Commercializing a Technology Use Global Business Strategy Approach: A Lesson Learned from HVAC Companies

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Abstract

Providing solutions in creating a climate that human needs using HVAC technology by implementing environmentally friendly principles, reducing carbon emissions, and saving energy solutions. This study discusses global companies utilizing technology for commercialization. A comparison of companies engaged in HVAC using a strategic management concept approach by analyzing external factors, resources & capabilities, competitive advantage, an attractive industry, strategy formulation, and implementation, to obtain superior returns. Data used in this study is secondary data from previous research and the company's official website. Because this is a comparative analysis based on case studies, generalizing the findings may be difficult. The results are the first company focus to implementing business strategy local production with build factory base on highest demand to get closer with the customer and the other one focuses on responsive strategy in the development of environmentally friendly technology. Both companies provide tangible evidence of commercialization technology. Managers can study the results of this research and use it to adapt their strategies, which have proven successful in commercializing the technology in the global market.

Keywords
HVAC Technology, Commercialization Technology, Comparative Analysis, Global Business Strategy

1. Introduction

Everyone needs comfortable air. The need for the comfort of the air we breathe in our daily activities and work activities is crucial. The comfortable air can raise the level of productivity at work. So, that the results obtained are more optimal. HVAC (Heating Ventilation Air Conditioning) is a solution for air comfort in human life. On the other hand, the issue related to environmental conditions such as the depletion of the ozone layer, carbon gas emissions, and high energy consumption in the HVAC system should be of particular concern. It becomes a step in improving and developing technology between human needs and a better environment.

The world today is stepping on the point of environmental awareness and efficiency. The environmental issue of global warming is at the center of attention to the development of environmentally friendly technologies, especially technologies related to cooling air (air conditioning). Meanwhile, efficiency is related to the amount of energy used by a product and savings in terms of costs. All global air-conditioning companies are competing for the development of friendlier technologies environment and more efficient. This is reinforced by the existence of an international framework related to environmental issues, namely the Sustainable Development Goals (SDGs) with 17 agendas, the Paris Agreement to the UN Framework Convention on Climate Change to reduce GWP & greenhouse gas emissions, the Kigali Amendment (international agreement to reduce the impact of global warming), and the UN Global Compact (UNGC) on human rights, labor, environment, and anti-corruption.

Several global air conditioning companies are competing in environmentally friendly technology and high efficiency will be reviewed is Daikin and Carrier, to be used as an evaluation for Trane in expanding business in Asia. The company has been worldwide with its products spread in various countries. Daikin has a business that has expanded to more than 160 countries with accelerated global development in its origin country Japan, and several other countries, namely the United States, China, Asia, and Europe. Carrier, based in the United States has served customers from more than 180 countries and Trane from Ireland selling products to America, Europe, and Asia.

Daikin is ranked 479th in the 2021 World's Best Employer category, 33rd place in America's Best Employers by state, and ranked 330th in the Global 2000 in 2021(Forbes.com 2021b). Carrier ranked 404 Global 2000 in 2021 (Forbes.com 2021). Trane Technologies is ranked 269th in the World's Best Employers 2021, ranked 139th Best Employers for Women 2021, ranked 612th Global 2000 in 2021, ranked 231st Best Employers for Diversity 2021 (Forbes.com 2021).

In achieving its success, the company has quality resources with the age of the company reach 100 years. Daikin was founded by Akira Yamada in Japan in 1924 starting with tube production radiators for airplanes. In 1938, the Mifujirator refrigeration unit for submarines using fluorocarbon gas was delivered to the Japanese Navy. 1966 started production of the centrifugal chiller. The year 2009 developed the Hexagon Module Chiller for buildings and factories to be marketed equipped with a DC inverter which is highly efficient, Daikin's Hexagon Module Chiller greatly improves cooling energy efficiency. With a shape hexagon that has a diagonally mounted air side heat exchanger, this chiller achieves savings space in side-by-side installation and optimal air intake. Daikin was founded in Indonesia in 2012 under the name PT Daikin Airconditioning Indonesia.

