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Technical innovation vs. sustainability – A case study from the Taiwanese automobile industry

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ABSTRACT

The impact of global warming and climate change is the most critical challenge of the 21st century. The greenhouse effect caused by technological development and industrial pollution has accelerated the speed of global warming. To effectively reduce global warming and encourage sustainable enterprise development, a comparative analysis approach is used to examine various domestic automotive products which utilize the up-to-date innovative technology. Their contributions to fuel consumption and emissions of the greenhouse gas, carbon dioxide (CO_2), are then investigated. This study focuses on technical innovation in a conventional engine and output power. The results indicate that innovative engines (such as the Ford turbo petrol/diesel engine, the EcoBoost/TDCi) have improved energy consumption and CO_2 emissions. In addition, an improvement in output power (such as Toyota hybrid vehicles) has also improved energy consumption and CO_2 emissions.

1. Introduction

The great impact of global warming and climate change on animal, plant and human civilization is a critical issue of the 21st century. A close relationship exists between climate change and human civilization (Tange, 2012). Human civilizations can be divided into two categories: technological civilizations and humanistic civilizations. The humanistic civilization has played an essential role in the last 5000 years, but during the last few centuries, a technological civilization has exceeded the humanistic civilization. The major advancements in human activities are closely related to technological developments which are associated with national strength. However, these scientific and technological developments have affected global warming. If this issue is not addressed, it will have disastrous consequences for future generations. The rapid development of technological civilization has changed the role of mankinds from a passive to an active role. The increase in disasters caused by typhoons, floods, landslides, earthquakes, and tsunamis reflect that humans are not in control of their destiny.

In attaining sustainable development, a sustainable energy policy plays an important role (Hepbasli, 2008) in increasing energy efficiencies and in developing renewable energy supply (Martin and Rice, 2012; Wee et al., 2012). Moreover, energy is a vital input for social and economic development (Bañosa et al., 2011). In order to encourage the development of a sustainable enterprise, we use a comparative analysis approach to examine various domestic automotive products based on the performance of their innovative technological engines. Their contribution to fuel consumption and emissions of the greenhouse gas, carbon dioxide (CO_2) are then compared. The comparison is based on the horsepower and torque generated by the unit

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engine displacement (measured in cubic centimetres [cc]), and their impact on fuel consumption and CO_2 emission. This study focuses on the technical innovation in a conventional engines and their output power. Technical innovation is explored by examining a Ford turbo petrol engine (EcoBoost engine) and the output power is explored by examining the power consumption of a Toyota hybrid vehicle (Hybrid Prius). Fig. 1 shows the research framework.

2. Literature review

To improve the quality of life with superior living environment, mankind continues to use more natural resources. The rapid population growth and continuous advances in technology accelerate deforestation, water pollution, mudslides, air pollution, holes in the ozone layer, biodiversity reduction, desertification, and global climate change (Root et al., 2003; Su et al., 2010).

Since the start of the industrial revolution in 1750, emissions of CO_2, nitrous oxide (N_2O), methane (CH_4), chlorofluorocarbons, and other greenhouse gases have increased. The impact has affected the earth as well as the atmosphere, resulting in global warming. Scientists have concluded that drastic climate changes have been caused by the excessive human developments. Since the 1980s, the rapid rise in the average global temperature, and unusual weather and climate phenomena (such as El Niño and La Niña) have caught the attention of the world on climate change issues (Cox et al., 2000; Vitousek, 1994).

2.1. What is global warming?

Climate change has become a critical issue which has been widely debated. The approaches used to reduce global carbon emissions are the contraction and convergence approach. Under these approaches, all countries should participate in global emission reduction by quantifying their emission limits. The scientific definition of global warming is "a tendency for the globe to warm up over a given period of time." Many scientific studies have focused on climate change; they concluded that

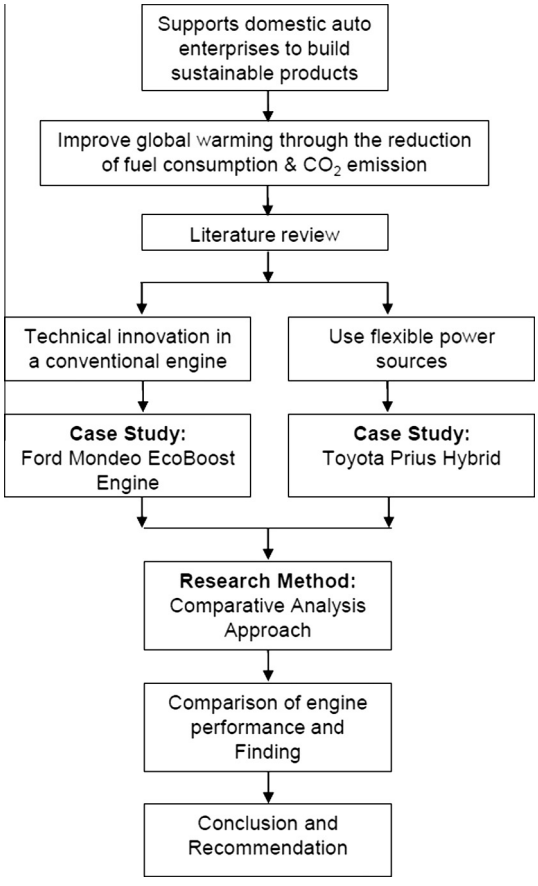

Fig. 1. The research framework.