THE DEVELOPMENT OF AN ONLINE MONITORING SYSTEM FOR INVENTORY CONTROL CONSIDERING CULTURAL VALUE INFLUENCES

MUHAMMAD FAKHRUL HAZIQ BIN MUHAMAD NAZRI
B092010119

BACHELOR OF MANUFACTURING ENGINEERING TECHNOLOGY (BMIW) WITH HONOURS

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Tarikh: 9/1/2024

Cop Rasmi:

DR. IHWAN GHAZALI
Pensyarah Kanan
Jabatan Teknologi Kejuruteraan Pembuatan
Fakulti Teknologi Kejuruteraan Mekanikal dan Pembuatan
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Universiti Teknikal Malaysia Melaka

Dr. Ihwan Ghazali
Penyelia Utama
Fakulti Teknologi Kejuruteraan Mekanikal dan Pembuatan
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I declare that this thesis entitled “The Development of an Online Monitoring System for Inventory Control Considering Cultural Value Influences ” is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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APPROVAL

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Manufacturing Engineering Technology with Honours.

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DR. IHWAN GHAZALI
Pensyarah Kanan
Jabatan Teknologi Kejuruteraan Pembuatan
Fakulti Teknologi Kejuruteraan Mekanikal dan Pembuatan
Universiti Teknikal Malaysia Melaka

Supervisor Name : Dr. Ihwan Ghazali

Date : 09/01/2024

DEDICATION

I dedicate this effort to my dear parents, Abah and Mak, who are always giving me support, love, encouragement, and prayers at all hours of the day and night. You inspire me with your kind words and encouragement.

ABSTRACT

Inventory management is a key part of a company's supply chain and processes. It is also important to the success of companies in a wide range of industries. Inventory management includes buying, keeping, and handling items. The main goal of inventory management is to get the right items at the right place, at the right time, and in the right amount. The conventional approach to inventory management is predicated upon the utilisation of manual counting techniques, which are susceptible to human error. This not only results in delays in updating inventory records, but also introduces the possibility of inaccuracies in the data collected in relation to the data extant. This study using cultural values to guide the use of internet of things (IoT) in stock control. Based on the findings of this research, a prototype of an online monitoring system for inventory management that takes cultural values into account will be created. By using SmartPLS, the correlation between factor of developing IoT in inventory management and cultural value can be determine. The development of prototype can be achieve based on the result.

ABSTRAK

Pengurusan inventori merupakan bahagian penting dalam rantaian bekalan dan proses sebuah syarikat. Ia juga penting untuk kejayaan syarikat dalam pelbagai industri. Pengurusan inventori melibatkan pembelian, penyimpanan, dan pengendalian barang. Tujuan utama pengurusan inventori adalah untuk mendapatkan barang yang betul, di tempat yang betul, pada masa yang betul, dan dalam jumlah yang betul. Pendekatan konvensional dalam pengurusan inventori bergantung pada penggunaan teknik pengiraan manual, yang rentan kepada kesilapan manusia. Ini tidak hanya mengakibatkan kelewatan dalam mengemaskini rekod inventori, tetapi juga membuka kemungkinan ketidak tepatan dalam data yang dikumpulkan berhubung dengan data yang ada. Kajian ini menggunakan nilai budaya untuk memandu penggunaan Internet of Things (IoT) dalam kawalan stok. Berdasarkan hasil kajian ini, satu prototaip sistem pemantauan atas talian untuk pengurusan inventori yang mengambil kira nilai budaya akan dicipta. Dengan menggunakan SmartPLS, hubungan antara faktor pembangunan IoT dalam pengurusan inventori dan nilai budaya dapat ditentukan. Pembangunan prototaip dapat dicapai berdasarkan hasil tersebut.

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LIST OF SYMBOLS AND ABBREVIATIONS

AI	-	Artificial Intelligence
AVE	-	Average Varience Extracted
BLE	-	Bluetooth Low Energy
CR	-	Composite Reliability
GUI	-	Graphical User Interface
HCM	-	High-order Component Model
HOC	-	Higher-order Component
HTMT	-	Heterotrait-Monotrait ratio
IoT	-	Internet of Things
IR	-	Industrial Revolution
LOC	-	Lower-order Component
PLS-SEM	-	Partial Least Squares Structural Equation Modelling
RFID	-	Radio-frequency Identification
SoC	-	System on Chip
VR	-	Virtual Reality
WSNs	-	Wireless Sensor Networks
LPWAN	-	Low-power Wide-area Network

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CHAPTER 1

INTRODUCTION

1.1 Background

An essential component of a company's supply chain and operations is inventory management that is crucial to the functioning of businesses across a range of industries. Inventory management combines procurement, storing and managing with the primary goal of collecting the proper inventory at the proper place, at the proper time, and in the accurate quantity. The inventory management system will also have a direct or indirect impact on an organization's profitability because it is closely related to the manufacturing function of the company (Khan et al., 2019).

Taking better decisions will increase cash flow and increase profitability for businesses. In any manufacturing industry, monitoring raw material and product consumption is seen to be vital for operational sustainability and profitability. Given the level of competition in the world today, manufacturers are constantly searching for inventory management systems that will help them cut costs and shorten the time it takes to procure goods and raw materials for production (Bose et al., 2022). The organization can efficiently and properly fill orders due to accurate inventory tracking. Proper inventory management will enable every business to operate with greater effectiveness. In addition, systematic inventory management helps cut down on labor costs related to inventory, such as time spent counting goods. Before ordering more items, the warehouse manager can keep an eye on the amount of stock. A business can alter its product range in response to demand thanks to

well-planned inventory control. Indirectly, it may help in managing unexpected shifts without compromising the quality of the product or the client experience.

Industry 4.0 is changing how companies produce, improve, and distribute their products. Modern technologies like the Internet of Things (IoT), cloud computing and analytics, artificial intelligence (AI), and machine learning are being adopted by manufacturers for their operations and production facilities. According to Tejesh and Neeraja (2018), industries, homes, colleges, and other native surroundings all heavily rely on smart systems. Since localization is so important in modern life, there is a linear growth in the localization concept in smart systems. Inventory management in the modern day is gradually getting more intelligent and computerized. For instance, Amazon purchased Kiva Systems' robotics project, which employed robots to move and sort merchandise. Robotics have also been used to operate warehouses by Alibaba and JD.com in succession (Tian and Wang, 2021). However, there is studies lacking which is cultural values that affect online monitoring for inventory management do not been consider yet and inventory management still has several flaws that are common today.

This research is very important since it can help manufacturer and developer to consider cultural influences in creating a website, application, system etc. in product development phase. This study determined whether users in manufacturing field especially in Malaysia look at the system seriously or just want the product function based on their feeling. For successful communication, customer happiness, and respect for various cultural backgrounds, cultural values must be taken into consideration in online inventory management.

1.2 Problem statement

A crucial part of running a business is managing inventory to make sure there is enough stock on hand to meet consumer demand since it directly affects the level of client

happiness, overall financial success and operational effectiveness. The discrepancy between the quantity listed in an organization's inventory management system and the actual quantity that is readily accessible is known as inventory record inaccuracy. Inventory record inaccuracy can cause serious problems in the retail industry, such as stockouts and revenue losses brought on by wasteful replenishment (Shabani et al., 2021). One problem that manufacturing companies still have not figured out is how to keep accurate records of their inventory. This has a big effect on how well an organisation does. For example, rescheduling operations can lead to lost sales, fines for delays, bad planning, and extra costs for using transport vehicles (Shabani et al., 2021). Traditional inventory management rely on manual counting that can lead to human error not only delay in updating inventory records in fact the data taken may not be accurate with the data existing. In line with the times, this method no longer suitable since industry 4.0 offer a beneficial technology that led to efficient management as it can be monitor through online.

1.3 Research objective

The main aim of this research is to apply internet of things (IoT) in inventory management based on cultural values. Thus, the objectives are:

a) To identify the factor of development internet of things (IoT) for inventory management system.

b) To evaluate the relationship of IoT inventory management system with cultural value influences.

c) To develop a prototype of online monitoring for inventory management based on cultural value influence.

1.4 Scope of research

The main scope of this research is to develop an online monitoring for inventory management using IoT considering cultural values. This project focus more on how to apply IoT into inventory management along with Industry 4.0.

This research involved Malaysian's people with a specific respondent in a manufacturing industry by general data of culture of Malaysia. The use of cultural value dimensions focusses on Hofstede cultural dimensions. ie

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Technology is advancing quickly in today's environment, which can be beneficial for any manufacturing organization. Through the use of robots, artificial intelligence (AI), machine learning, virtual reality (VR), cloud tech, and data science, the Fourth Industrial Revolution (IR 4.0) will change the way businesses work. The Internet of Things (IoT) has recently been implemented in smart factories to advance the digital transformation of manufacturing and enable businesses to operate more efficiently, affordably, and sustainably. IoT is a key technology that makes it possible for smart companies to grow, which are becoming increasingly popular (Soori et al., 2023). Moreover, in these post-COVID-19 days, technology has become more crucial than ever. Study by Rizou et al. (2022), show that Artificial Intelligence (AI) plays a crucial role in COVID-19 initiatives, including contact tracing, diagnosis, drug treatment, and vaccines. By taking advantage of the rising fame of radio-frequency identification (RFID), wireless, mobile, and sensor devices, IoT has made it possible for efficient industrial systems and apps to be made. This was supported by Al-Saedi et al. (2017) that study on applying IoT to CNC machine that consist of sensors, middleware and user interface as the operation needs a real time data like vibration, temperature, noise level, etc. IoT can be used to develop smart houses, smart sewage systems, and smart security equipment and by fusing all of these smart systems together, a smart city may be built (Prangshu Dweep Baruah et al., 2019). Impact of Industry 4.0 and challenges were discussed follow by types of manufacturing and it different

considering cultural influences. Next, the approach and advantages of smart manufacturing was studied.

2.2 Internet of Things (IoT) definition

For the past few years, IoT has become one of the most important tools of this century in recent years. Since there are cheap computers, the cloud, big data, analytics, and mobile technologies, physical things can talk to each other and receive data without much help from people. IoT connects both the digital and physical worlds to enhance services by allowing factories to communicate production processes, maintenance schedules, and environmental conditions (Kalsoom et al., 2021). In the present hyperconnected world, digital systems can record, watch, and change every contact between things that are connected.

The main goal of the IoT is to make it possible for invisible, different, and individually recognizable real-world objects all around us to share information on their own. The aim is for multiple devices to communicate seamlessly and continuously so as to provide accurate identification and timing for each object (C. Y. Chen et al., 2022). Modern technologies, such as Wireless Sensor Networks (WSNs) and Radio-Frequency Identification (RFID), which are sensed by sensor devices and analyzed for decision-making before an automated action is executed, make this feasible. Wahida et al. (2018) described that the Internet of Things (IoT) is a network of interconnected devices that enables connection with other devices using technologies like RFID, remote wireless communication, sensor networks, etc.

In each IoT ecosystem or environment, there are four critical levels. The first layer involves using several sensors and actuators to recognize data or information in order to perform different activities. In the sensor field, the most important things are the hardware that helps identify and store information, collects information from the sensor network, lets people talk to each other, and controls how information is processed (Wahida et al., 2018).

Based on this, the second layer of a communication network is utilized to transmit the acquired data in the second layer. The majority of growing IoT applications use the middleware layer, also known as the third layer, to act as an interface between the network and application layers. On the fourth layer, there are a variety of end-to-end IoT applications, including smart utilities, smart transportation, smart industries, etc. Along with to these four layers, numerous gateways connect these layers to ease the transfer of data (Hassija et al., 2019). To sum up all of this, refer to figure 1.

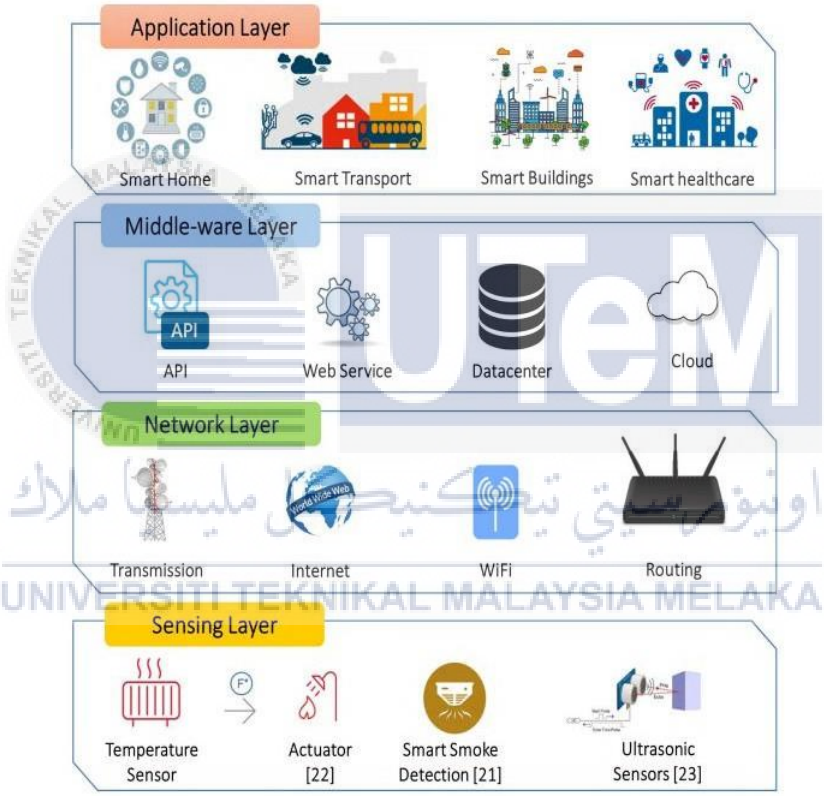


Figure 2.1 Layers in IoT system

2.2.1 Perception layer

The perception layer is made up of real things that are watched or controlled by sensors and actuators. The main goal of this layer is to receive sensor data and carry out commands.