Carrier, founded by Willis Carrier in 1915 in the United States, Willis Carrier powered the engine that would be powering the world's first modern air conditioning system, installed in the summer of 1902 at the factory Sackett & Wilhelms printery in Brooklyn, New York. The invention of the modern air conditioner in July 1902 was just the beginning for Willis Carrier, whose contribution to efficient industrial production and the improvement of human comfort over the next 50 years was so comprehensive that he became known as the Father of Air Conditioning. In 1922, Carrier launches the first centrifugal chiller, which opens the door to the convenience of large-scale air conditioning. In 2001, Carrier got the Gold Certification in Design Energy and Environment (LEED- Leadership in Energy and Environmental Design). Carrier winner of air conditioning innovation in 2020 with the product OptiClean Dual-Mode Air Scrubber & Negative Air Machine (Coolingawards.com 2021). Carrier was established in Indonesia with a joint venture company called PT Berca Carrier Indonesia in 2015, with Carrier and Toshiba products.

Trane was founded in 1913, started by James Trane who opened a plumbing shop in La Crosse in 1885. Inspiration came during the winter in Wisconsin, James Trane invented a low-pressure heating system called the Trane Vapor Heating System. With innovation, Trane grew to become a pioneer of air conditioning in 1931. Trane fundamentally changed the air conditioning concept of large buildings with the launch of Turbovac this year 1938, the industry's first hermetic centrifugal chiller and the first step to the series a long innovation lead to the current CenTraVac Trane,

becoming the industry standard for air conditioning systems. It is the most energy-efficient system suitable for large buildings and has earned Trane a Best of the Best Award from the US Environmental Protection Agency (Trane.com 2020). Since March 2020 Trane is under the management of Trane Technologies (tranetechnologies.com 2020) with the main business of climate innovation being challenged in a sustainable future based on heating, cooling, and cooling transport. Trane was established in Indonesia in 2005, under the name PT Trane Indonesia.

The company is interesting to study in terms of business strategy, with the age reach hundreds of years the companies is still standing and growing in various parts of the world. In the success of implementing the strategy, there are several supporting components such as resources, capabilities, competitive advantages, industry attractiveness, and strategy formulation and implementation to achieve their respective advantages with above-average revenues. Therefore, the company will be discussed one by one in terms of the business strategy of the technological innovation and technopreneurship system that is applied, so that hopefully it can be a lesson for Trane Company if it wants to spread business in Asia especially reaching the market in Indonesia.

2. A Comparative Study Approaches

2.1 Global Business Strategy Concept

Entering the era of globalization, all companies in the world can compete internationally without borders. Global strategy is a strategy that focuses on achieving the goal is to maximize profits in a global scope without leaving the existing local value (Ghemawat 2007). Three important things in global strategic planning are delivering value products to the market, strengthening competitiveness in terms of low costs, and creating strong business models (Motohashi 2015).

2.2 Strategic Management Concept

Strategic management is a process to generate various alternative decisions and actions strategies that support the achievement of company goals. The process in strategic planning includes inputs in the form of internal and external environments contained in the vision and mission. Vision and mission are spelled out in the formulation and strategy implementation. Strategy formulation is divided into six types, namely, strategy at the business level, competitive rivalry and competitive dynamics, company level, acquisitions and restructuring, international strategy, and cooperative strategy (Hitt et al. 2007). Implementation can be done at the level of corporate governance, organizational structure and control, strategy leadership, and entrepreneurship. All lead to competitive strategies that generate above-average returns. There are two models in the strategic management concept is an industrial organization (I/O Model) dan resources-based model (Hitt et al. 2007). The industrial organization model focuses on the identification of the company's external environment. Resource-based model identification about the company's internal environment.

