



Hydrogen vehicle as a new insight towards flexibility to achieve sustainable development goal in Automobile sector: A case study

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Abstract

Organizations are striving towards sustainability strategies to make them cleaner and environmentally friendly firms. In this study, the automobile firm is studied to identify how flexibility has been adopted by the firm to make them more sustainable by achieving sustainable development goal 7 in the automobile sector. The flowing stream strategy has been applied to the automobile (AM) firm in selected case. All the aspects of flexibility have been analysed in term of change and continue forces. These forces further been analysed to define the type of flexibility firm is following. The final outcome of this study is the conceptual framework for flexibility to adopt sustainability with strategic suggestion to maintain flexibility which helps to maintain sustainability in organisation.

Keywords: Sustainability, Flexibility, Case study, Strategy

1. Introduction

The Indian automobile sector is one of the most dynamic sectors in the country. According to the sustainable development goals countries try to adopt all the goals. As energy is the basic requirement of every country thus all countries are trying to consider clean energy as a new paradigm for the automobile industry (Wang et al., 2022). By using a clean source of energy this sector tries to cover sustainable development goal seven, which is related to cleaner and affordable energy (Li and Nam., 2022). The automobile sector is one of the related sectors to energy consumption as the main requirement to run the automobile sector is oil which is the major contributor of energy source available for the automobile sector. The automobile sector tries to use cleaner and renewable energy sources to fulfill the energy requirement. The cleaner energy source not only helps in achieving the seventh sustainable development goal but also provides energy independence to the country as well (James et al., 2022; Wang et al., 2022). Hence, the government focuses on identifying a sustainable option for energy to run the automobile sector. The automobile sector firms run their business by manufacturing new types of cars in terms of design and fuel and also trying to adopt the new advancement in vehicles in terms of different types of fuels like TATA produces electric cars (Ji, 2021; Nielsen and Wilhite, 2023). However, some firms are focusing on other options for sustainable energy other than electric cars and trying to focus on hybrid vehicles and hydrogen cell vehicles (Ioannou et al., 2017; Zakari, et al., 2022). This provides huge flexibility in the automobile industry. This study tries to analyze the change perspective of the automobile industry and analyze how the new paradigm of hydrogen cell provides more flexibility to the automobile industry by using the flowing stream strategy as methodology. Thus, the objective of this study is to analyze the flexibility in the automobile industry in terms of sustainable development.

2. Literature review

The projected growth in population, affluence, and people's appetites for the type of personal mobility car act as the activator for car-producing firms. According to the most recent data, car stock would increase from 800 million in 2002 to over 2 billion by 2030 (Mihăilă, 2023). China's vehicle fleet is expected to more than double, reaching 390 million by then. Despite the massive increase in the number of cars, its estimated vehicle ownership rate would be around 270 vehicles per 1,000 people,

which is comparable to Japan and Western Europe in the mid-1970s and South Korea in 2001. The growth of vehicles in India is anticipated to follow a similar trajectory (Chau, 2001; Schipper and Ng, 2004; Narayanan, 2001)

The truth is that economic development has traditionally been associated with an increase in demand for transportation, particularly for vehicles with at least four wheels, such as cars, trucks, and buses (Madlener and Sunak, 2011). Vehicle ownership increases slowly at the lowest per-capita income level. Following that, it increases twice as fast as middle-income income (\$3,000 to \$10,000 per capita). Thus raising the car on road affects the total level of carbon dioxide emissions which will continue to rise steeply (Dargay and Gately, 2018; Vu, 2011). Numerous studies have discovered that the socioeconomic characteristics of households and commuters have a significant impact on transportation CO₂ emissions. The most significant predictor of transportation greenhouse gas emissions has been determined to be car availability. (Brand & Boardman, 2008; Brand & Preston, 2010; Brand et al., 2013; Ko et al., 2011). Using the linear regression method and log-transformed transport CO₂ emissions as the explained variable, it was discovered that owning at least one car increases weekly transport CO₂ emissions by 44%-59% in the UK (Brand et al., 2013). Studies also suggest that this act is the major reason of automobile industry shifted the manufacturing process towards sustainability by making new cars that run on clean energy sources.