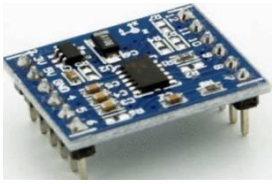
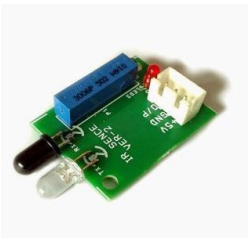
2.2.1.1 Sensors

A sensor is a component that receives signals and responds to them. Physical elements like temperature or humidity are captured, converted to electrical impulses, and sent to the IoT system. IoT sensors are frequently small and energy efficient. Table below listed some of IoT sensors that are used in industry.

Table 2.1 Sensors lists and its application

Sensors	Applications
Accelerometer sensor	An accelerometer detects the acceleration of a body or object in its instantaneous rest frame, or the rate at which the object's velocity changes over time. Many electronic items, including cell phones, wearable technology, and other items, have accelerometer sensors.
Vibration sensor	A vibration sensor is a device that measures how strong and how often a machine, system, or piece of equipment tremors and vibrates. These measurements may be used to identify asset imbalances and other issues as well as forecast future failures.
Ultrasonic distance sensor	An ultrasonic distance sensor is a device that uses ultrasonic waves to find out how far away something is. It sends out high-frequency sound waves and figures out how long it takes for the waves to come back, which is a good way to measure distance.
Temperature sensor	Temperature sensors measure the amount of heat energy existing in a source in order to detect temperature changes and transfer them into data.
Voltage sensor	A voltage sensor is a type of sensor that measures and keeps track of the voltage level of an item. electricity monitors can tell how much AC or DC electricity is present. The voltage goes into this monitor, and it can send out switches, basic voltage signals, current signals, or sounds.
Infrared sensor	A pressure sensor can tell when the pressure of a gas or liquid changes. The gauge watches for changes in pressure and warns linked systems about them when it happens.

Table 2.2 Sensor's diagram

Sensors	Diagram
Accelerometer sensor (Miftahussalam et al., 2023; Popreeda et al., 2022; Saed Tarapiah et al., 2014)	
Vibration sensor (Biansoongnern et al., 2016; El et al., 2020)	
Ultrasonic distance sensor (Appiah et al., 2020; Bhalekar et al., 2023)	
Temperature sensor (Kanade & Prasad, 2021; Nayyar & Puri, 2017)	 
Voltage sensor (Hammoumi et al., 2018; Khalid et al., 2017)	 
Infrared sensor (Hammoumi et al., 2018; Khalid et al., 2017)	 

2.2.1.2 NodeMCU

NodeMCU is an open-source software and hardware development platform built around the ESP8266, which is a cheap System on Chip (SoC). According to Gabriel and Wang (2022), NodeMCU is a low-cost customizable module with a 3.3 V operational

voltage that can be programmed with either the Arduino IDE or the Lua programming language. Media's et al. (2019) also stated that the NodeMCU board is a System on Chip (SoC) that includes the TCP/IP protocol and may operate on a network as a server, client, or both. It is linked to the relay switch in this type, and the loads are controlled by its four digital output pins. The ESP8266 Wi-Fi module attached to the device is in charge of configuring the IoT facility.

Figure 2.2 NodeMCU (Media's et al. 2019)

2.2.1.3 Arduino UNO

Massimo Banzi made Arduino in 2005 in Italy so that people who aren't experts could use a cheap, easy-to-use tool to build hardware projects. The board is open source, and anyone can use it to make their own board because it is shared under a Creative Commons licence. The microprocessor on this board can be set up to recognize and handle real-world objects. By reacting to sensors and inputs, the Arduino can talk to a wide range of outputs, such as LEDs, motors, and screens. The sensors have interfaces and connect to the Arduino in order to receive the signal and when the signal is received, it is transmitted to the Arduino, which then communicates with the ESP8266 server and transmits the signal to the device being used (Gabriel and Wang, 2022).

Arduino has become a very popular choice for makers and makerspaces that want to build engaging hardware projects because it can be used in many different ways and costs very little. UNO with Atmega328 processor that can operate at 16MHz is widely used probably the most well-known Arduino board on the market and in the industry (Kondaveeti et al., 2021).

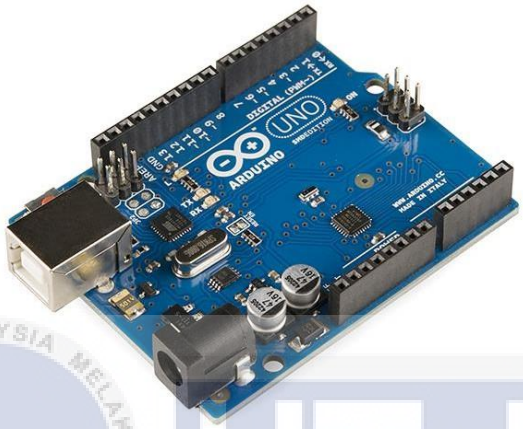


Figure 2.3 Arduino UNO (Sawatrukkul and Thongchaisuratkrul, 2019)

2.2.1.4 Raspberry Pi

According to Wang et al. (2023), the most well-known single board computer (SBC) is the Raspberry Pi, which was created by the Raspberry Pi Foundation in collaboration with Broadcom due its affordable price and strong capabilities, which have been used in applications for structural health monitoring (SHM). These tiny computers, about the size of a credit card, are intended to support the teaching of fundamental computer science and programming concepts at educational institutions as well as provide an accessible and adaptable platform for a range of projects and applications.

The board has an ARM11 CPU and a 40-pin GPIO that may be connected to sensors and actuators. In addition to Ethernet, Wi-Fi, and USB network connection capabilities, the Raspberry Pi has built-in video, audio, and USB inputs that may be connected to a keyboard

and mouse. Consequently, it is possible that it was created using strong programming languages like C, Python, etc.

Figure 2.4 Raspberry Pi (Venkatesh et al., 2018)

2.2.2 Connectivity

IoT connection refers the methods and tools used to connect IoT devices and enable data interchange and interaction with other IoT devices and external systems. Connectivity in communication technology is essential to modern society since it allows for global interaction, data sharing, and the spread of creative applications and services. In our connected world, it has transformed many different businesses and continues to influence how people communicate, work together, and access information. There are a range of technologies available for IoT such as traditional cellular (2 G/ 3 G/ 4 G), Low Power Wide Area, Wi Fi, Bluetooth, etc. The range of communication, data transfer rate, power consumption, and the particular needs of the IoT application are all factors that influence the connectivity option. Figure below show the factor that influence connectivity in simple way.

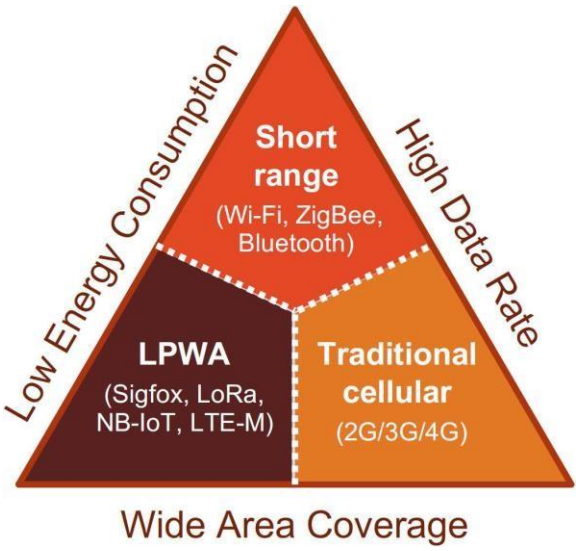


Figure 2.5 Factor that influence connectivity

Common IoT link-layer technologies are cellular, Wi-Fi, and Ethernet, as well as more specialized alternatives like low-power wide-area network (LPWAN), ZigBee, Bluetooth low energy (BLE), RFID, and NFC (Magaia et al., 2021). Regardless of the brand of operating system or software tools used, the Internet of Things protocol set offers a language that is common by all connected systems. The table below lists the well-known IoT technologies.

Table 2.3 Communication technology (Tabaa et al., 2018)

Technology	Standard	Frequency	Range	Transmission speed
Bluetooth	Bluetooth 4.2	2.4 GHz (ISM)	50 – 150 m (Smart/BLE)	Mbit/s (Smart/BLE)
Zigbee	IEEE802.15.4	2.4 GHz	10-100 m	250 Kbit/s
Z-wave	Z-Wave Alliance ZAD1283/ITU-T G.9959	900 MHz (ISM)	30 m	9.6 / 40 / 100 Kbit/s
6lowPan	RFC6282	2.4 GHz	--	--

Wifi	802.11n	2.4 GHz and 5 GHz	50 m	600 Mbit/s max
Sigfox	Sigfox	900 MHz	30-50 km (E ruraux), 3-10 km (E urbains)	10-1000 bit/s
LoRa	LoRa	3 frequencies	15 km	0.3-50 Kbit/s

2.2.3 IoT platform and middleware

An Internet of Things (IoT) platform is a piece of software or hardware that makes it easier to set up, control, and communicate with IoT devices, data, and apps. It works as a bridge between the real world of connected objects and the digital world of data and analytics. The middleware concept improves up development by enabling compatibility across multiple services and applications through the provision of a scalable processing and communication interface (O. Ali et al., 2022). An IoT platform allows data from IoT devices to be collected, processed, and analysed. It also gives developers, businesses, and end users services and tools to connect with and use that data. Since many platforms enable different capabilities, application developers can choose a platform based on their needs (Agarwal and Alam, 2020). Wahab Raza et al. (2019) conclude that the most crucial factor in selecting a middleware is whether middleware is able to recognise and fulfil the needs of a person or organisation interested in the IoT market. Some available platform used in IoT:

i. Node-RED

A programming tool called Node-RED makes it easier to construct IoT and commercial applications. It is a free, open-source logic engine that lets writers of all skill levels connect databases, real I/O, cloud-based systems, and APIs. Users work with Node-RED through a browser-based flow builder. This makes it easy to connect multiple devices and APIs by just connecting nodes into logical flows.

ii. Thingspeak

Thingspeak is an open-source IoT platform that enables the collection, analysis, visualisation, and management of device data. It supports both on-premises and cloud installations and connects devices using MQTT, CoAP, and HTTP, which are industry-standard IoT protocols. Never lose data with Thingspeak's combination of scalability, defect tolerance, and speed.

iii. Zetta

Zetta is a Node.js-based open-source platform for developing Internet of Things servers on geographically dispersed devices and in the cloud.

iv. Microsoft Azure IoT

Microsoft Azure IoT services are intended to be scalable. Azure's purpose is to provide a permanent service through efficient data storage and to assist the organisation in providing a fast and accurate solution with available data in the repository for each organisational entity. Application services, communications, data storage, and efficient databases are all available.

v. Blynk

Blynk is an application developed specifically for the Internet of Things (IoT). The application allows the user to remotely control and monitor the system. Through a smartphone, it can remotely store sensor data, display data, and control programs.

2.2.4 Application layer

In networking, the application layer is the top layer of the Internet of Things ecosystem. Its job is to provide services and platforms that let applications used by end users connect to each other over a network. The application layer is in charge of providing users

with certain services that the IoT could provide, such as smart houses, smart city, and smart health (Sethi and Sarangi, 2017). The application layer communicates directly to the end user and gives applications a way to share data, no matter what the network infrastructure is underneath. It describes the protocols, standards, and formats that are used for contact and data sharing at the program level. The application layer provides services to the user and serves as an abstraction containing protocols that enable communications between different applications (Magaia et al., 2021).

2.3 Industry 4.0

There were four developments throughout the industrial revolution, Roblek et al. (2016) summarized that, namely the first industrial revolution in 1776 with mechanization, the second in 1913 with mass production, the third in 1990 with automation, and the fourth in 2011 with cyber-physical systems. In 2011, when Germany hosted the Hannover Fair, the Industrial Revolution 4.0 was initially announced. A policy to implement development objectives through the High-Tech Strategy 2020 is the Fourth Industrial Revolution (IR 4.0), which was introduced by Germany.

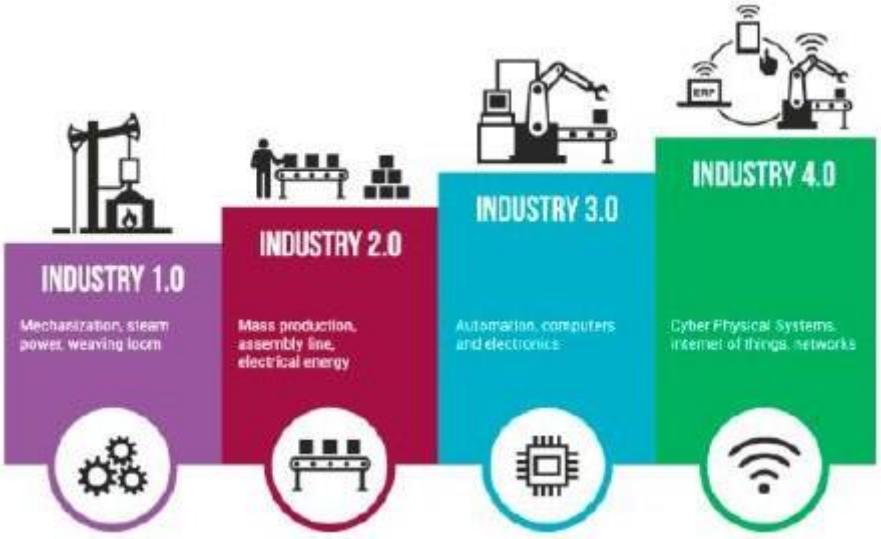


Figure 2.6 Industrial Revolution (Tabaa et al., 2018)

Smart inventory management and logistics system development is made possible by Industry 4.0. These networked and data-driven technologies provide automated material handling, effective order fulfilment, and optimized inventory movement. Businesses may increase accuracy, cut lead times, and boost customer satisfaction by using Industry 4.0 technology. IoT has made it possible for makers to make digital changes in a variety of ways, such as to focus on the customer, make production more efficient, automate tasks, gain a competitive edge, and get quick results. (Kalsoom et al., 2021). It enables the transition to a digital economy, boosts productivity and competitiveness, and offers chances for sustainable economic growth (Yuan, 2020).

