CHAPTER 1

INTRODUCTION

Energy is often one of the largest expenses for manufacturers (Shrouf and Miragliotta, 2015; Davis et al., 2012). In a survey about energy management conducted by Panoramic Power, nearly 77% of companies confirmed obtaining data of energy consumption partially from energy monitoring tools with limited data points (Vardi, 2015). Although this information could be useful for accounting and finance teams, it is not enough to help the accounting and finance teams to better understand the waste identification or cost analysis of energy consumption. The manufacturers may need a real-time monitoring tool that could track energy consumption pattern at the device level. Thus enables managers and executives to grasp value-added insights for decision-making process. For instance, insights about waste and preventive equipment failures.

Previous research have reported that the IoT could be the solution for the problem of how to make real-time energy data available (even at the device level). One of the most remarkable advancements made possible by the IoT in manufacturing industry is energy management (Vardi, 2015; Tang et al., 2018; Shrouf and Miragliotta, 2015). Moreover, accounting and management activities in manufacturing companies could be benefited by Internet of Things (IoT) (Zhang and Tao, 2017; ICAEW, 2019; Vardi, 2015; Lee and Lee, 2015). The IoT and accounting both enable managers to manage a business without having to be physically present in order to monitor the products flow through a manufacturing plant or understand their costs (Vardi, 2015; ICAEW, 2019). This practice of managing a business from a distance could provide a powerful means of improving the efficiency of manufacturing companies (Vardi, 2015; Zhang and Tao, 2017; ICAEW, 2019; Tsiatsis et al., 2019). One of the prominent accounting activities that could be enhanced by the IoT through its ability to improve information quality is cost analysis, which eventually could lead to reduced cost (ICAEW, 2019;

Tsiatsis et al., 2019; Shrouf and Miragliotta, 2015). With improvements in information quality, the IoT offers many opportunities for accountants to better understand and reduce costs in a range of areas in manufacturing companies (Zhang and Tao, 2017; Tsiatsis et al., 2019; ICAEW, 2019; Tang et al., 2018; Vardi, 2015; Lee and Lee, 2015; Shrouf and Miragliotta, 2015). Particularly, IoT technology is promoting digital transformations by rethinking and remodelling the ways of how to improve efficiency in manufacturing companies.

The implications of the IoT for manufacturing industry have not been the focus of the existing contributions in the literature, specifically regarding its main effects on cost management in manufacturing companies and its practical application (ICAEW, 2019; Tang et al., 2018; Vardi, 2015). Therefore, this study aims to fill this gap.

Combining the IoT with accounting has several potentials, such as improvement of the management of cost through more efficient ways of handling assets, people and risks, better forecast future performance and better decision-making (ICAEW, 2019). Otherwise, the IoT technology applied to assist accounting in cost management is still in its infancy, because the existing literatures rarely explained the use of IoT data by management accountants (ICAEW, 2019), specifically in manufacturing industry. Therefore, this paper attempts to determine the main implications of the IoT technology on cost management for accounting and finance teams in manufacturing industry and emphasises the focus on the decision-making processes in relation to energy management in manufacturing industry. It follows the cost analysis perspective in energy management with a focus on the food manufacturing industry.

For the manufacturing companies who are using IoT technology, they use the IoT for application in process and quality improvement, energy consumption management and financial management (ICAEW, 2019; Tsiatsis, et al, 2019; Vardi, 2015; Shrouf and Miragliotta, 2015). In these areas, the prevailing applications were in forecasting and planning, decision-making, control and performance evaluation. The accounting and management teams were also benefitted further by

IoT deployment through its management application in relation to cost control (ICAEW, 2019; Shrouf and Miragliotta, 2015). However, there is also a significant amount of companies using IoT technology who finding it difficult to integrate the IoT into finance processes (ICAEW, 2019). Thus, we analyse the link *between* IoT adoption, cost control and energy management in manufacturing industry.

Therefore, the research question in this paper is as follows: "What are the major effects of IoT technology on energy management for achieving cost efficiency in food manufacturing industry?" In order to achieve this, we conducted an exploratory study. The study is articulated in two distinct steps which includes a theoretical and a practical study. The initial part explains an overview of the previous studies. We overview the main contributions from the previous studies on the phenomenon investigated, so that we could identify the research gap and the primary directions to guide our subsequent practical analysis. Then, we follow a descriptive method to investigate the implications of the IoT technology on energy management for achieving cost efficiency and the potential involvement of the accounting and finance teams within the energy management related to the food manufacturing industry. For the descriptive narrative, we gathered information through secondary data analysis.

We investigated the food manufacturing sector as our research context for three main considerations. First, the food manufacturing industry has been depending on energy as one of their vital resources in the industry. According to UN Water (2015), the food production along with its supply chain were one of the largest energy consumer (after the chemical and petrochemical industry, iron and steel industry, and non-metallic material industry) due to their responsibility for 30% of the total global energy consumption. In addition, 48.50% of the energy in food production was mainly used for food handling activity (Lillie, 2015; Jagtap et al., 2019). Second, the food manufacturing industry has experienced prominent changes because of the IoT adoption. Third, the food manufacturing industry has to face increasing threats due to energy shortages and higher energy costs. The food manufacturing industry needs to find the most effective and efficient way to tackle

this issue and energy efficiency improvement has been on the top of the list (Jagtap et al., 2019). This study's emphasis is on an Australia-based dairy factory where the application of an IoT-enabled sensing technology has been implemented with the aim to reduce the energy consumption in the factory.

Our main finding outlines the need to analyse the food manufacturing industry and to investigate the main effects of the IoT technology on energy management from the cost efficiency perspective. The Australia-based dairy factory assessed the benefit of using energy data by installing IoT energy smart meters in order to enhance operational efficiency in their power dryers. The IoT-based energy smart meters can improve the efficiency and productivity of energy consumption by enabling and enhancing the visibility and reliability of energy consumption in the factory.

Therefore, this paper primarily contributes in analysing topics that are seldom discussed together, notably the link between energy management and cost efficiency through the IoT technology. Moreover, this study can represent a helpful direction for investigating the managerial solutions needed for successfully and effectively adopting IoT technology from the energy efficiency and cost efficiency perspective within the food manufacturing industry.

Section 2 of this paper presents a review of the primary concepts in this study, such concepts as the primary issues related to the IoT adoption, energy management and cost efficiency as applied to the food manufacturing industry. Then, Section 3 explains the research methodology, which consists of a two-step research approach which consists of an overview of the literature on the phenomenon investigated and a descriptive methodology. Section 4 presents the descriptive narrative and the main results along with suggestions for future research. Lastly, Section 5 outlines the conclusions, research limitations as well as theoretical and managerial implications.