Recently, some notable works have been carried out in the literature showing the integration of renewable energy resources in the automobile industry with the integration of some exciting technologies such as photovoltaic cells, electric vehicles, and hydrogen fuel cells that would help in achieving zero emission. Thus, the options in technology related to renewable energy sources help to combat climate change and also leads to the sustainable development goal of clean and affordable energy source (Doğan, et al., 2022; Mamun et al., 2022). Thus, the flexibility can be analyzed by considering zero emission which can be achieved by making electric vehicles, hydrogen fuel cell vehicles, and photovoltaic energy-dependent vehicles. This study tries to analyze the different dimensions of flexibility by considering AM Firm (hypothetical name) case.

3. Methodology

The qualitative research method has been used in this study to analyse the concept. The two qualitative research methods as case study and Flowing stream strategy have been used in this study

3.1 Case study research method

A case study is a research method used to develop an in-depth, multifaceted knowledge of a complex issue in its real-world context. It is an established method of research that is widely used in many disciplines, especially the social sciences. In this study the AM Firm (hypothetical name) case has been analysed to study the flexibility (Sardaret al., 2022; Mishra, 2022).

3.2 Flowing stream Strategy

Flowing Stream Flowing Stream Strategy (FSS) is described as "strategic change management that can be better leveraged with a clear understanding of organisational continuity." (Sushil 2012). The FSS is characterised by continuous and changing forces that must be balanced within the organisation. The FSS framework was partly used to define flexibility in an AM Firm (hypothetical name) an automobile firm case study. The components increase, maintain, and reduce are used to define flexibility in the hotel (Singh, 2018).

4. AM Firm (hypothetical name) case

From 1956 onwards, the automobile firm became on the growing firm in automobile sector by producing best car and adopting the lean manufacturing system. The firm started from Japan established its brand name in term of best production system. AM Firm (hypothetical name)'s total production output for December 1959, after the first phase of the Motomachi Plant's construction was finished, was 10,453 units, breaking the monthly production threshold of 10,000 units. In addition, the Tiara Model RT30L, equipped with a 3R engine (1,897 cc, 90 hp) designed for the US market, was introduced in March 1964 and quickly became popular among US customers.

The market desired a larger vehicle, so sales of the new-model Crown increased steadily. To satisfy this demand, AM Firm (hypothetical name) Motor Co., Ltd. began work on the Crown Eight (VG10), the company's first large vehicle since World War II. The Crown Eight was a full-scale large car with an aluminium alloy V8 engine, sized between the regular Crown model and giant American vehicles. (2,599 cc, 115 hp). Kanto Auto Works, Ltd. handled manufacturing, which included enlarged body panels from the Crown RS40 model. Compact economy passenger cars and compact trucks started to account for a significant share of the market in the second half of the 1960s, as cars became popular among working families and self-employed people. Cars evolved from items that represented economic status to comfortable tools that could be bought and driven by anyone. Furthermore, the postwar baby boom generation started to emerge as a significant demand factor in the automobile market. Cars were fashionable tools for them, tightly connected to their lifestyles and expressing their individualism. Aside from traditional family cars, stylish hardtops (passenger cars without roof-supporting centre pillars) and coupes started to gain popularity. There is a high demand for sporty vehicles with high performance factors for development of racing cars.

The AM Firm (hypothetical name) 1600GT was developed as a mass-production vehicle by Engineering Division, which was in charge of racing cars, with the prospect of entering auto racing in mind. By modifying the chassis to match the performance of the 9R engine, the acceleration performance and maximum speed were improved. Hence AM Firm (hypothetical name) improved their models according to the requirements. However, the recall issue are significant test for the automotive industry, which had been steadily growing up until that point. As consumer activism gained traction, companies in the automotive industry gained a renewed understanding of the significance of automotive safety and quality issues, as well as a reaffirmed understanding that the automotive industry has a broad impact on society and daily life, not just economically. This leads to adopt the AM Firm (hypothetical name) all significant change factors like reinforcement of sales system, cars are developed according traffic accidents they manufacture safe cars, make cars with less emission and towards oil crisis AM Firm (hypothetical name) developed hybrid cars and hydrogen fuel cell cars. The AM Firm (hypothetical name) philosophy to respect environment given back and be safe put it as sustainable manufacturing category (TM, 2023; Nkomo, 2019).