For supply chain management, Industry 4.0 creates new opportunities. Improved connection and real-time data exchange allow supply chains to be more efficiently coordinated, improving inventory control, reducing lead times, and improving responsiveness to market needs. According to Soori et al. (2023), IoT sensors can monitor inventory levels in real-time, enabling manufacturers to better manage their stock levels and prevent stock outs, which can cut down on production delay time and guarantee that they always have the supplies they need to satisfy client requests. J. Chen et al. (2019) also propose that opportunities exist to greatly enhance maintenance, repair, and operation inventory management due to developing manufacturing and information technologies known as Industry 4.0 technologies as it allows manufacturing equipment real-time prognostics so that component failure may be predicted in advance.

2.4 Implementation of IoT in inventory management

A firm or organization's usage of traditional methods and practices for inventory control and tracking is referred to as traditional inventory management. Inventory managers manually maintain their stock utilizing paper-based methods or spreadsheets to keep track

of the goods, amounts, and locations. Using IoT in inventory management can make the tracking and control of goods much more accurate, efficient, and automated that can completely change how companies keep track of their stock.

2.4.1 Real-time tracking

The continuous monitoring and tracking of inventory levels, locations, and movement utilizing IoT devices and sensors is referred to as real-time tracking in the context of inventory management (Jamkhedkar et al., 2021). Real-time monitoring offers up-to-the-second information about the status of inventory products, in contrast to conventional inventory management techniques that rely on human tracking or irregular updates. It involves the installation of Internet of Things (IoT) gadgets like RFID tags, barcode scanners, or sensors that gather data in real-time and send it to a centralized database or cloud platform. In order to give firms immediate access to their inventory, this data is then connected with inventory management software or enterprise resource planning (ERP) systems. Based on Zhao and Tu (2021), businesses may also utilise this technology to monitor inventory movement from manufacturing sites to warehouses and distribution centres, giving them insight into the whole supply chain process. Beside that, Sharma et al. (2023) stated that through the use of Internet of Things (IoT) technologies, such as Wi-Fi for data transmission, businesses may collect real-time data on inventory levels, the exact location and state of commodities, and also oversee the operational status of industrial units in the supply chain. Companies can watch the movement of goods across the supply chain, keep an eye on stock levels, and rapidly spot any inconsistencies or problems using real-time tracking. With such fine-grained insight, businesses can take well-informed decisions, react quickly to changes in demand, and improve inventory management. By allowing stakeholders to access shared real-time inventory data, it also improves supply chain cooperation, improving operational efficiency and coordination. In general, real-time

tracking in inventory management transforms how businesses manage their inventories. Companies can successfully satisfy consumer requests, reduce stockouts, optimize inventory levels, and use IoT and real-time data to enable data-driven choices.

2.4.2 Enhance data analytic

In order to analyze and get useful insights from the massive amounts of data created by real-time tracking and other sources, enhanced data analytics in inventory management is used. Enhanced data analytics extends beyond surface-level information, in contrast to conventional inventory management techniques that depend on manual computations or straightforward reporting. Advanced algorithms and machine learning tools are used in advanced data analytics to find hidden trends, correlations, and patterns in massive volumes of data (Rozados and Tjahjono, 2014). To find patterns, trends, and correlations in the inventory data, statistical models, algorithms, and machine learning are used. Utilizing the power of data analytics, businesses may increase operational efficiency, optimize inventory levels, and make better decisions. In addition to helping to detect any possible bottlenecks or problems in the supply chain, this enables enhanced supplier relationship management (Liu, 2022). By analyzing historical data, market patterns, and outside influences, firms may more precisely estimate demand, spot future stockouts, and match inventory to customer demands. By combining data from many stakeholders and examining performance measures across the supply chain, it also makes supply chain optimization easier. As a result, coordination is enhanced, lead times are shortened, and overall efficiency is raised. Additionally, improved data analytics aids predictive modelling, allowing businesses to forecast future demand, optimize inventory allocation, and proactively deal with anticipated inventory issues.

2.4.3 Cost efficiency

The strategic management of inventory to minimize costs while preserving or enhancing operational performance is referred to as cost efficiency in inventory management. In order to achieve cost efficiency in inventory management, businesses can employ a range of strategies including the implementation of just-in-time inventory systems, regular demand forecasting and monitoring, optimisation of order quantities, exploration of vendor-managed inventory partnerships, and utilisation of advanced inventory management software (Nazuk et al., 2021). It means cutting back on expenses connected to transporting, storing, and managing inventory as well as stockouts, overstocking and outdated inventory costs. Businesses may optimize inventory levels based on precise demand forecasts and real-time tracking by implementing cost-effective practices. Through the avoidance of unneeded inventory building and the reduction of capital invested in inventory, this strategy serves to reduce carrying costs. Cost-effectiveness also contributes to a decrease in stockouts, ensuring that products are accessible to satisfy consumer requests and preventing missed sales opportunities. Additionally, it lessens holding costs and waste by preventing overstocking and inventory obsolescence. Companies may optimize resource allocation, save labor costs, and boost overall efficiency by simplifying operational procedures, utilizing technology, and making data-driven choices. Cost-effective inventory management ultimately enables companies to improve their financial performance by maximizing profits, enhancing cash flow, and maximizing the use of their resources.

2.4.4 Improve customer service

Enhancing the experience and satisfaction of consumers through efficient inventory management is the main goal of improving customer service in inventory management. Companies that prioritize customer service aim to respond to requests from customers in a

timely, accurate, and consistent manner. This includes minimizing order processing lag time, making sure the correct items are accessible when consumers need them, and keeping the right quantities of inventory. In order to guarantee customer satisfaction, it is crucial to promptly handle their requests and issues, since customers appreciate timely replies (Guerola-Navarro et al., 2022). Businesses may react more quickly to shifting client wants and market trends by utilizing real-time tracking, demand forecasting, and supply chain coordination. A more dependable and smooth experience for consumers is made possible through improved customer service, which also lowers stockouts and backorders. Additionally, it enables businesses to adjust inventory offers and suggestions depending on consumer preferences and behavior, ultimately personalizing the customer experience. Companies can encourage client loyalty, improve their brand, and get a competitive edge in the market by concentrating on enhancing customer service. Outstanding customer service in inventory management ultimately results in greater customer satisfaction and enduring client connections.

2.4.5 Human error

In order to build Internet of Things (IoT) for inventory control, human error must be considered as a key factor. The possibility of human mistake still exists despite the use of cutting-edge technologies and automation. Internet of Things (IoT) solutions for inventory management may minimise mistakes, eliminate inventory inconsistencies and decrease cognitive stress by actively addressing the influence of human operators (Neumann et al., 2021). Data entry, system configuration, device administration, and decision-making are just a few of the steps in the IoT-enabled inventory control process where human error may happen. Inaccuracies in inventory tracking, improper order fulfilment or delays in supply chain activities might result from errors made when inputting data, setting IoT devices or interpreting information. Zhang and Liu (2021) emphasized that businesses may put in place

a number of strategies to lessen the effects of human error in IoT-based inventory management. Designing strong IoT systems that take into account possible human fallibility requires an understanding of the role that human error plays. This entails offering appealing user interfaces, clear instructions, straightforward data entry methods, and thorough training to users engaging with IoT-enabled inventory control systems. Additionally, adding error-checking features, validation procedures, and automatic warnings can aid in the immediate detection and reduction of mistakes. By improving human-computer interfaces, simplifying procedures and offering efficient training and assistance, the goal is to reduce human error. Companies may increase the dependability, accuracy, and efficiency of inventory control systems, which will lead to better inventory management techniques and customer satisfaction, by taking into account human error as part of IoT development.

2.4.6 Control of product

The strategic management of product movement in the supply chain is referred to as controlling the flow of items in inventory management. Through maintain effective operations, it requires keeping an eye on and controlling the flow of commodities from purchase through distribution. According to Folinas et al. (2018), efficient order fulfilment and distribution are made possible by inventory management, which controls the flow of products in the supply chain. Díaz-Reza et al. (2018) stated that the company's competitiveness and profitability are enhanced as a result of happier customers and better business operations. Controlling product flow enables businesses to improve their supply chain management strategies. To make sure that things are accessible when and where they are required, they may continuously monitor inventory levels, follow product movement, and make educated choices. This lessens interruptions, shortens lead times, and boosts the effectiveness of the supply chain as a whole. Controlling the flow of goods also helps businesses to proactively detect and fix any inventory gaps, which avoids stockouts and

shortages. It makes it easier for firms to produce and buy according on demand, enabling them to match their operations to actual client need. Controlling product flow also improves visibility and traceability across the whole supply chain. Products may be tracked as they go through the supply chain, their status can be checked, and bottlenecks or delays can be found. This makes it possible to make proactive decisions and solve problems quickly. Businesses may react quickly to changes in the market and client preferences by modifying their inventory levels and distribution plans when they have a clear picture of the product flow. Overall, inventory management helps businesses optimize their supply chains, increase operational effectiveness, and efficiently adapt to changing market conditions.

2.5 Culture value

2.5.1 Definition of culture

In other words, culture is the foundation of a social link. More specifically, it is the way a society organizes its activity within the community. (Hofstede et al., 2002; Moalosi et al., 2010). Hofstede (2011) noticed that a group of people can be different from another based on their culture, which he defined as the ways in which their minds are linked. As defined by Verkuyten and Yogeeswaran, (2020), a culture is a group of habits and ways of doing things that have grown over time in reaction to certain problems. According to Hofstede (2011), Each of the various components of culture may be reduced to a pattern, a successful conduct, or a character to understand the pattern. Researchers emphasized that culture is a common natural mentality that displays a pattern of characteristics that have evolved over time in a way that may discriminate between other groups (Hora et al., 2019). The next subsection gives a description of each element of culture.

2.5.2 Cultural dimension

The cultural dimension relates to an individual's preferences, which may differ from one region, state, or country to another (Iamratanakul, 2017). The literature deals on a wide range of cultural topics, with standard, commonplace, ideal, attitude, behavior, purpose, ritual, tradition, and so on being some of the most important ones (Durana et al., 2019). Individualism vs. collectivism, masculinity vs. femininity, uncertainty avoidance, and power distance are the four cultural dimensions that Hofstede (2017), a pioneer in the area of cultural studies divided the elements of culture into. The figure below shows the six dimensions of culture.

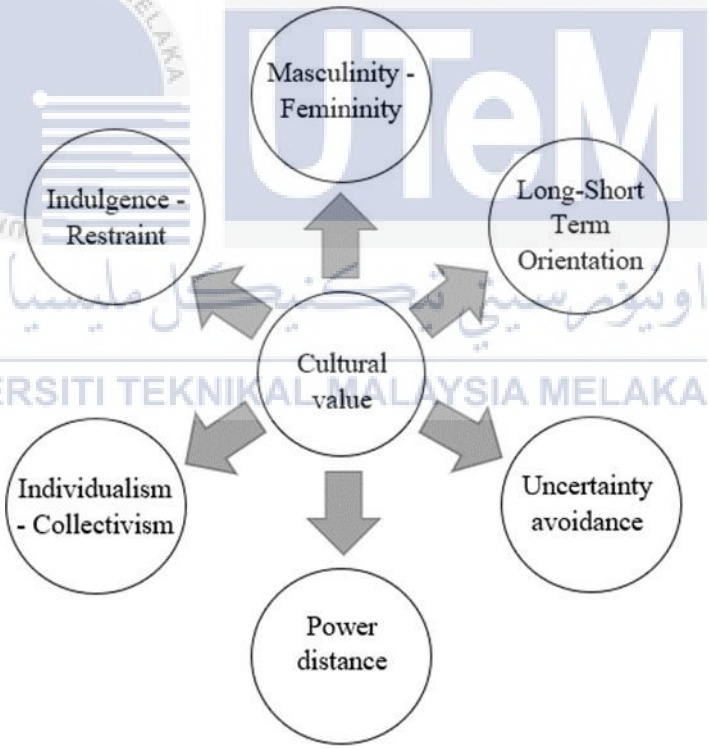


Figure 2.7 Six cultural dimensions

2.5.3 Individualism – Collectivism

Individualism is characterized by two qualities, including independence and a lack of fear about not blending in with a group (Beugelsdijk et al., 2017). Individualism is a

personality trait that describes an individual's tendency to prioritize his or her own interests over those of a group. Individualists typically prioritize their own interests over those of others (Ghazali et al., 2021). According to Hofstede (2011), individualists believe that choices should be made with their own goals in mind. The opposite of individualism, collectivism, refers to those who support communal activity and regard themselves as members of a larger group (Hofstede, 2011). Collectivism priorities the achievement of the entire group over individual success in contrast to individualism. Consider a consumer's decision to purchase a well-known or in-demand item from the market. This type of buyer tends to be collectivistic because he wants to include himself in the group of people he is buying for.

Davis et al. (2008) conducted research to learn more about the interests and habits of people who make online purchases. Davis et al. (2008) applying the Hofstede cultural dimension known as individualism-collectivism, cross-cultural research between China and the United States was conducted. According to the study, consumer preferences that took this cultural aspect into account produced different results in countries that emphasize both individuality and collectivism. The findings of this study demonstrate that a collectivist societal culturally places a larger emphasis on arousal and enjoyment when it comes to the content of web design for online shopping. Individualist customers are not directly touched by the enjoyment of site design, in contrast to collectivist customers. However, as the client's personality may be impacted by a wide range of diverse factors, it is impossible to identify the client's personality using only one dimension. Thus, considering the other five dimensions is recommended since it could provide a more in-depth understanding of the client's qualities in regard to a product that is already on the market.

2.5.4 Masculinity – Femininity

Masculinity is the degree of social traits that emphasize more on the ideals of achievement, aggressiveness, and the acquisition of an item (Hofstede, 2003). Moreover, Hofstede and Bond (2011) highlighted the idea that power explains culture at a level where masculinity is thought to be important. It was also emphasized that having a high degree of masculinity encourages a person to set objectives, do tasks well, accomplish those goals, be successful, compete with others, and be courageous (Hofstede, 2011). In contrast to masculinity, femininity is a personality attribute that places a higher value on things like one's quality of life, empathy for others and for the communities in which they live, cooperation, harmony, and the upkeep of intimate, caring for personal connections (Kristjánsdóttir et al., 2017).

