufacturing firms [22].

These kinds of state-level initiatives can be scaled up on the national and intentional levels. The U.S. has tried to expand the remanufacturing business to other countries through the FTA. The U.S. has 16 FTAs with 20 countries. Among them, “remanufacturing” is mentioned in 11 of these FTAs. For example, the U.S.–Singapore FTA, which was signed on May 6, 2003 and was implemented on January 1, 2004, defines “recovered goods,” “remanufactured goods,” and “used” [23].

Article 3.19 Definitions

13. Recovered goods means materials in the form of individual parts that result from:

(a) the complete disassembly of used goods into individual parts; and

(b) the cleaning, inspecting, or testing, and as necessary for improvement to sound working condition one or more of the following processes: welding, flame spraying, surface machining, knurling, plating, sleeving, and rewinding in order for such parts to be assembled with other parts, including other recovered parts in the production of a remanufactured good of Annex 3C;

14. A remanufactured good means an industrial good assembled in the territory of a Party, designated under Annex 3C, that:

(a) is entirely or partially comprised of recovered goods;

(b) has the same life expectancy and meets the same performance standards as a new good; and

(c) enjoys the same factory warranty as such a new good; and

15. Used means used or consumed in the production of goods.

By defining “remanufactured goods” and “used goods” in the FTA, the U.S. has tried to distinguish between remanufactured goods and used goods to prevent applying import restrictions on used goods to remanufactured goods. Annex 3C of the FTA listed HS1 codes with product descriptions, such as “compression-ignition internal combustion piston engines,” “pumps for liquids,” “transmission shafts,” “radio apparatus, radio navigational aid apparatus,” “electronic integrated circuits and micro assemblies,” “parts and accessories of the motor vehicles,” and others. In total, 46 six-digit HS codes and 16 four-digit HS codes are listed in the annex of the free trade agreement [23] internationally.

3.4. Trans-Pacific Partnership (TPP)

The TPP was agreed to by 12 countries, including Australia, Brunei, Canada, Chile, Japan, Malaysia, Mexico, and...
3.5. Actions of the EU

The European Commission issued the communication document titled “Towards a Circular Economy: A Zero Waste Programme for Europe” in 2014, which mentions remanufacturing as an important pillar for achieving a circular economy. However, prior to “Towards a Circular Economy,” strategic documents by the EU on the sustainable use of natural resources and resource efficiency issued between 2005 to 2011 did not mention “remanufacturing.”

The European Remanufacturing Network (ERN) was established in 2015, with support of “Horizon 2020,” an innovation funding program of the EU [24]. The project document on “The European Remanufacturing Network – Coordinating and Supporting European Remanufacturers” pointed out that the U.S. and China had a common vision and strategy for remanufacturing and that the EU could lose competitiveness by not supporting remanufacturing.

3.6. Mechanism of Diffusion on Remanufacturing

Previous studies classify four mechanisms of policy diffusion: coercion, competition, learning, and emulation [25, 26]. In the case of diffusion of remanufacturing policy in Asia, all of these mechanisms have come into play.

The U.S. asked for partner counties to include the definition of remanufactured goods in the FTAs. By defining remanufactured goods, partner countries of the U.S. with FTAs cannot apply restrictions on importing second-hand goods to remanufactured goods. Many partner countries accepted including the definition of remanufactured goods in the FTAs, because the U.S. is a huge market for various goods. This type of influence is regarded as coercion. Partner countries of the U.S. also recognized the importance of remanufacturing and introduced relevant policies. For example, Singapore established a research center on remanufacturing.

The 3R Initiative and some APEC activities, such as conducting workshops and publishing reports, disseminate the concept of remanufacturing to participating countries. China may learn and emulate the remanufacturing policies to catch up to developed countries in this area. Competition is another driver of introducing remanufacturing policy.

These four mechanisms of coercion, competition, learning, and emulation work to disseminate remanufacturing practices to various Asian countries.

4. Policies for Promoting Remanufacturing

Based on the reviews on national and international initiatives to promote remanufacturing in Asian countries, some policies for promoting remanufacturing have been identified.

4.1. Awareness Raising

Remanufacturing is not popular, compared with the campaigns of reduce, reuse, and recycle. It is important to raise awareness about remanufacturing among various stakeholders, including business sectors, consumers, and government officers.

For the business sector, the economic size of the remanufacturing business is key information. Giutini and Gaudette [22] cited an estimation by Lund [27] that the shipment value of remanufacturing activity was USD 53 billion, which was slightly bigger than the value of the household consumer durables sector (USD 51 billion) and slightly lower than the value of steel mill products (USD 56 billion). They also claim that remanufacturing can reduce capital investment expenditures. The U.S. and the EU also reported on the market size and employment of remanufacturing industries in their regions [28, 29].

Remanufacturing also generates environmental benefits. Remanufacturing processes reduce energy and resource consumption. Investors concerned with sustainability may prefer to invest in companies putting effort into remanufacturing.