2.2.1 External Environment

The external environment is factors outside the company that affect the continuity of the company to do business strategy formulation process. External factors, namely, the general environment (demography, economy, politics, culture, and technology), industry environment (new entrants, supplier power, strong buyers, threat of substitute products, and competition between competitors), and competitor environment (Hitt et al. 2007). External environment factors generally focus on the future of the company. The industry environment focuses on factors and conditions that affect the level of profitability of the company. The competitor environment focuses on predicting competitors' dynamics, responses, and intentions. Knowing external factors, where we are with the culture, economy, and political system, and knowing with which companies compete and the factors that allow us to have above-average profits, then the company has a competitive edge. The importance of researching the company's external factors, we can map the opportunities and threats facing the company. By studying the external environment the company can identify the strategy to be chosen.

2.2.2 Internal Environment

The internal environment is all resource factors owned by the company including assets, capabilities, and core competencies. Assets include all visible assets in the form of finance, buildings or factories, technology, organizational forms, patents. Invisible resources include innovation, reputation, brand, ideas, and skills human resources (Hitt et al. 2007).

Capabilities reflect the ability to use the available resources as a whole to achieve company goals (Hitt et al. 2007). Where there is an interaction between tangible and intangible resources. Capability sourced from unique skills and

knowledge, functional expertise. Capability development through the exchange process information and knowledge between each functional division. Core competence is the ability or advantage of a company compared to competitors. Company activity in adding value or unique value to an item or service in a certain period. By studying the internal environment the company can identify what steps to choose in implementing a strategy.

2.3 State of The Art

Several articles describe business strategies to achieve competitive advantage. Comparison between two large companies that are growing will make it easier for business actors who want to develop their business as well as for beginners to choose a strategy that suits their main business. The business strategy for commercializing technology with a comparative approach has been described in previous research. Comparison of large companies engaged in two-wheeled vehicles with sources of electrical energy, explains the strengths, weaknesses, opportunities, and threats and how the company is dealing with them (Istiqomah et al. 2020). Global business strategy planning to earn above-average revenue by combining resources owned, capabilities, and competitiveness between the two companies engaged in battery swab technology has provided lessons on technology commercialization strategies (Aqidawati et al. 2020). Comparative research between companies engaged in the commercialization of technology and the main business of drones, using the I/O strategic management approach (Industry/Organization and resource-based models, obtained the results that the company has successfully competed in the global realm (Khofiyah et al. 2020).

Currently, business actors in the HVAC field are competing in making environmentally friendly technological innovations, economical energy, to the use of renewable energy sources. Consumer demand and regulation on carbon emissions become an idea to develop the technology. And from the industrial side, the technology has become soft commercial land. A lot of research has been done on HVAC technology related to low emissions carbon, energy-saving, low GWP (Global Warming Potential) levels. Combining HVAC technology with system heating results in energy efficiency and cost (Chiang et al. 2017). HVAC technology for green buildings has been developed to be more environmentally friendly, energy-efficient, and more efficient (Zhang 2021). Some ideas for the application of green HVAC concepts with environmentally friendly and energy-efficient designs were discussed by (Huo 2021).

3. Methodology

In this study, we conducted a comparative study(figure 1) of three companies engaged in the same field, namely HVAC for chiller product specifications. The two companies are Daikin and Carrier. We research the concept of strategic management. The five approaches we used in our study of the companies. First, identify the resources owned by each competing company. Second, identification of the company's capabilities related to the skills possessed that are different from competitors. Third, we translate the company's competence to manage resources and capabilities in a competitive advantage. Fourth, placing it in the attractive industry of the three companies. Fifth, determine the strategy formulation and implementation of the companies. The formulation of this strategy and its implementation are the keys to the company's success in earning an above-average income.