2.5.5 High – Low Power Distance

Power distance is an idea that refers to the degree to which less powerful members of a group or organization realize and anticipate that power has been distributed unequally (Hofstede, 2011). High power distance is linked to hierarchies or existential inequalities, which means that there may be disagreements between those in power and those with less authority, that it will be hard for those in power to work together, that it will be hard to talk to superiors, and that those in power will have special rights. According to Moon et al. (2018), a person with a large power distance is less creative, prone to conservatism, and could show unpredictable behavior. This component demonstrates the effects of power disparities and the interactions between various authorities in society (Ghazali et al., 2021). It also influences the hierarchical structures and dependent relationships that occur in the contexts of society, the family, and organizations. A low power distance shows that social

inequality can be fixed, that structures are made for practical reasons, and that everyone should be linked (Hofstede, 2011).

2.5.6 High – Low Uncertainty Avoidance

Uncertainty avoidance is a trait of personality that characterizes how a person responds to confusing, uncertain, and unstructured situations (Hofstede, 2011; Nakata and Sivakumar, 2015). The aggressive, emotional, security-seeking, and intolerable cultural traits are those that are related to a high level of uncertainty avoidance (Ghazali et al., 2017). On the other hand, less aggressive, less tolerant, and self-aware cultural traits are connected to a low degree of uncertainty avoidance. According to Razzaghi et al. (2019), when people are fearful of uncertainty and ambiguity to the point where they desire to avoid certain situations, that behavior is known as uncertainty avoidance.

2.5.7 Long – Short Term Orientation

In contrast, a society with a short-term emphasis is more likely to be focused with the circumstances of the recent past and the present, giving less attention to the future. A culture with a long-term perspective is more likely to be concerned with the future, as seen by activities like saving and persistence (Hofstede, 2011). Characters with a short-term perspective are frequently more focused on the immediate result, being sure of the truth of their convictions, and achieving their short-term objectives (Ghazali et al., 2017).

2.5.8 Indulgence – Restraint

By the Dutch social psychologist Hofstede (2011), indulgence and moderation were presented as cultural characteristics. They refer to the extent to which cultures support or oppose the satisfaction of human wants and aspirations. This dimension focuses on how

people see the norms and values around living life to the fullest, including indulging in pleasure, against practicing self-control and restraint.

Cultures that place a strong emphasis on seeking happiness, satisfaction, and personal fulfilment are those that practice indulgence. People are more prone to indulge in their needs and look for instant pleasure in such communities. These cultures frequently place a high value on freedom of choice, autonomy, and self-expression. They frequently approach amusement, leisure, and the pursuit of pleasure with a laid-back attitude. On the other side, cultures that place a high value on the management and control of satisfaction are known as restraint cultures. Social norm observance, self-control, and impulse control are valued more highly in these civilizations. People must show self-control and discipline when it comes to their emotions, wants, and actions. Traditions, uniformity, and upholding social order are frequently valued more highly in these societies. They may discourage excessive indulgence since they tend to have a more serious and restrained attitude to leisure activities.

It is crucial to remember that indulgence and restraint are merely two distinct cultural attitudes; none is naturally either good or bad. Depending on the situation, each strategy may have advantages and disadvantages. For example, high indulgence cultures could encourage personal invention and creativity, but they might also encourage impulsive behavior or a lack of long-term planning. High constraint cultures, on the other hand, can encourage discipline and social cohesiveness but might also limit individual freedom and innovation.

2.5.9 Malaysia's culture index

In Hofstede's study of various cultures, more than 70 nations from across the world were represented. (Hofstede, 2017). Every nation, including Malaysia, has a separate classification for the culture. Figure below show cultural dimension index in Malaysia.

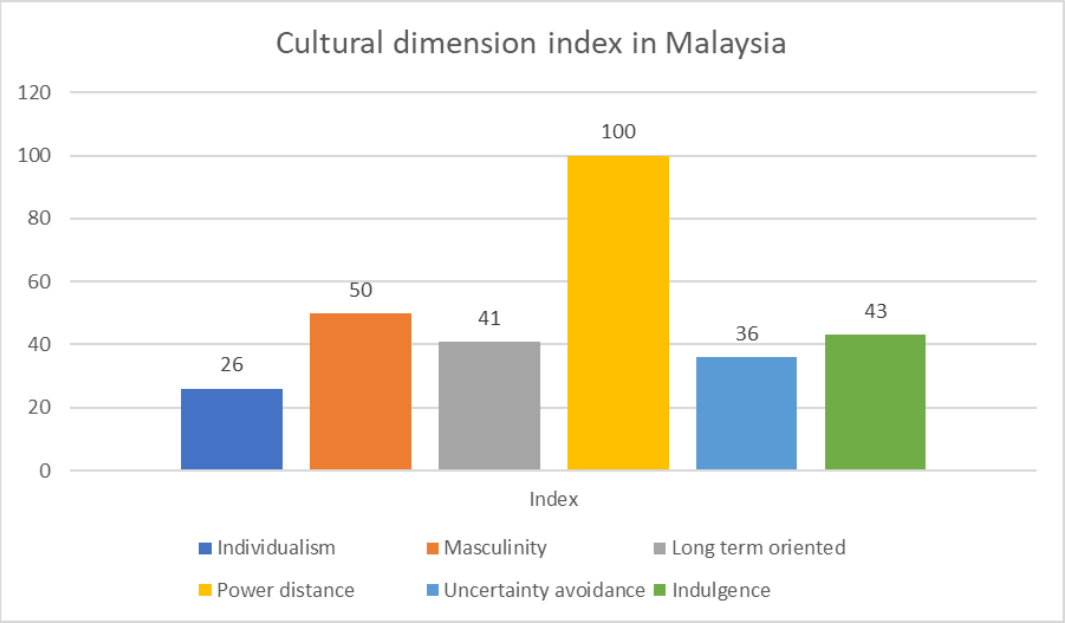


Figure 2.8 Cultural dimension index in Malaysia (Hofstede, 2017)

According to Hofstede (2017), Malaysian societies were designated as collectivism. In Malaysia, the power gap is quite wide. Since masculinity and femininity both have identical index values, there was no categorization for masculinity that could be made (Hofstede, 2017). Lastly, Malaysia has an equally low ranking for uncertainty avoidance and long-term orientation (Ghazali et al., 2017). A long-term approach received a slightly higher index value than the avoidance of uncertainty. These explanations of the cultural dimensions allow us to conclude that each dimension has its own distinct qualities. It is possible for the cultures of two regions to differ significantly from one another.

Table 2.4 The characters of cultural dimensions (Hofstede, 2011)

Cultural dimensions	**Explained characters**	
Collectivism-Individualism	Collectivism	Individualism
	"We" consciousness holds sway.	"I" consciousness holds sway.
	Identity is based on the social system.	Identity is based on the individual.
	Belief is placed in group decisions.	Belief is placed in individual decisions.
	Expertise, order, duty and security are provided by organization or clan.	Autonomy, variety, pleasure and individual financial security are sought in the system.
	Friendships are predetermined by stable social relationships, but there is a need for prestige within these relationships.	The need is for specific friendships.
Masculinity-Femininity	Masculinity	Femininity
	Men should be assertive, women should be nurturing.	Men need not be assertive but can also assume nurturing roles.
	Sex roles in society are clearly differentiated.	Sex roles in society are more fluid.
	Men should dominate in society.	There should be equality between the sexes.
	Performance is what counts.	Quality of life is important.
	You live in order to work.	You work in order to live.
	Money and things are important.	People and environment are important.
	Independence is ideal.	Interdependence is ideal.
	Ambition provides the drive.	Service provides the motivation.
	One admires the successful achiever.	One sympathizes with the unfortunate.
	Big and fast are beautiful.	Small and slow are beautiful.
	Ostentatious manliness is appreciated.	Unisex and androgyny are ideal.

Uncertainty Avoidance	High uncertainty avoidance	Low uncertainty avoidance
	The uncertainty inherent in life is felt as a continuous threat that must be fought.	The uncertainty inherent in life is more easily accepted and each day is taken as it comes.
	Higher anxiety and stress are experienced.	Ease and lower stress are experienced.
	Time is money.	Time is free.
	There is an inner urge to work hard.	Hard work, as such, is not a virtue.
	Aggressive behavior of self and others are accepted.	Aggressive behavior is frowned upon.
	More showing of emotions is preferred.	Less showing of emotions is preferred.
	Conflict and competition can unleash aggression and should therefore be avoided.	Conflict and competition can be contained on the level of fair play and used constructively.
	A strong need for consensus is involved.	More acceptance of dissent is entailed.
	Deviant persons and ideas are dangerous intolerance holds sway.	Deviation is not considered threatening; greater tolerance is shown.
	Nationalism is pervasive.	The ambiance is one of less nationalism.
	Younger people are suspect.	More positive feeling towards younger people is seen.
	There is great concern with security in life.	There is more willingness to take risk in life.
	There is a need for written rules and regulations.	There should be as few rules as possible.
Power distance	High power distance	Low power distance
	There should be an order of inequality in this world in which everybody has a right-full place; high and low is protected by this order.	Inequality in society should be minimized.
	A few people should be independent; most should be dependent.	All people should be interdependent.
	Hierarchy means existential inequality.	Hierarchy means an inequality of roles, established for convenience.
	Superiors consider subordinates to be different kind of people.	Superiors consider subordinates to be “people like me”.
	Subordinates consider superiors as different kind of people.	Subordinates consider superiors to be “people like me”.
	Superiors are inaccessible.	Superiors are accessible.

Power distance	High power distance	Low power distance
	Power is a basic fact of society that ante-dates good or evil. Its legitimacy is irrelevant.	The use of power should be legitimate and is subject to the judgment as to whether it is good or evil.
	Power-holders are entitled to privileges.	All should have equal rights.
	Latent conflicts exist between the powerful and the powerless.	Latent harmony exists between the powerful and the powerless.
	Cooperation among the powerless is difficult to attain because of their loss-faith in people norm.	Cooperation among powerless can be based on solidarity.
Long-short term oriented	Long-term oriented	Short-term oriented
	Attaching more importance to the future.	Values promoted are related to the past and present, including steadiness.
	Foster pragmatic values oriented towards rewards .	Respect for tradition.
	Persistence.	Preservation of one's face.
	Saving (thrift).	Reciprocation.
	Capacity for adaptation.	Fulfilling social obligations.
Indulgence-Restraint	Indulgence	Restraint
	Greater proportion of respondents who say they are extremely happy	Less individuals who are happy
	Greater significance of leisure	Lower priority given to entertainment
	Higher rates of obesity in nations with enough food	There are fewer fat people in nations with rich food sources.
	There isn't much emphasis placed on keeping the country in order.	Increased police presence per 100,000 people

2.6 Conceptual model development

2.6.1 Hypothesis and preferences evaluation

In order to analyze the factor of development IoT for inventory control and the impacts on cultural value, well-established conceptual frameworks from the research literature were highlighted here.

As stated in the literature section, several perspectives exist for defining the significance and attributes of culture. Nevertheless, Hofstede's investigation has established a hypothesis that describes the characteristics of cultural values. This idea has been verified and confirmed in several study domains, including marketing, organization, individual, group, and national levels. The Hofstede theory encompasses six cultural dimensions: collectivism-individualism, masculinity-femininity, high-low uncertainty avoidance, long-short term orientation, high-low power distance and indulgence-restraint.

A hypothesis has been briefly defined to explain the qualities of development of online monitoring system for inventory control as there are several opinions on this matter. In the literature section, it was dedicated that the factor of development of online monitoring system for inventory control were almost influence by real-time tracking, enhance data analytic, cost efficiency, improving customer service and control flow of product.

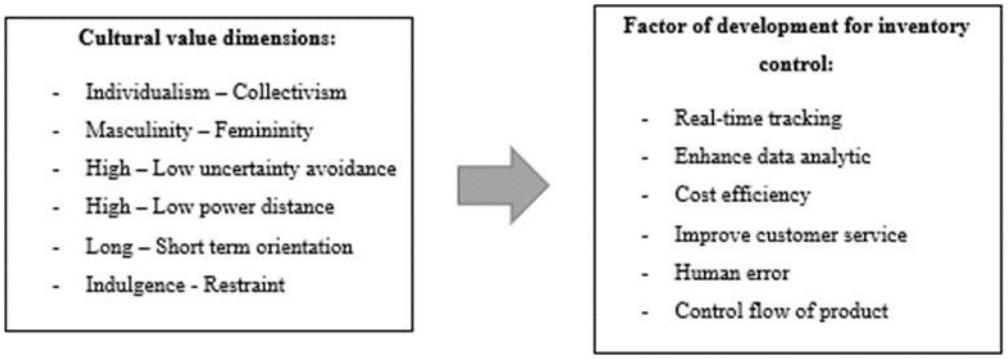


Figure 2.9 Framework to identify cultural influence on factor

2.6.1.1 Collectivism – Individualism

Collectivism refers to the state of belonging to a group that maintains one's best interests in exchange for loyalty, rather than being independent. Individualism, defined as the pursuit of self-interest without considering social connections, is in direct opposition to collectivism (Hofstede, 2011). Malaysia is characterized by a relatively high degree of collectivism. However, the research conducted by Huff and Kelley (2018) on a specific subgroup contradicts this conclusion in a substantial manner. Huff and Kelley (2018) performed a cross-national study in seven countries, including Malaysia, to examine the impact of individualism vs collectivism on organizational trust and consumer views. The findings indicate that individuality, as opposed to collectivism, has a more prominent role in influencing the degree of confidence that customers in Malaysia place in an organization. Thus, in order to determine the impact of collectivism on development of online monitoring for inventory control the following hypothesis are put forward:

H1: Collectivism has a significant influence towards development of online monitoring system for inventory control.

2.6.1.2 Masculinity – Femininity

Gender role differentiation is represented by masculinity and femininity. The masculine culture prioritizes traits such as assertiveness, wealth accumulation, accomplishments, and triumph. Conversely, the feminine culture prioritizes the well-being of others, lifestyle, and enhancing the overall standard of living (Ghazali et al., 2021). Classifications of societal culture that are most frequently employed in management literature are cultural. This is due to the fact that they effectively analyze the connection between numerous organizational factors and societal culture (Pakdil and Leonard, 2017). In the realm of manufacturing, cultures dominated by masculine have a slight edge,

especially when it comes to creating large numbers of items. These cultures thrive on completing tasks quickly, efficiently, and precisely. They tend to focus more on the function rather than the personality of the online monitoring system which make it not too complicated compared to femininity they will focus more on the condition. Product quality is ranked second in importance, following product appearance. Thus, to access the impact of this culture on the development online monitoring system, the following hypothesis are proposed:

H2: Masculinity has a significant influence towards development of online monitoring system for inventory control.