4.1 Flowing stream strategy framework

The flowing stream strategy has been applied to the above in the following steps:

Step 1: Identifying the change and continuous factors in the automobile sector.

1. Continuity factors

- Manufacturing process improvement: From the AM Firm (hypothetical name) case it is evident that AM Firm (hypothetical name) always work with improvising their manufacturing system by using Just in Time process.
- Exploitation of resources to save environment: AM Firm (hypothetical name) tries to reduce waste during production system.
- Be with philosophy to stick which principles: Always follow the basic philosophy to be in tune with environment.
- Inbuilt research and development for renewable energy: Always constantly developing and working on identifying new sources of renewable energy.

2. Change Factors

- Responsiveness: AM Firm (hypothetical name) act towards the requirement of customer and environment
- Adaptability: adopting new technology by exploiting resources

Step 2: Impact analysis of change forces

The Forces description and outcomes are:

F1: Responsiveness: the change require high force because it is important to respond according to the change

- Strategic action toward change force: Developing Hybrid vehicles
- The nature of this force is high.

F2: Adaptability: To adopt the sustainable and green fuel concept the existing resources have been used to develop the green fuelled car.

- Strategic Action: Making hydrogen fuel cell car as Green fuelled car
- Outcome The nature of this force is high.

Step 3: Strategy diagram

The strategy diagram for the case firm is shown below

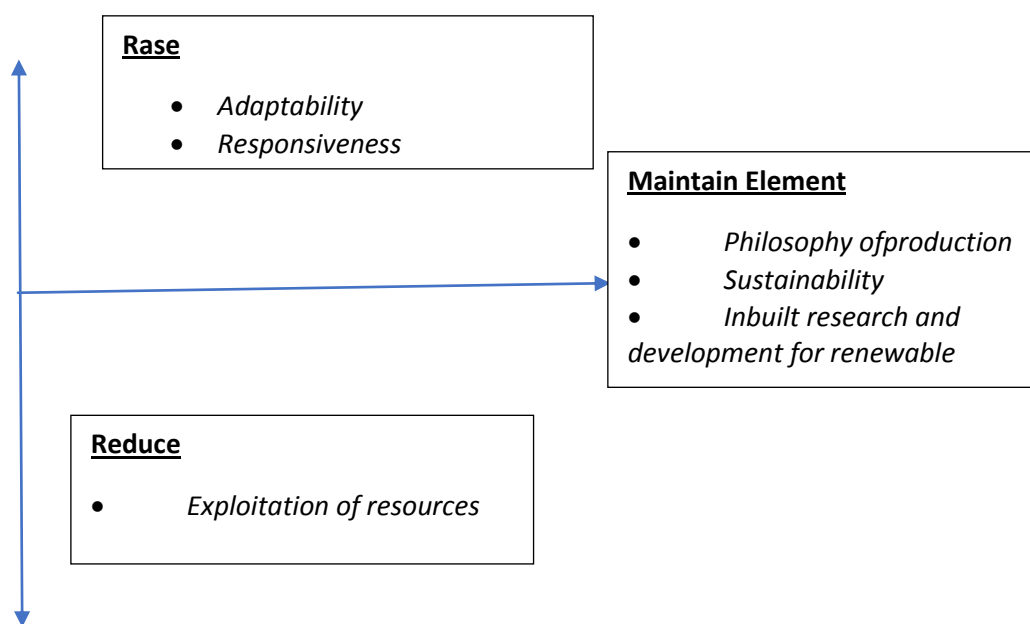


Figure 1: Description of strategy as raise, reduce and maintain elements

Step 4: Mapping C-C Matrix

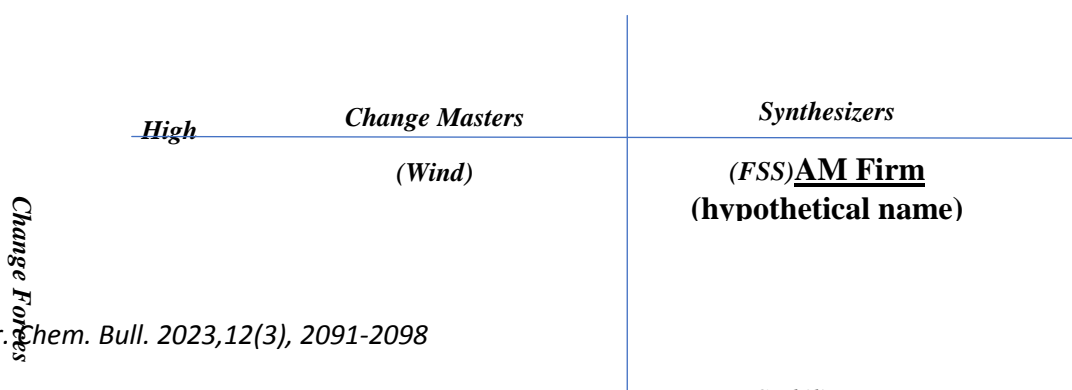


Figure 2: Description of case firm strategy in in Continuity and Change matrix(C-C Matrix)

The change and continuous forces have been analysed from the case and when the outcome is traced it has been identified that AM firm is lie in the Synthesizer quadrant. This shows that by AM firm can maintain sustainable development goals in their products by adopting flowing stream strategy.

Step 5 Strategy formulation matrix for the case

The continuity and change forces have been analysed in this step to suggest strategies form marinating flexibility in long terms that organisation become suitable while performing higher than competitors.

Table 1: Strategy suggestion for adopting and maintaining flowing stream strategy

	Continuity FORCE			
Change Forces	<u>CO1: Manufacturing process</u>	<u>CO2: The exploitation of resources</u>	<u>CO3: Philosophy</u>	<u>CO4: Inbuilt research and development</u>
CH1: Adaptability	With just in Time and Zero waste Production system should maintain	Tries to use renewable resources for sustainable production	Philosophy always adapts the sustainable development goal	Clean energy sources like hydrogen fuel cell car design