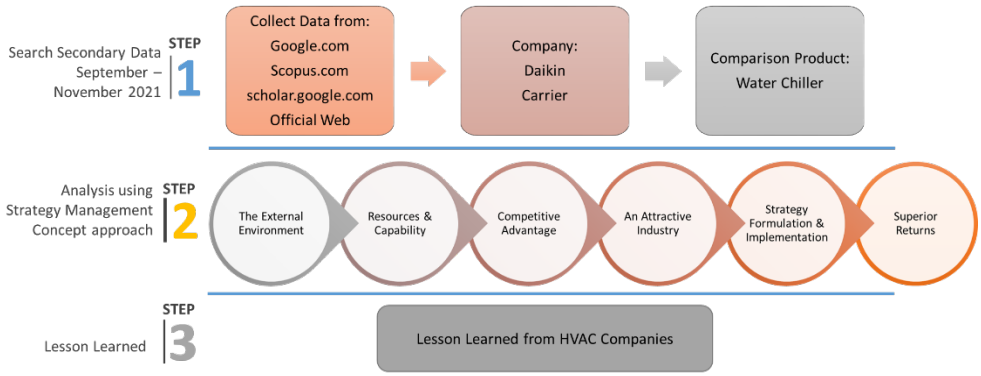

Figure 1. Comparative Study Framework

We used secondary data from the internet and previous research from scopus.com and scholar.google.com. We use Google search engine with keywords “Daikin” and "Carriers". Other supporting data from the company's official website.

4. Result and Analysis

We summarize the data that became a comparative study between companies engaged in HVAC. To Our comparative analysis displays water chiller products from each company. Company identification includes resources, capabilities, competitiveness, attractive industry, strategy formulation, and superior returns obtained.

4.1 Product Comparison

Figure 2 and Table 1, show a comparison of the products of the two HVAC companies. Water chiller as product comparison of the company.

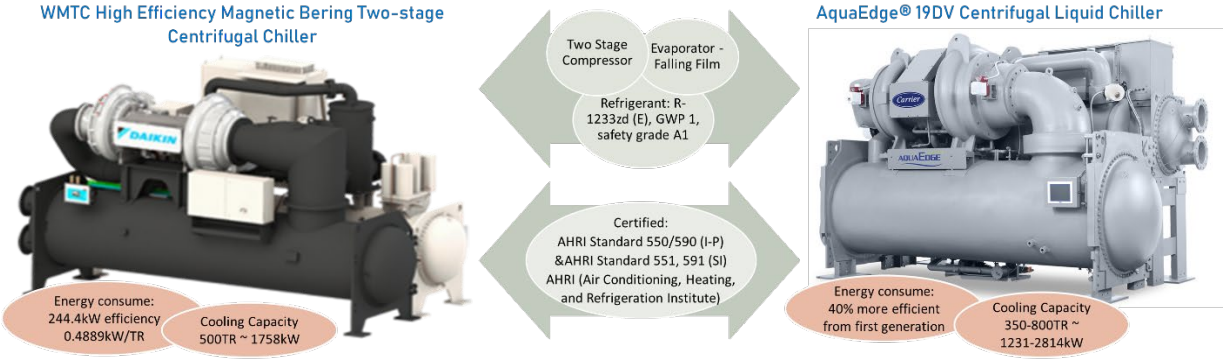

Figure 2. Product Comparison

Table 1. Comparison product (specification)

Specifications	DAIKIN	CARRIER
Oil-Free	Yes	Yes
Without Gear	Yes	Yes
Generator Mode	Yes	Yes
Touchscreen	Yes	Yes
Auto Restart	Yes	Yes
Bearing	Magnetic	Ceramic
Multifunction	Cooling	Heating & Cooling
Guarantee	Yes	Yes

Daikin strives to innovate to provide the best chiller performance combining technology the most advanced with a water-cooled chiller (water-cooled chiller). Guaranteed reliability with drive system design magnetic bearings that do not require lubrication, high accuracy sensor installation for position detection shaft at high frequency, can be run in generator mode in case of a power shutdown, equipped extra bearings. Driveline magnetic bearing, namely the drive shaft system is directly connected to the motor, without oil and friction so that the resulting noise and vibration are lower. Low cost of ownership with minimizing energy costs by taking advantage of two-stage compressors, using a more efficient falling film evaporator, and without having to change the oil. The Magnitude cooler is based on Daikin's latest magnetic bearing technology, oil-free, seal-free technology, gears, and surface appearance for long periods. This makes the chiller work optimally, with an efficiency level of 40% better than the previous generation (standard centrifugal chiller) (coolingpost.com 2020). Indonesia launched online in 2020 (daikinapplied.com 2020).