2.6.1.3 Uncertainty Avoidance

Uncertainty avoidance is a term that describes the degree to which individuals experience a sense of danger as a result of ambiguity and uncertainty, and as a result, they make an effort to steer clear of circumstances that involve these elements. The tendency of individuals to avoid situations that cause them confusion or ambiguity out of fear of being intimidated by such situations is known as uncertainty avoidance (Hofstede, 2011). Uncertainty may give impact on the inventory management or control since manager want a precise calculation of stock in the warehouse. From there, employee will ensure there no stockout or any problem relate to the products. High uncertainty avoidance makes inventory management more effective and systematic because there will be no stockout, no delay in delivery, standardizing work and more which all of that are important in order to get better in industry. Thus, development of online monitoring for inventory control will be influenced by uncertainty avoidance that described by the following hypothesis:

H3: Uncertainty avoidance has a significant influence towards development of online monitoring system for inventory control.

2.6.1.4 Power Distance

Power distance refers to the extent to which individuals in organizations and institutions who have less power are willing to accept and expect that power is distributed unequally (Hofstede, 2011). As hierarchy implies inequality, a high-power distance signifies challenges in managing relationships among the weak, and the possibility for conflict between the strong and the powerless. Organizations with a low Power Distance foster interpersonal engagement and communication among employees across all levels of the organizational structure. Furthermore, these companies have a tendency to enhance the authority and influence of individuals employed inside the organization (Dubey et al., 2019). In order to create an online monitoring system for inventory control in a cultural context where there is a significant power difference between individuals, it is crucial to design the system with functionalities that support centralized decision-making, well-defined reporting hierarchies, strict access restrictions, and efficient communication protocols. The system must have hierarchical access levels, specialized reporting functionalities, and customization choices to correspond with the power dynamics present in the organization. Hence, the proposed hypothesis is as follows:

H4: Power distance has a significant influence towards development of online monitoring system for inventory control.

2.6.1.5 Long – Short Term Orientation

Long-term orientation refers to the cultivation of values that prioritize future benefits, including persistence and thrift (Hofstede, 2011). In order to synchronize an online monitoring system for inventory control with a cultural value system that emphasizes long-term orientation, it is essential to create a system that is both adaptable and scalable. This system should facilitate ongoing enhancements and be capable of adapting to future changes.

The system should include predictive analytics that forecast future trends, strategic planning tools to make long-term decisions, and training programs that prioritize the development of skills related to new technology. By prioritizing sustainability measures, recordkeeping, and knowledge management, organizations can guarantee the long-term preservation of institutional knowledge. Therefore, organizations that exhibit the attribute of long-term orientation are particularly focused on the future use of the online monitoring system. Thus, the working hypothesis is as follows:

H5: Long-term orientation has a significant influence towards development of online monitoring system for inventory control.

2.6.1.6 Indulgence – Restraint

Based on Hofstede (2011), indulgence and restraint were portrayed as cultural characteristics. They related to the degree to which cultures facilitate or hinder the fulfilment of human desires and ambitions. This dimension examines individuals' perspectives on societal norms and values related to pursuing a fulfilling life, which encompasses both the pursuit of pleasure and the exercise of self-control and restraint. In order to align an online inventory monitoring system with cultural values, prioritize the development of a pleasurable and interactive user experience. Incorporate gamification elements to enhance motivation, prioritize the development of a user-friendly interface featuring intuitive design, employ visually appealing representations of inventory data, and permit personalization options. Incorporate interactive functionalities, guarantee a design that is responsive across various devices, optimize workflows to enhance efficiency, and incorporate positive feedback mechanisms to reinforce effective inventory management behaviors. By prioritizing user pleasure and enjoyment throughout the system, organizations may improve user adoption and contribute to efficient inventory control. Thus, to identify

whether indulgence has a significant influence towards the development of online monitoring for inventory control, the following hypothesis is proposed:

H6: Indulgence has a significant influence towards development of online monitoring system for inventory control.

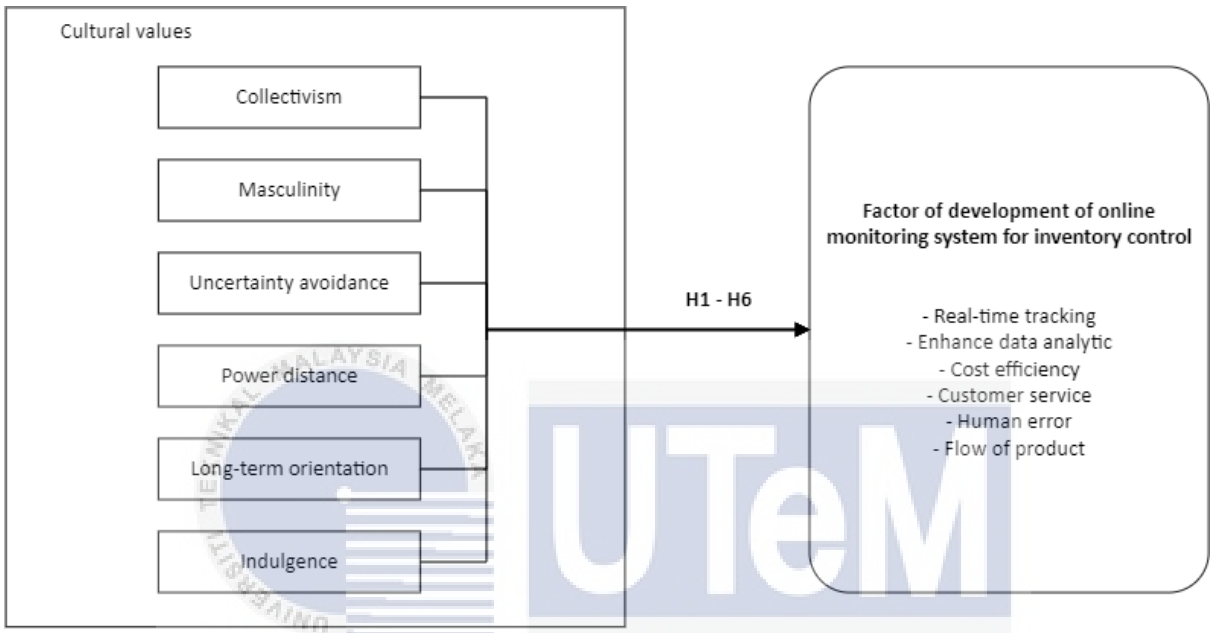


Figure 2.10 Hypothesis evaluation

As illustrated in figure above, six hypothesis have been generated in order to identify the cultural value influences towards development of online monitoring system for inventory control. The arrows symbolizing the six cultural components are designed to align with the idea of development of online monitoring system. On the left side of the framework, the construct of the cultural values consists of six cultural dimension which are collectivism, masculinity, uncertainty avoidance, power distance, long-term orientation and indulgence. On the other side, there are six factor of development of online monitoring system for inventory control which are real-time tracking, enhance data analytic, cost efficiency, customer service, human error and flow of product. The six generated hypothesis that need to be tested using proper research methodology are presented in the table below.

Table 2.5 Hypothesis of the research

Cultural Value	Hypothesis
Collectivism	**H1**: Collectivism has a significant influence towards development of online monitoring system for inventory control.
Masculinity	**H2**: Masculinity has a significant influence towards development of online monitoring system for inventory control.
Uncertainty avoidance	**H3**: High uncertainty avoidance has a significant influence towards development of online monitoring system for inventory control.
Power distance	**H4**: High power distance has a significant influence towards development of online monitoring system for inventory control.
Long-term orientation	**H5**: Long-term orientation has a significant influence towards development of online monitoring system for inventory control.
Indulgence	**H6**: Indulgence has a significant influence towards development of online monitoring system for inventory control.

2.7 Research gap discussion

Inventory management still has a number of issues that remain common today due to a lack of research that take cultural norms that impact online monitoring into consideration. This study is crucial because it may assist manufacturers and developers in taking cultural influences into account while developing a website, application, system, etc. throughout the product development process. This study investigated if consumers, particularly those in Malaysia's industrial sector, take the system seriously or just expect the product to work according to their feelings. Cultural values must be taken into account in online inventory management for effective communication, satisfied customers, and consideration of different cultural backgrounds.

CHAPTER 3

METHODOLOGY

3.1 Introduction

Every study needs a defined strategy in order to fulfil its goals, organize research in a methodical and scientific way, and make it easier to solve problems. This chapter offers a summary of the fundamental research methodology that was applied to this study. In general, the study has been split into three primary sections in order to complete this study. At the first stage, the aim is to determine the way cultural value give impact to online inventory management. Data and information will be collected through a survey to have a better understanding of the cultural value in an organization. Next, the data will be extracted to see the correlation between factor of development IoT for inventory control using SmartPLS. After getting the result, a prototype of online inventory control will be develop based on factor and culture that has the highest rank.

3.2 Research method

When academics speak to research method, they mean the comprehensive plan or framework they develop to address a certain research issue or achieve a particular objective. It requires making decisions about possible study designs, methods for collecting data, sample sizes, and analytical techniques. Various phases in the design of the study are included in both qualitative and quantitative research approaches.

In order to answer research questions and evaluate hypotheses, quantitative research employs a methodical and structured strategy to collecting and analyzing numerical data.

Data must be gathered consistently, frequently through surveys, experiments, or measurements, and statistical analysis must be used to reach conclusions and establish generalizations about a wider population. In quantitative research, researchers usually specify variables, form a hypothesis, and create a study that enables the gathering of measurable, objective data. To guarantee statistical power and representativeness, large sample sizes are frequently employed. The collected data are analyzed using statistical techniques including correlation analysis, regression analysis, and descriptive statistics. These techniques support determining the relevance of findings as well as patterns, correlations, and trends.

Qualitative research is a methodical and in-depth strategy for comprehending and interpreting social phenomena through non-numerical data. It focuses on examining and analyzing the details, significance, and circumstances of human experiences, acts, and interpersonal relationships. Interviews, focus groups, observations, and the examination of texts or documents are examples of qualitative research methodologies. With the use of these techniques, researchers may hold open-ended discussions, watch behaviors in the wild, or examine rich textual data to learn more about the underlying viewpoints, meanings, and social dynamics at work. Narratives, quotations, themes, or in-depth descriptions are frequently used as data collection methods in qualitative research. In order to recognize patterns, themes, and conceptual frameworks that arise from the data, researchers immerse themselves in the data and use a variety of analytical methodologies, such as thematic analysis or grounded theory. In-depth examination of irrational experiences, cultural influences, social dynamics, and personal interpretations is a key component of qualitative research.

Table 3.1 Different between qualitative and quantitative research

Criteria	Qualitative	Quantitative
Research Question	Typically, a dissertation begins with an inquiry that seeks to look deeply into a topic, be it meaning, experience, or social phenomenon.	The purpose is to collect data and draw conclusions about a subject.
Data Collection Methods	Utilizing techniques such as in-depth interviews, focus groups, participant observation, and document analysis, the researcher amasses huge data. Researchers can use these methods to learn more about the participants' beliefs, emotions, and interpretations.	Collects standard, numeric data from a large sample using techniques such as surveys, experiments, and existing databases. Researchers are constantly in quest of relevant and generalizable data.
Sampling	Applies a sampling method in which subjects are selected based on their potential to cast light on the research question at hand. Researchers frequently use smaller samples in an effort to accomplish data saturation, the point at which accumulating additional data yields no additional information.	Frequent use of random or stratified sampling to maximize generalizability and ensure representativeness. Compared to qualitative research, quantitative research typically employs larger sample sizes.
Data Analysis	Consists of a systematic cycle of organizing, classifying, and analyzing collected data. To identify themes, patterns, or classifications deriving from qualitative data, researchers frequently employ software or manual procedures.	Statistical methodologies are necessary for analyzing and interpreting quantitative data. Inferential statistics allow researchers to derive conclusions about the population based on a sample of data, whereas descriptive statistics summaries the facts.
Reporting	Qualitative research findings are frequently presented in narrative format, with supporting citations and examples. There may also be an opportunity to explain the researcher's reflexivity and subjective involvement, which would lend clarity to the researcher's role in the study's development.	Statistics, diagrams, and tables are typical methods for communicating research findings. The metrics of central tendency, variation, correlation, and statistical significance, all articulated numerically, occupy the center of attention.

A study methodology called mixed method research combines quantitative and qualitative research methods. This strategy is used when the researcher concludes that one method is less suitable than the other (Durana et al., 2019). Thus, to achieve this objective, it was imperative to collect and evaluate data of both qualitative and quantitative. In cases where the researcher considers a singular methodology insufficient in achieving the study objective, an alternative approach would be to utilize a mixed method. Figure below shows how the research method used in this study worked as a whole.

When deciding on the appropriate method to employ, whether it be quantitative, qualitative, or a combination of both, several distinct factors must be considered. The discussion has to refocus on the challenges encountered during the study and the achievements in meeting the research objectives (Ghazali et al., 2021). Figure below show a flow chart used for this research in order to achieve all the objectives.