Some governments, such as Japan, the Republic of Korea, and Malaysia, have a green public procurement program [30]. In the case of Yachiyo City in Japan, retreaded tires and rebuilt parts are listed in green procurement programs [31]. It is important to include remanufactured goods in green public procurement programs.

4.2. Quality Control

It is difficult for consumers to verify the quality of remanufactured goods. Guidat et al. [32] pointed out that counterfeit products sold in abundance affect the uncertainty among consumers about the quality of remanufactured parts, based on a survey of motorcycle owners in Vietnam. The study also found that positive marketing of remanufactured products increases the potential positive acceptance of remanufactured products. Certifications of the quality of remanufactured goods may improve consumer’s preference for remanufactured goods.

Some remanufactured products have quality standards. For example, some countries have standards on retreaded tires. As mentioned in Section 2.2, the International Electrotechnical Commission Standard on the Process of Refurbishment of Used Medical Imaging Equipment [33] was issued by the International Electrotechnical Commission in 2019.

National governments can develop or support industrial associations to develop industry standards for remanufactured goods.
In addition, if counterfeit remanufactured products are sold in the market, governments and/or industrial associations should regulate such counterfeit products from the viewpoint of safety and property rights.

4.3. R&D

As described in Section 2.3, Singapore established a research center for remanufacturing technologies. Remanufacturing processes require various technologies. To facilitate the R&D on remanufacturing technologies, the center facilitates collaboration among researchers and industries to develop more advanced technologies for remanufacturing.

However, Xu et al. [34] pointed out that although China has made significant progress in the field of automation and intelligent remanufacturing technology, it is difficult for research institutes to meet the various technological demands for remanufacturing.

One of the reasons why the ERN was founded was the competition with other regions such as the U.S. and China, which had a common vision and strategy for remanufacturing. The network tries to facilitate cross-sectoral activities for knowledge transfer related to remanufacturing [24].

4.4. Trade Facilitation

Some countries have applied the restriction of importing secondhand goods to remanufactured goods. The U.S. put efforts into eliminating such trade barriers in other countries, by defining remanufactured goods in free trade agreements. TPP is another opportunity to reduce the trade barriers to remanufactured goods. Supply chains of various products are formulated beyond national borders. Trade restrictions on remanufactured goods and cores may discourage remanufacturing.

Based on the interviews with remanufacturers in Southeast Asia, Matsumoto et al. [17] pointed out that some governments issue import licenses for secondhand goods to a few select companies. In addition, cores for remanufactured goods are regarded as secondhand goods. As a result, some remanufacturers have difficulties accessing supplies of cores from other countries.

A technical guideline adopted by the Basel Convention stated that “used equipment is waste in a country if it is defined as or considered to be waste under the provisions of that country’s national legislation” [35].

Governments should create appropriate trade measures to facilitate remanufacturing, which have positive impacts on investment in remanufacturing businesses.

4.5. Third-Party Remanufacturing and Intellectual Property Rights

According to Milios [36], it is possible that third-party remanufacturers are in breach of intellectual property rights. In Japan, OEMs of printer/copying machines and refill businesses argued that the refill business breaches intellectual property rights in court. The decision by courts in Japan on this matter has been split, that is, on whether the refill business represents a breach of intellectual property rights.

It is also unclear who bears the extended producer responsibility for remanufactured goods [34]. To improve resource efficiency through remanufacturing, the way to share the responsibility by both OEMs and remanufacturers should be considered.

4.6. Trade-Off Between Remanufacturing and Other Issues

Svensson-Hoglund et al. [37] pointed out that newly introduced chemical regulations on products may be an obstacle to remanufacturing. Some chemical regulations such as REACH prohibit the use of several chemicals in products. Remanufactured goods containing prohibited chemicals are prohibited from being sold in the market.

Regulations in Asian countries may have a negative impact on remanufacturing. As mentioned in Section 2.6, Indonesia prohibited the sales of retreaded tires in its domestic market. Appropriate measures have been taken to establish standards for retreaded tires and invest in capacity for testing remanufactured goods.

5. Conclusion

Many environmental policies require that the private sector fulfill mandatory standards, such as emission and effluent standards, and targets under extended producer responsibility schemes. Such mandatory requirements may not be adequate for remanufacturing. As mentioned in previous sections, policies to promote remanufacturing seek to remove the existing barriers in current regulations, such as distinguishing remanufactured goods from secondhand goods and developing industry standards for remanufactured goods.

In addition, raising awareness of remanufactured goods among producers, consumers, and policymakers is important. The U.S. contributed to raising awareness through the 3R initiative and negotiation of FTAs with Asian countries. The number of countries that promote remanufacturing has increased in the last 20 years in Asia.

Nevertheless, regional efforts to promote remanufacturing are still limited. As the EU established the ERN, Asian countries should also consider establishing a similar network to create a better business environment for remanufacturing in Asia.

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