Water-cooled centrifugal chiller is Carrier's technological innovation for heating and cooling solutions. Every building is different, type, use, layout, and weather have a large influence on heating and cooling requirements, these requirements vary at different times of the year. The process of adjusting to changes in the weather requires a chiller

that can accommodate this. Carrier water chiller has multifunctional features, through a complete system approach of effective cooling and heating at the same time. The result is a chiller so reliable, great performance, so durable that after installation we don't have to think about it again.

4.2 External Environment

One part of the external analysis is competitor analysis. This is important in the technology business competition. If the product launch is delayed, the product is certainly headed for the valley of death.

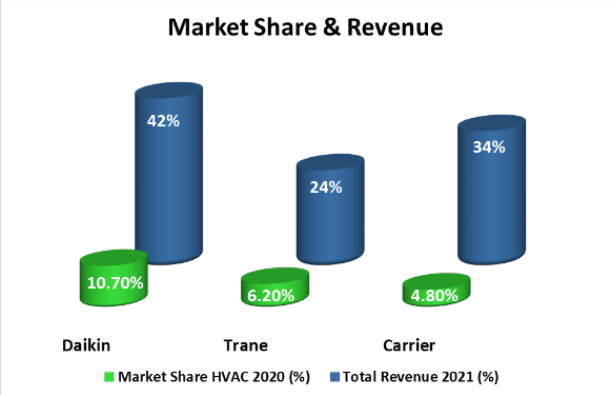

Figure 3. Market Share & Revenue
Source: (Deallab 2021) and official website company (data process)

In order of global competition, Daikin with the highest share in 2020 was followed by Trane and Carrier. The highest revenue of 2021 in the HVAC field was led by Daikin in the first quarter at 42%, Carrier was the second-highest at 34% in the financial statements in the third quarter, while Trane's third-quarter revenue position was 24% in the third quarter. We introduce Trane here to find out where the company is in this business. As shown in figure 3.

4.3 Internal Environment

The internal environment that will be discussed in this study is the resources and capabilities. The resources owned by the company are seen from the number of employment, asset ownership, the amount of investment in R&D, and patents owned. Daikin absorbs the most labor and assets. Carrier invested the most in the R&D division by issuing eight thousand patents. While Trane is still under the two companies. As shown in figure 4.

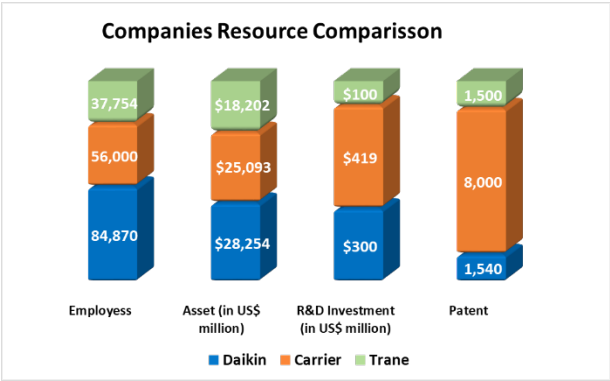

Figure 4. Company's resource comparison

Figure 5, is an overview of the market sales for the two companies. The Asia Pacific is Daikin's largest market reaching 57.6%, while Carrier is 15%.