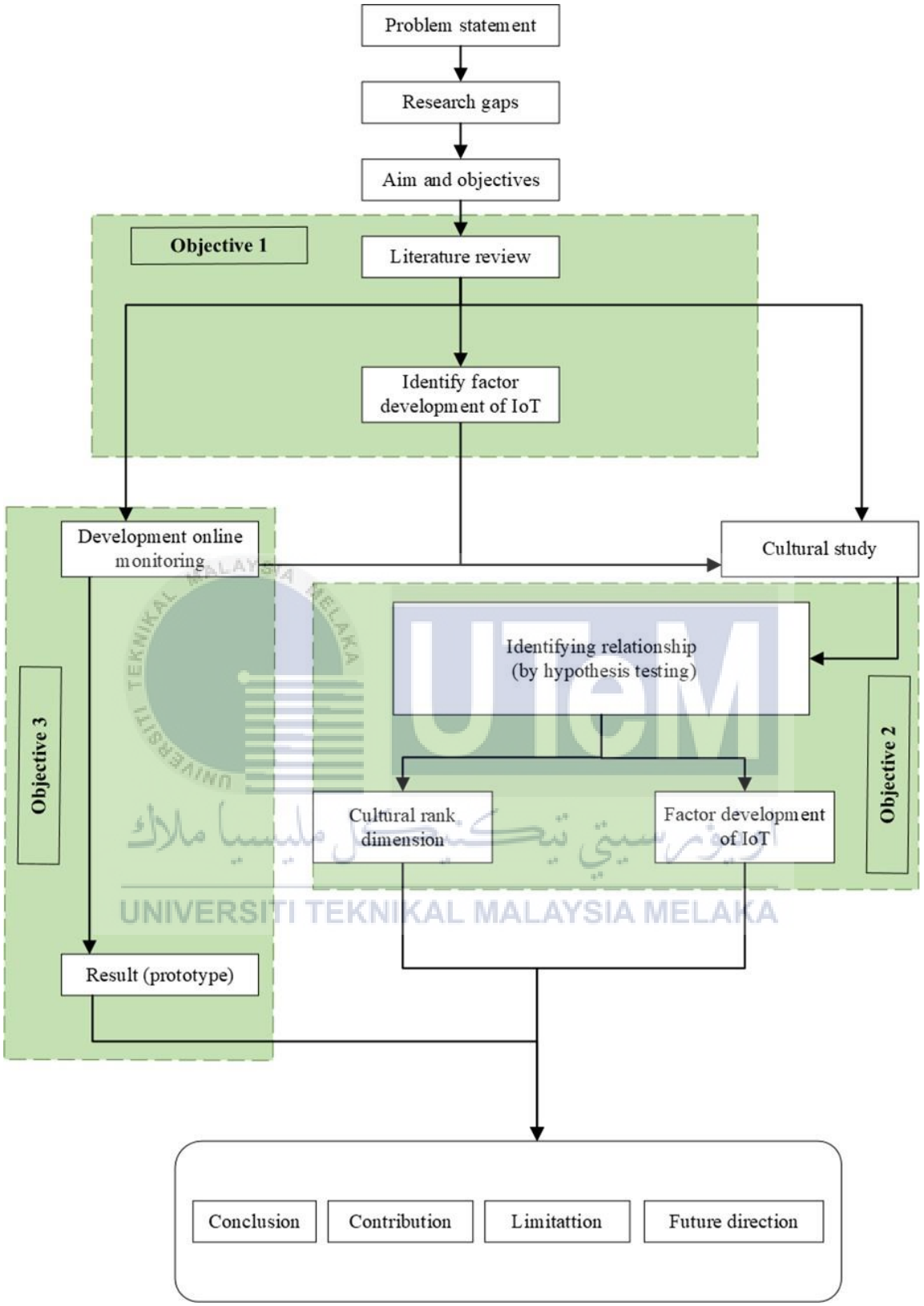


Figure 3.1 Research method used in this study

3.3 Data collection

3.3.1 Questionnaire development

In this study, a questionnaire was used to gather information about what clients wanted. For the purpose of achieving a successful data collection performance, it is essential that the researcher possesses a comprehensive comprehension of the process involved in developing a questionnaire.

3.3.2 Design of questionnaire

The process of developing a structured set of questions that are used to collect information from respondents is referred to as questionnaire design. To ensure they successfully collect the relevant information, questions must be properly planned and written. A questionnaire's design is extremely important since it has a direct impact on the reliability and validity of the information gathered. For the people who fill out the questionnaire, it is crucial that it be clear, concise, and uncomplicated (Goshime et al., 2019). In order to lessen the amount of strain respondents feel in their eyes, the questionnaire's questions must also be correctly organized and apart from one another. To get feedback from each participant and learn more about their requirements and expectations for the proposed research, a series of questionnaires were developed. Google Forms was used to create an assessment form that takes cultural preferences into account and is meant to assess the factor development of IoT for inventory control. The first section of the document contains the details that are relevant to the respondents' demographic data. The next two sections' content is made up of items related to the construct used in the model. The summaries of the descriptions that come after each section are as follows:

i. Section A

The section of the questionnaire consists of five questions asking about age, gender, marital status, education level and salary range. Respondents can choose only one answer for each question.

ii. Section B

In this section, there is thirty items that reflect the six cultural dimensions. It was classified into six items of collectivism, four items of masculinity, and five items each for uncertainty avoidance, power distance, long-term orientation, and indulgence. To avoid the respondent being confused, a brief of explanation was provided for each cultural dimension in the survey.

iii. Section C

This section includes six factors that are taken into account while designing an online inventory system. These factors include real-time tracking, enhance data analytic, cost efficiency, improve customer service, human error, and flow of product. There are five identical instances of each characteristic in this section. Respondents were asked to tick the relevant boxes in the designated columns to indicate the relative relevance of each response choice.

Table 3.2 Construct and items in questionnaire

Construct	Number of items
Collectivism	5 items
Masculinity	5 items
Uncertainty avoidance	5 items
Power Distance	5 items
Long-term orientation	5 items

Indulgence	5 items
Real-time tracking	5 items
Enhance data analytic	5 items
Cost efficiency	5 items
Improve customer service	5 items
Human error	5 items
Flow of product	5 items
Total	60 items

3.3.3 Scale of questionnaire

A scale is a measuring technique that was created by adding several ratings to a questionnaire. The primary objective of this study was to determine the cultural dimension that have an impact on development of online inventory management using IoT. The likert scale was used to assess participant responses to the study's items because it is easy to use, respondent-friendly, and more reliable than alternative scales. The application of a likert scale with response possibilities ranging from 1 to 7 contributed to enhancing the accuracy of the data gathered. Both section which are Section B and Section C have a scale value of 1 meant “strongly disagree” and 7 meant “strongly agree”. A complete questionnaire is available at the Appendix B

3.3.4 Population and sample

A particular responder from the manufacturing sector and general information about Malaysian culture were used in this study. Age did not been limit for the respondent and every employee in manufacturing industry can join this survey. There need about 80 respondents at the end of the research.

3.4 Data analysis

Data analysis is the methodical process of looking through, cleaning, manipulating, and modelling data in order to draw out important information and obtain new perspectives. It involves gathering relevant information from many sources and verifying the authenticity and dependability of that information through data cleansing and quality checks. Once the data is ready, exploratory data analysis techniques are used to summarize, visualize, and find the first trends in the data. After that, statistical analysis is carried out in order to test hypotheses, look at correlations, and make conclusions about the data that are meaningful. Data analysis is an essential component in many fields, aiding companies in process optimization, researchers in the discovery of new information, and organizations in the making of data-driven choices that promote success and progress. Based on this study, the data analysis will determine cultural value effect on factor of development IoT for inventory control.

3.4.1 Partial Least Squares Structural Equation Modelling (PLS-SEM)

A statistical method called PLS-SEM is used to examine complex correlations between variables in structural equation models. Researchers may evaluate both the measurement model and the structural model concurrently using this variance-based method. PLS-SEM is especially helpful when working with small sample numbers, irregular or categorical data, or when the theory is still being developed. It gives researchers information about how variables relate to one another, facilitates hypothesis testing, and aids in the process of coming to conclusions and making decisions based on the analysis' findings. PLS-SEM is frequently used to find complicated associations and comprehend the underlying

mechanisms in data across a variety of sectors, including social sciences, management, marketing, and information systems.

3.4.1.1 Justification by PLS-SEM

The PLS-SEM approach was used in the current study to assess the hypotheses outlined in the research framework. There is possibility proposed model could have a complicated connection. The conceptual framework proposed had 12 distinct components and several distinct indicators. The online inventory system was influenced by six cultural dimensions, each of which has 30 indicators. The factor of development IoT for inventory control consists of 6 different structures with 30 different indicators. Due to the fact that it does not restrict the number of variables that may be used in the analysis, the PLS-SEM has thus been chosen the best method. Each major criterion has a number of sub criteria that can be considered. It is possible to examine both the sub criteria's importance and the criterion's relevance.

Figure 3.2 Indicator and construct in suggested model

3.4.1.2 Specify measurement model

The concept, the metric, and the measurement approach should all be highlighted while examining the research framework. It is necessary to utilize a construct, often referred to as a latent variable, to measure ideas that are difficult to see in their pure form. A tool for analyzing these concepts is a construct.

Cultural values have six different aspects. These characteristics were taken into account while choosing the constructs or latent variables that would be examined in this study. Each dimension has indicators that assist illustrate how significant that dimension is. This way of thinking is characterized by collectivism, masculinity, power distance, uncertainty avoidance, long-term orientation, and indulgence. To differentiate them from one another and make the procedure easier, each of the indicators utilized in the study should be given a unique code.

Table 3.3 The indicators of collectivism construct

Collectivism indicator	Code
People should put the group they are a part of ahead of their own needs.	COL1
Even when things are hard, people should stick with the group.	COL2
The group's well-being is more important than individual gains.	COL3
The success of the group is more important than the success of any one person.	COL4
People should be told to stick with the group even if it means giving up their own goals.	COL5

Table 3.4 The indicators of masculinity construct

Masculinity indicators	Code
Having a successful career is more crucial for males than it is for women.	MAS1
Men are more likely to use logic and reason to figure things out, while women are more likely to trust their emotions.	MAS2
Men typically use an aggressive, violent approach to solving difficult situations.	MAS3
A guy can always perform some tasks better than a woman.	MAS4
In our society, being strong and tough are seen as good qualities.	MAS5

Table 3.5 The indicators ofuncertainty avoidance construct

Uncertainty avoidance indicators	Code
I need instructions that are very clear and specific so I always know what to do.	UAI1
It is important to follow directions and steps very carefully.	UAI2
Standardized ways of doing things at work are helpful.	UAI3
Rules and regulations are significant because they let me know what is required of me.	UAI4
It is important to have instructions for tasks.	UAI5

Table 3.6 The indicators of power distance construct

Power distance indicators	Code
Most decisions should be made by those in higher positions without involving those in lower positions.	PDI1
The opinions of those in lower positions shouldn't be asked too frequently by those in higher positions.	PDI2
Social connections with those in lower positions should be avoided by those in higher positions.	PDI3
People in high position shouldn't give important jobs to people in lower position.	PDI4
People in lower positions shouldn't argue with what people in higher positions decide.	PDI5

Table 3.7 The indicators of long-term orientation construct

Long-term orientation indicators	Code
Taking good care of financial management.	LTO1
Persistence is the quality of continuing despite obstacles.	LTO2
Stagnation and stability of the self.	LTO3
Long-term planning.	LTO4
Putting up a lot of effort to achieve success in the future.	LTO5

Table 3.8 The indicators of indulgence construct

Indulgence construct	Code
I often treat myself with enjoyable things, even if they are not required.	IND1
I believe it is important to reward myself for my hard work and achievements.	IND2
I believe in enjoying the present moment rather than worrying too much about the future.	IND3
I believe that life is too short to deny oneself simple pleasures and comforts.	IND4
I think it's important to put my own fun and happiness first, even if that means going against what society says I should do.	IND5

Next, the factor of development of IoT for inventory management is made up of 7 distinct components. These constructs are responsible for real-time tracking, enhance data analytic, cost efficiency, improve customer service, human error, and flow of product.

Table 3.9 The indicators of real-time tracking

Real-time tracking	Code
Regular reports on inventory amounts are necessary for good inventory management.	RTT1
Tracking in real time can help warehouse managers make better decisions.	RTT2
Tracking in real time can help warehouse managers make better decisions.	RTT3
Stock outs and overstocks can be avoided by having up-to-date information on where products is located.	RTT4
Having quick access to store info makes it easier to predict demand.	RTT5

Table 3.10 The indicators of enhance data analytic construct

Enhance data analytic	Code
When it comes to handling products, using data can help you make better choices.	EDA1
Using Internet of Things (IoT) data can improve the awareness and availability of the supply chain.	EDA2
It is possible to make inventory control more efficient by using info from the Internet of Things (IoT).	EDA3
We can make smarter decisions about product management by using Internet of Things (IoT) data.	EDA4
Overall success can be better by using data.	EDA5

Table 3.11 The indicators of cost efficiency construct

Cost efficiency	Code
Applying Internet of Things (IoT) devices can help lower inventory control costs	CEF1
Costs for things like labor and storage will decrease due to Internet of Things (IoT)-enabled product tracking.	CEF2
By using Internet of Things (IoT) data, warehouse management will be able to see and handle costs better.	CEF3
Applying Internet of Things (IoT) to keep track of goods could reduce down on stock-outs and overstocks.	CEF4
By using Internet of Things (IoT) to keep track of goods, you can cut down on product failure and the costs that come with it.	CEF5

Table 3.12 The indicators of improve customer service construct

Customer service	Code
Internet of Things (IoT) technology could make clients satisfied with product management.	CSV1
Tracking goods through the Internet of Things (IoT) can help customers get their orders faster and more accurately.	CSV2
Internet of Things (IoT) technology will give customers proactive order status and delivery information.	CSV3
Inventory control with Internet of Things (IoT) may reduce lead times and increase on-time delivery.	CSV4
Internet of Things (IoT) technologies can make it easier to deal with customer questions and issues.	CSV5

Table 3.13 The indicators of human error construct

Human error	Code
In a typical inventory management system, inaccurate inventory counts might cause problems.	HME1
Applying Internet of Things (IoT) would reduce inventory management errors.	HME2
Employee training may decrease human error in Internet of Things (IoT)-based inventory control systems.	HME3
Creating a responsible and continuous improvement culture may decrease inventory control mistakes.	HME4
Real-time alerts and notifications from Internet of Things (IoT) help avoid or solve inventory control problems.	HME5

Table 3.14 The indicators of flow of product

Flow of product	Code
Internet of Things (IoT) can improve supply chain product visibility and traceability.	FOP1
Internet of Things (IoT) technology may improve operational efficiency by offering full product movement visibility and management.	FOP2
Internet of Things (IoT) data and analytics could improve product routing and scheduling for optimal flow.	FOP3
Inventory control can be more accurate and faster using Internet of Things (IoT).	FOP4
Product flow may be monitored and controlled using Internet of Things (IoT) technology.	FOP5

It is crucial to clarify the measure model for each component in order to identify cultural values and how they impact online inventory system. The analysis might be carried out in a formative or reflective approach. Whether reflective or formative data should be used depends on how the construct is conceptualized and what the study's objectives are. There are shades of grey in this decision. It has not been produced yet, but it is still a topic of discussion in many other industries.