CH2: Responsiveness	Sustainable practices during the production process to reduce the wastage	Only exploit resources in a responsible manner by consuming term of reusing them	Philosophy uses social concern about employees and society	Continuous improvement in research in developing solar and hydrogen technologies with new engine design.

Result and Discussion:

The continuity and change factors identified from the AM Firm (hypothetical name) case in step 1 show that to meet the sustainable requirement the firm should continue with Research and development, working philosophy, and manufacturing process while the change should be required to adapt the sustainable changes occurring in the market and responsive towards it. Step 2 tries to collect the reflection in terms of the nature of force the combination shows that adaptiveness should be high, and responsiveness should be medium to high. The step 3 reflects the continuity forces and change forces in raise, reduce and maintain element. As to maintain the flexibility firm should consider Philosophy of firm, sustainability and research and development as critical force; raise adaptability and responsiveness forces and reduce improper extraction of resources as shown in figure 1. The mapping of the change concept in the C-C matrix in figure 2 shows that AM Firm (hypothetical name) lies in the synthesizer column by using the flowing stream strategy category where execution excellence is very high and strategy will evolve further in terms of adaptation and realignment. The table 1 helps in understanding and further strategic suggestions for AM Firm (hypothetical name) to adopt Sustainable development goal 7.

The Flexible strategies to create while adopting SDG 7 are as follows:

- *With just in Time and Zero waste Production system should maintain.*
- *Sustainable practices during the production process to reduce the wastage.*
- *Only exploit resources in a responsible manner by consuming term of reusing them*
- *Philosophy uses social concern about employees and society.*
- *Continuous improvement in research in developing solar and hydrogen technologies with new engine design.*
- *Clean energy sources like hydrogen fuel cell car design.*
- *Philosophy always adapts the sustainable development goal.*
- *Tries to use renewable resources for sustainable production.*

Conclusion

The stages of the flowing stream strategy outlined in this paper deal with the interaction of two distinct continua; one is made up of forces of continuity and change realities, and the other is made up of strategic factors pertaining to both customers and the business. The deployment of the flowing stream strategy is intended to take into account both the continuity and change of the customer and business factors. The case examples given at various stages are illustrative in nature to capture the nuances of the suggested methodology rather than presenting the complete strategy of a case organization. This study also provides a strategic suggestion to adopt SDG 7 in the automobile sector.

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