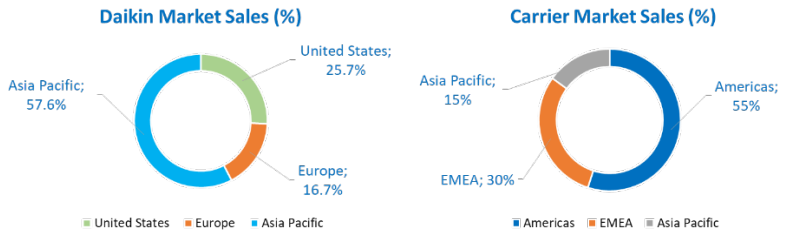

Figure 5. Market sales of Daikin & Carrier

The capabilities of the two companies are described in table 2. The two companies have almost similar capabilities as good management, building social community, strong relationships with suppliers and customers. It's just different in practice, each company has its characteristics. They have their art in corporate governance. Having a strong SCM will provide significant benefits in the form of higher profits and market share (Reklitis et al. 2021).

Table 2. Capabilities

	Daikin	Carrier
Capability	- Management with a reliable CEO - Management focuses on people, with diversity that is expected to increase product innovation - CSR as an effort to build a reputation - Build a strong SCM by involving quality control, labor, and environmental protection - Build strong relationships with customers	- Independent director - Involvement of the board of directors in meetings - Building a social community - Build a strong SCM with quality supplier selection - Establish two-way communication with customers - Established a Carrier University educational institution to provide reliable training on HVAC technology

4.4 Competitive Advantage

Achieving competitive advantage in the realm of fair competition. Every company can do creativity, innovation according to what customers need. Customer-oriented competitive advantage will actively attract decisions in the use of a product.

For Daikin, making creations with air is an innovation in itself, in polluted air conditions and an uncertain climate, Daikin comes with an innovative air filter product, and has been developed in India. Providing aftersales service in all Daikin branches will make it easier for consumers to get service and spare parts services. Offering more efficient products with inverter technology. Build CSR (Corporate Social Responsibility) is one of the advantages that is carried out by Daikin as an effort to build a good name and reputation. Daikin provides easy access through a website that is always updated. The dimensions of CSR for companies include maintaining the environment and being responsible for environmental conservation which can automatically improve the image and productivity of the company (Oh et al. 2017). Daikin has a strong SCM with fulfilling CSR through environmental impact reduction. Implementing SCM at the highest level, can increase competitive advantage and improve organizational performance (Li et al. 2006). With higher SCM practices, it will result in a higher competitive advantage (Putri et al. 2019).

Carrier developed the latest value innovation with OptiClean Technology Dual-Mode Air Scrubber & Negative Air Machine to clean and remove air that is potentially contaminated with viruses, application of BAS (Building Automation System) in HVAC. EcoBlue technology for rooftop weather series with axial fan, 40% energy saving. Aftermarket special services with the BlueEdge service platform offer preventive maintenance, service & repair,

control functions, modifications, engineering, life cycle cost analysis. Build a social community, economic, cultural, and involvement in education as an effort to build business sustainability.

4.5 An Attractive Industry

The industry is categorized as attractive with its characteristics, among others: high barriers to entry so that not all companies easily enter this industry, there is a weak relationship between suppliers and buyers, few threats of substitute products, moderate competition among industry players, and high-profit potential (Hitt et al. 2007).

This industry is attractive because of its close relationship with technology and the environment. Has high barriers to entry, related to technological innovation and high costs. Suppliers and buyers have a weak position, suppliers with material availability demands are adjusted by manufacturers with strict selection. Although the product is tailored to the needs of consumers, consumers have a weak position with the existing product choices by the development of technological innovations from the company. Technology that is always new causes less threat of the presence of substitute products. Up-to-date technology is an attractive competitive advantage and is at the core of this business. Industry players compete moderately by considering the views of various stakeholders. This industry is developing in the realm of technology so that at the commercialization stage the technology will provide high profits, as evidenced by continuous innovation designed to customer needs.