The arrowheads of the construct are different in the reflective and formative measuring procedures. The arrowheads for reflective measurement point from the construct to the indicators. The arrowheads from the indicators to the construct point in for formative measurement. We will discuss how to analyze the metrics that are both reflective and formative in the section that follows.

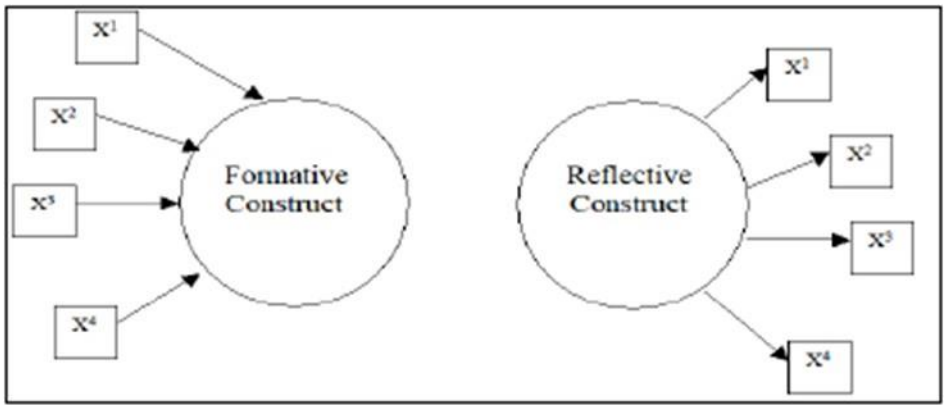


Figure 3.3 Formative and reflective construct (Hafiz Hanafiah, 2020)

3.4.1.3 Evaluation of reflective measurement

The effectiveness of the reflective measurement technique might be evaluated in three distinct ways. Checking for internal conformity is the first stage in the procedure. This contains both the composite reliability (CR) and Cronbach's alpha. People believe that an exploratory investigation is best served by a critical threshold between 0.6 and 0.7. The CR must be more than 0.6 in order to determine how dependable and consistent something is. The second action was to examine the convergent validity. You must consider both the dependability of the indicators and the average variance extracted (AVE) while determining convergent validity. The outside loading must be more than 0.7 in order to assess the gauge's dependability. The range of 0.4 to 0.7 is suitable for use in the research if, however, eliminating the indicators does not result in an increase in the CR and AVE scores (AVE should be more than 0.5).

The effectiveness of the reflective measurement technique might be evaluated in three distinct ways. To determine if there was internal homogeneity or not was the first phase in the procedure. This contains both the composite reliability (CR) and Cronbach's alpha. People believe that an exploratory investigation is best served by a critical threshold between 0.6 and 0.7. The optimal range for advanced study, however, is between 0.7 and 0.9. The CR

must be more than 0.6 in order to determine how dependable and consistent something is. The second action was to examine the convergent validity. You must consider both the dependability of the indicators and the average variance extracted (AVE) while determining convergent validity. The outside loading must be more than 0.7 in order to assess the gauge's dependability. The range of 0.4 to 0.7 is suitable for use in the research if, however, eliminating the indicators does not result in an increase in the CR and AVE scores (AVE should be more than 0.5).

The influence of the discriminant validity was examined in the last stage. The degree to which one idea may be regarded as qualitatively different from those of other constructions, according to empirical standards, is referred to as its discriminant validity. The discriminant validity of the findings in this study was evaluated using the Heterotrait-Monotrait ratio (HTMT). The HTMT value should be less than 0.85, as recommended. Discriminant validity is insufficient if the outcome is higher than 0.85.

3.4.1.4 Evaluation of formative measurement

The formative measuring approach might be assessed in three different ways. The first step was to examine at the convergent validity of the formative measurement. For it to be correctly read, the overall weight must be significant. If the external weight was regarded unimportant, it is necessary to look at the formative measurement's peripheral loading. The crucial threshold loading for the formative assessment must be higher than 0.5 than it is for the reflecting measurement.

The second step of the new measurement model method was to find the collinearity problems. On the other hand, high relationships between two formative elements can make it hard to figure out how to study them and what they mean. This is not the same as the signs

that glow in the dark. In the formative measure method, problems with collinearity can be found if the variance inflation factor (VIF) is less than 5.

Analyzing the value and significance of the formative indicators was the method last stage. The bootstrapping approach may be used to assess the significance of the findings. If the indicator has scores of 2.57, 1.96, and 1.65, respectively, and a loading of greater than 0.5, and has a statistical significance of 1%, 5%, or 10%, it should be preserved since it provides important information.

3.4.2 Evaluation of structural model

The procedure last phase was using structural modelling assessment to back up the creation of hypotheses. This was completed following determination of all significant thresholds for both reflective and formative measures. To determine how accurate the structural model was, there were six separate processes. To start, it was necessary to examine the structural model to check for any collinearity issues. By examining the critical level of the value of the tolerance or the value of the VIF, issues with collinearity can be discovered in a manner akin to how the formative measurement operates. This level must be set to a value of at least 5 and not less than 0.2.

The importance of the route coefficient needed to be determined next. The route coefficient demonstrates how a structural model's many "constructs" are believed to be interconnected. They are equivalent to a regression study's standardized beta. A recommendation was given to do 5000 bootstrap samples in order to obtain an accurate estimate. With scores of 2.57, 1.96, and 1.65, respectively, it is proposed that the relevance level of the route coefficient be adjusted to 1, 5, or 10%.

Finding the coefficient of determination (R^2), which demonstrates the proportion of an internal construct's variance that can be accounted for by its predictor constructs, was the

third stage. This step was necessary since the assumptions made in the preceding two phases regarding the predictor models required it. Depending on the topic of study, R^2 might signify several things. The outcome may be 0.75, which would be a strong result; 0.50, which would be an average result; or 0.25, which would be a weak result. However, 0.20 is considered to be a high value for predicting how others would behave. The model's effect size (f^2) was determined in the procedure' fourth stage. How much a predictive construct affects an endogenous construct may be determined by looking at the effect size, commonly known as f^2. There is a recommendation that the critical levels for the size of the effect be set at 0.02, 0.15, and 0.35, which, in descending order, reveal a tiny, medium, and big effect.

The next stage was to assess the accuracy of the data's predictive power (Q^2). This serves as both a prediction test and a prediction measurement for the model. Numbers greater than zero should be present in Q^2. A construct is considered to have no predictive value if its quantity falls below the crucial threshold. Running the blindfolding procedure in the Smart-PLS software will reveal the values of Q^2. The final action we took was to attempt to determine the size of the impact (q^2). To quantify the extent to which an exogenous construct influences the Q^2 of an endogenous latent variable, impact size (q^2) is utilized. It is recommended that an endogenous construct's relative predictive relevance should fall within the values of 0.02, 0.15, and 0.35, which, respectively, denote small, medium, and big.

3.4.2.1 High-order Component Model (HCM)

One might attempt to alter what their clients desire at various levels of thought. Numerous first-order constructions as well as second-order, higher-order, and yet further constructs may have an impact on what customers want. High-order component models (HCM), a PLS-SEM testing technique, were utilized to gauge a model's effectiveness. Higher-order structures (HCM) are more abstract and feature more layers of constituents

(Hair et al., 2019). According to Hair et al., (2019), a researcher can simplify the HCM and reduce the number of interactions in the structural model to make the PLS-SEM route model easier to grasp. As a result, the route model makes more sense and is simpler to comprehend. Higher-order component (HOC) displays the more abstract elements of an abstract entity whereas lower-order component (LOC) displays its subdimensions. Sending the HOC all of the LOC's proposed signs will allow the HOC to utilize them to create its measuring model. The technique in question is known as the repeated signal approach. HCM designs may be classified into four categories: reflective-reflective, reflective-formative, formative-reflective, and formative-formative.

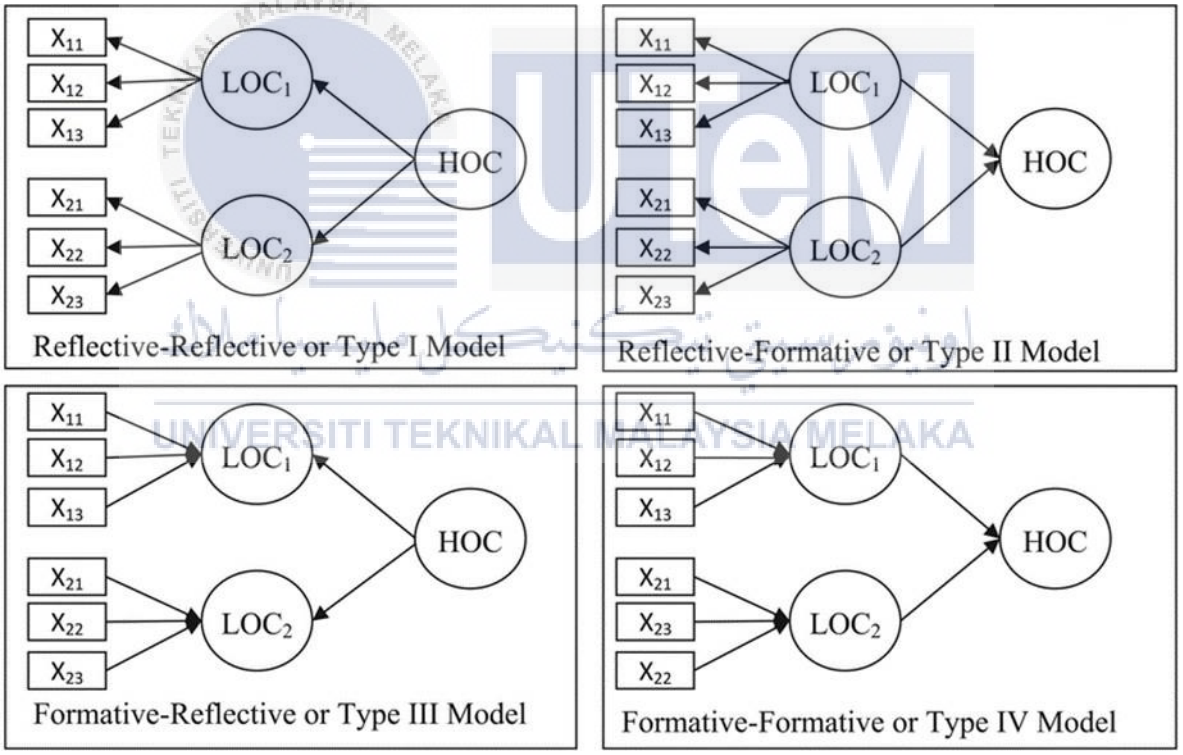


Figure 3.4 The types of hierarchical component model. Reflective-reflective, reflective-formative, formative-reflective and formative-formative (A. Ali et al., 2021)

Another strategy was to employ a two-stage process that simplified the interaction between the structural model and the path measurement for the High-order Component

Model (HCM) analysis (Ali et al., 2021). With this approach, the manifest markers in the HOC are determined by the scores of the latent variables of the LOC's constructs.

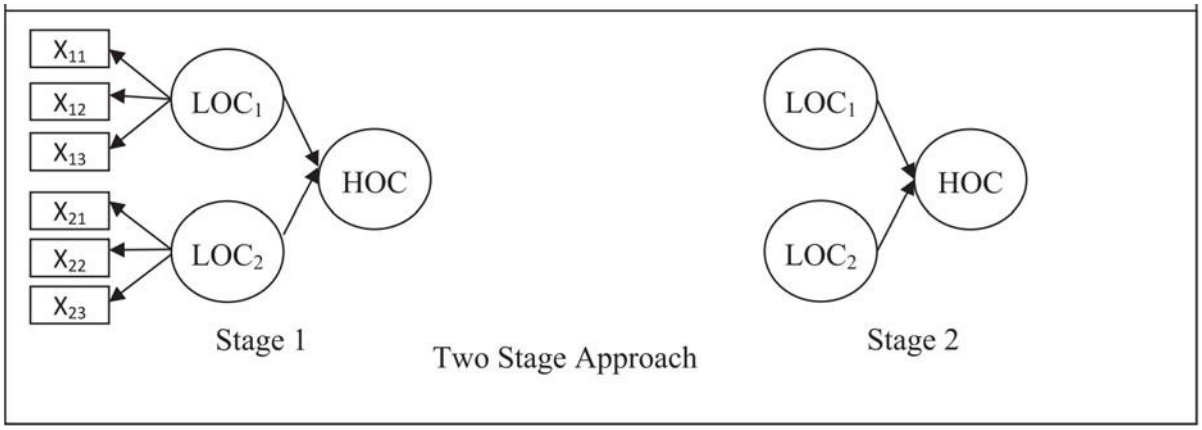


Figure 3.5 The two-stages approach for the HCM analysis (A. Ali et al., 2021)