HVAC is an exciting industry with technology in its products. And not all companies can enter this industry because it takes decades to pioneer this business. This industry will continue to grow with the development of humans and the environment. Providing solutions for human needs in comfort while building technology that is safe for the environment. Business developments related to HVAC, with the estimated development of the industry in a certain period, become the main issue of the company's existence in the business corridor. It is estimated that the estimated global HVAC development will increase. The HVAC business in 2020 is globally valued at $127.4 billion and is expected to continue to grow at a Compound Annual Growth Rate (CAGR) of 5.9% from 2021-2028 (Grandviewresearch.com 2021). The market for HVAC control systems (Temperature Control Systems, Ventilation Control Systems, Humidity Control Systems, and Integrated Control Systems) in 2019 was $14,559,000 and is predicted to reach $19,939,400 by 2027, with a CAGR of 5.7% from 2020-2027 (Chinchane Amar 2021).

4.6 Strategy Formulation and Implementation

Targeting the right market with the right products, providing services, and developing technology is the core of technology-based business continuity. R&D investment is the one important sustainability strategy for the company to develop a unique product as a character and as a force to gain a competitive advantage (Yang and Lai 2021). R&D investment is important to support and development in high-tech industries (Liu et al. 2019).

Daikin maximizes efforts to meet market needs in several countries with the highest demand, using a local production strategy. Daikin built 100 production bases around the world to get closer to consumers (daikin.com 2021). Daikin positions North America as a large market with great opportunities and positions India with a population as large as China for future market share. Strengthening technology development to become a leader in the HVAC world with a big R&D investment. Providing solutions to customers becomes a business promotion step. Build a strong supply chain so that customer demands are met accurately and quickly. Digitizing in technology transformation for sustainable innovation. Making innovative creations related to air modification, so that cool air is comfortable and free from viruses. Improve human resource capabilities through advanced diversity management covering different social, cultural, ethnic backgrounds, lifestyles by utilizing the uniqueness and strengths of each individual as an organizational strength.

Carrier chooses a strategy that is responsive to the environment, with a focus on reducing carbon emissions by one gigaton in each of its products as an effort to achieve zero-emission. Building relationships with stakeholders including employees, customers, suppliers, and communities. R&D investment, invest in science and technology. Creating solutions for people and our planet in the challenges of climate change. Establish a responsible supply chain program and assess key suppliers based on company criteria to achieve better quality taking into account consumer needs. Competent in the digital world and technology in every process. Conduct innovation and efficiency by reducing energy

consumption by 10% in the production process and strive to achieve zero waste. Contribute to the provision of clean water at the factory site.

4.7 Achieve Above Average Returns

Using resources and capabilities, establishing a structured business strategy, and responding appropriately to market needs, are some of the efforts to obtain above-average income. Figure 6, provides an overview of the company's HVAC sales results in 2021. Daikin started with sales results in the first quarter of $19.8B, Carrier $15.5B in the third quarter, and Trane $10.6B in the same quarter as Carrier. The data was obtained from the company's official web.

The following is data related to the income of the three companies which are summarized from the annual report. Daikin's total net revenue was $21.7B as of March 31, 2021 (daikin.com 2021). Carrier's total revenue as of September 30, 2021, was $17.5B (corporate.carrier.com 2021) and Trane had total revenue of $12.5B in the third quartal (tranetechnologies.com 2020). From the comparison of the three, Trane is still in the last position from other companies. So Trane has to keep trying to increase revenue and compete with Daikin and Carrier. Shown in figure 7.

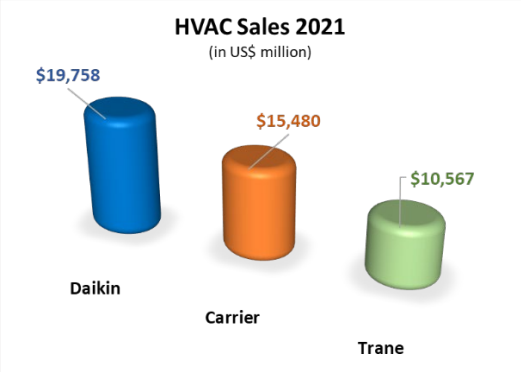

Figure 6. HVAC sales 2021

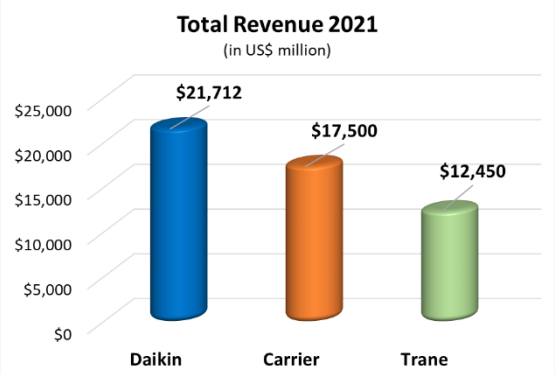

Figure 7. Total revenue 2021

4.8 Lesson Learned

From the description above, it can be learned that the company started a business with technology. The application of the latest technology is the key for a product to enter the global market. The ever-changing nature of technology makes all three companies invest highly in R&D. Innovation and technology are the biggest assets in carrying out its business strategy. Ownership of resources and capabilities in running a business is an important point for the continuity of the business operating system. The ability to manage existing resources and turn them into something more valuable is an invaluable asset. Well-organized management can create synergies between these resources and capabilities. Positioning the market, recognizing competitors, and understanding the development of the industry itself is a stage that must be managed carefully. So that the direction of a company's business strategy can be determined properly to realize competitive advantage.

Creating a competitive advantage in the technology industry is a long step in the course of business strategy. Conducting various researches for product innovation, creating new products according to consumer desires, with various facilities and ease of operation and maintenance. Renewability is a definite demand. The development of products that are more valuable in the eyes of customers becomes an added value for the company, both materially and non-materially. Positioning the business in an attractive industry category because not all business people can directly enter this industry. It takes a long journey and continuous efforts in innovation and technological innovation. The highest management must be able to formulate strategies and implement them. Define the strategy so it can be understood by all interested parties. The chosen strategy must cover all aspects, in this business, it prioritizes the interests of air comfort and can minimize negative effects on the environment. In the end, with external and internal analysis, knowing our position in this industry, and formulating the appropriate strategy will result in above-average income. Daikin and Carrier have already proven it.

The lessons learned from the two companies and can be used for evaluation for the Trane Company to expand in Indonesia are as follows, big investment in R&D for technological innovation for product development in technology

and digitization by offering convenience for consumers to operate the product, market expansion to developing countries such as Indonesia and India by establishing factories based on the highest demand so that they can reach more consumers, product innovation is efficient, environmentally friendly, and at a lower price, development of HVAC technology that leads to public health by developing filters that can filter viruses and quickly promote the results of product development so that they can become pioneers in these new technologies, build CSR and collaborating with social, cultural, environmental, and educational institutions will automatically have a positive impact on the company's reputation

5. Conclusion

A comparative analysis of companies has been carried out. The analysis was carried out using a strategic management approach. Internal and external factors have been described, internal factors include the company's resources and external analysis is analyzed by looking at competitors. Daikin chose the strategic option by building factories in the countries with the highest interest in its products and providing strong aftersales service. Carriers choose a responsive strategy related to the environment and provide special aftermarket services offering preventive maintenance, service & repair, control functions, modifications, engineering, life cycle cost analysis.

All of the companies get above-average returns from implementing their strategy. Technology innovation it's important to get sustainability for this business. Innovation takes a long time, costs a lot, and has a high risk. The company already has branches in Indonesia and competes with the same main business, namely HVAC technology. This comparative result can be used as a recommendation for Trane companies in Indonesia to implement global business strategies to achieve above-average returns.

The limitation of this research is that the literature and data are obtained only from internet sources. Further research if possible can be done using data on the actual condition of the company. So that more accurate data and analysis are obtained.

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