3.4.2.2 HOC – LOC

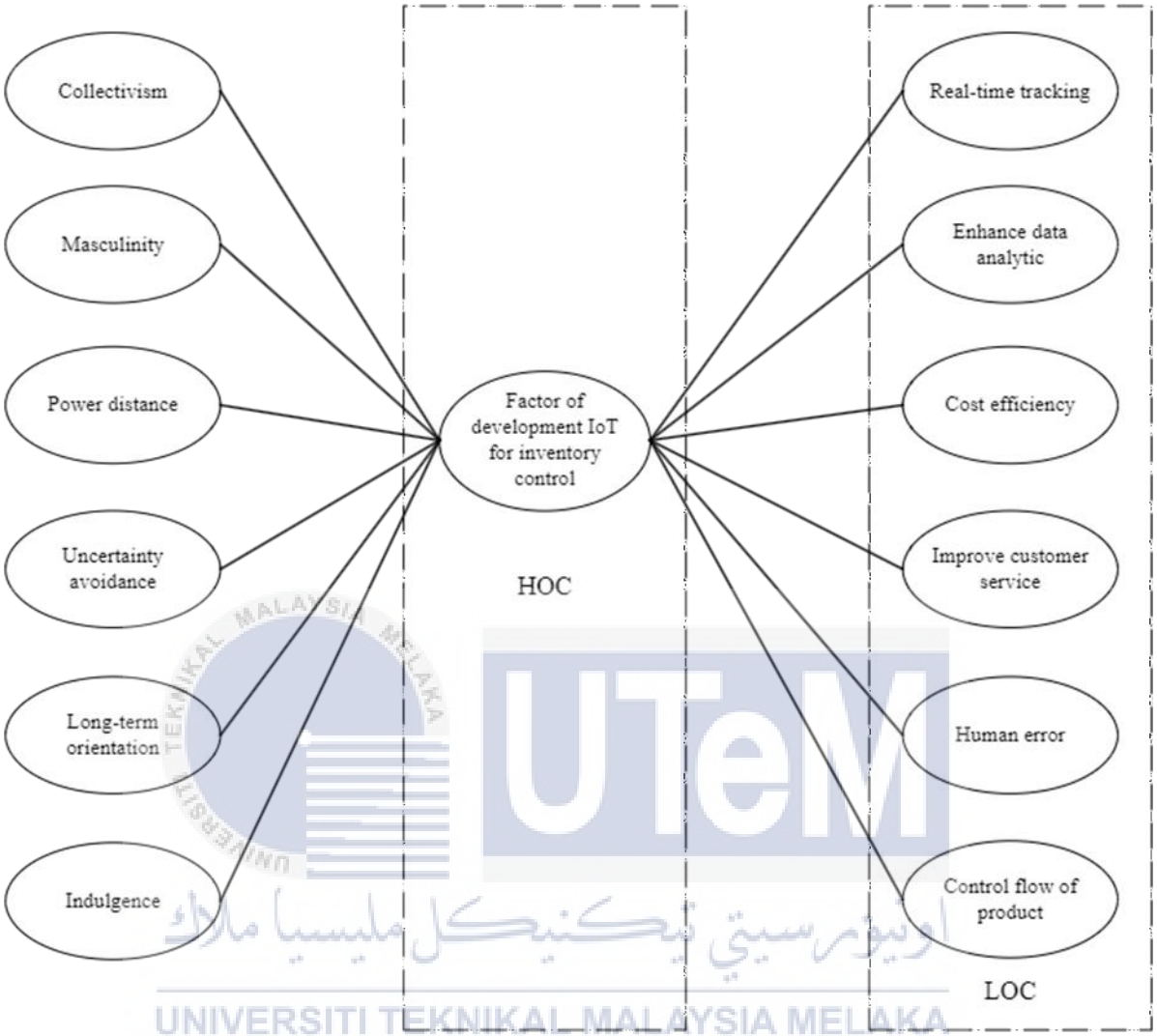


Figure 3.6 HOC-LOC classification

Figure above shows that respondent preferences on cultural value influences on online inventory system are the only construct classified as a second-order construct. Since the respondents' choices still entail at least one layer of subconstruct or lower-order construct, higher-order constructs (HOCs) constitute the second level of abstraction (LOC). Respondent top choice in LOC span the area of real-time tracking, enhance data analytic, cost efficiency, improve customer service, human error and control flow of product. Since every sign identified in the LOC was also present in the HOC, the nature of the link between the two could be determined. This concept is frequently referred to as the HCM's enduring

symptoms. Before the measurement model is calculated, the criteria for the model should be classified as formative or reflective. When assessing a model's effectiveness with the reflective measurement model, researchers commonly misunderstand the findings. We examined how the online inventory system influenced and was affected by different cultures using a reflective-formative assessment technique. The indicators for the six cultural dimensions were categorized as parts of the reflective measurement model due to the high levels of correlation between them and their accuracy in predicting the cultural dimensions. Therefore, the constructions of the cultural dimension were not significantly changed by the adjustment or removal of the markers. Real-time tracking, improved data analytics, cost effectiveness, improved customer service, reduced human error, and product flow were given Levels of Concern (LOC), whilst respondents' preferences were given Levels of Concern (HOC).

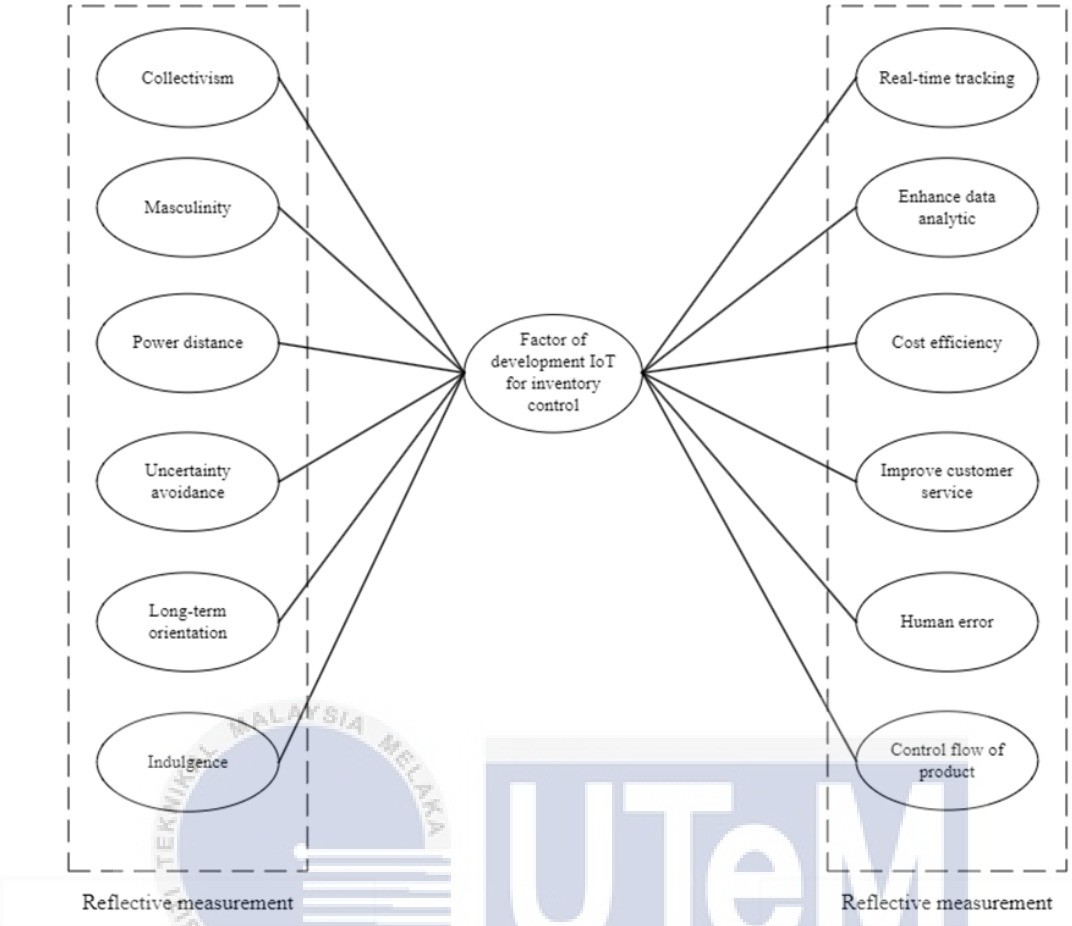


Figure 3.7 The classification of construct measurement

Since it was not expected that the indicators of real-time tracking, enhance data analytic, cost efficiency, improve customer service, human error and control flow of product would have a high level of correlation with one another, this model of measurement is considered reflective. Therefore, the meaning of the constructs will change if the indications are removed.

3.5 Phase 1: Sensing Layer

After the data have been extracted, prototype will be developed. In this phase, all the sensor and hardware that being use are installed. The project is described in this section along with its component, microcontroller, and materials. A sensor is a crucial part since it

gives the system a reaction and enables monitoring. The microcontroller serves as the brain of the device, keeping an eye on the output while it does a certain duty.

3.5.1 Hardware development

The 4-pin multi-purpose ultrasonic sensor has several uses. It functions as both a distance estimator and an obstacle avoider. Ultrasonic sensors use ultrasonic waves to measure distance. It sends out an ultrasonic pulse and receives up the wave that the target reflects. The idea is to use the ultrasonic sensor to measure how far away it is from the stack of items.

To connect ultrasonic sensor to nodeMCU ESP8266 board, connect GND pin of the sensor to the GND pin of the nodeMCU. After that, connect VCC pin of the sensor with VIN of the nodeMCU. These two steps are same to apply at the two sensors. Lastly, connect TRIG pin and ECHO pin with digital-1 pin, digital-2 pin and the other one with digital-6 pin and digital-7 pin. This circuit can be refer as shown below.

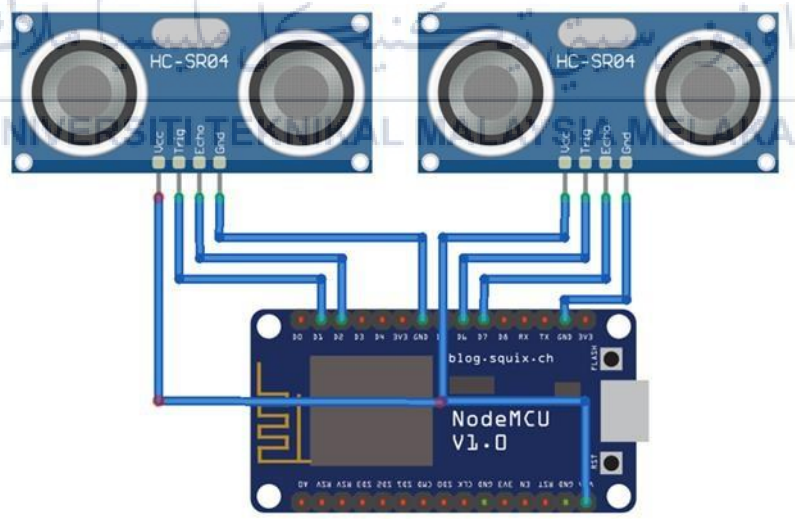


Figure 3.8 Circuit diagram

3.6 Phase 2: Network Layer

In this part, a language called C++ will be used to code a program that will turn on the hardware's features. Once the code is written on the Arduino IDE, it will be uploaded to the NodeMCU. When sensors are set up and code is uploaded to the hardware, the data can be sent to the internet and handled by the ThingSpeak platform.

3.6.1 Software development

In order to upload the code and submit data to the ThingSpeak platform, connect the nodeMCU ESP8266 board to a computer using a micro-USB connection. This part talks about the programmed that was used to make this project. The software is the most important part of making the prototype work, and it is also the most important piece of software needed to make code for this project. The code written in this file was coded and sent to the ESP8266 device. This code lists all the parts used, like the ultrasonic distance monitor and the ESP8266. Ultrasonic sensors measure the distance based on the wave that reflected. Then, Arduino IDE has also been used to code the programmed for the ThingSpeak system. The ESP8266 sends all the output info from both devices.

3.7 Phase 3: Application Layer

3.7.1 ThingSpeak App

Users can gather, visualize, and analyze real-time data in the cloud using the open data IoT analytics platform ThingSpeak. ThingSpeak Platform is employed in order to connect to the cloud platform. The ThingSpeak platform is open source, free, and user-friendly. Most Arduino boards, the ESP8266, and other popular microcontrollers are supported by the platform. A local server will be built using the ThingSpeak platform, allowing data to be kept within the network.

3.7.2 Schematic diagram

In order to better understand the operating principles used in the design and production of all work drawings, a schematic of the system is shown in figure below. Microcontroller is connected to the ultrasonic sensors that will measure and detect any items. The data is gathered and sent over the ThingSpeak platform after the hardware has been installed and coded in the Arduino IDE. Individual can monitor and send data to ThingSpeak and even can send an alert using web service like ThingHTTP.

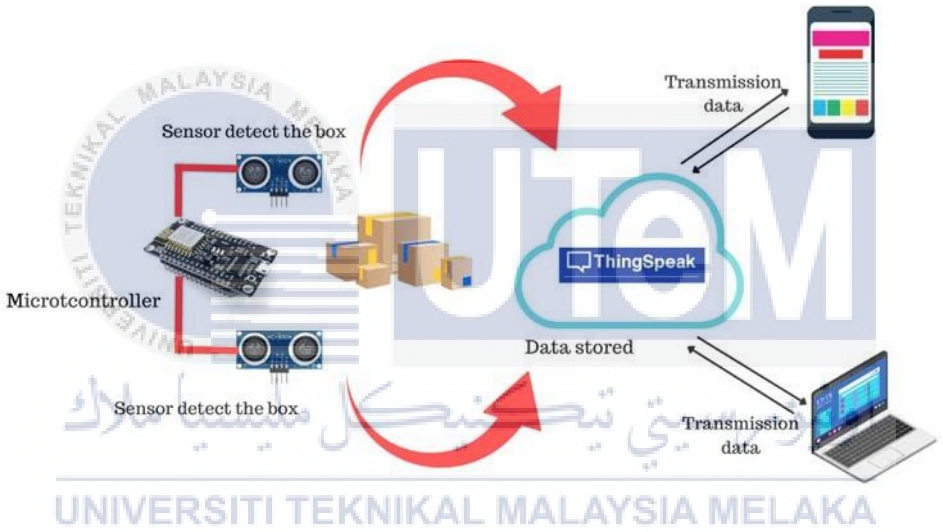


Figure 3.9 Schematic diagram

3.8 Summary

The methodology of analysing the data of SmartPLS is use to figure out the correlation between factor of development IoT for inventory management. It involves a set of method and techniques for measuring and analysing things.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

This chapter consists of two equally essential sections. In the previous section, we discussed how to conduct a process analysis to determine how a culture's values influence online inventory system. This topic was analyzed using information gathered from the perspectives of workers. The descriptive analyses included the respondent's profile, how missing data were handled, how well the group was selected, and how reliable the data were. When these analyses reached a point where they could be considered complete, it was time to test the hypotheses. It was determined whether the six cultural factors of collectivism and individualism, masculinity and femininity, uncertainty avoidance, power distance, long-term and short-term orientation, and indulgence had any effect on the online inventory system. This was done by looking at the statistically suggested critical threshold of significances level. This will illustrate how cultural values influence the configuration of an online inventory system. Before proceeding with the structural model, however, all significant thresholds must be examined and verified. In the second section of this article, the method used to determine how cultural values influence online inventory is described.

4.2 Respondent perspective

4.2.1 Descriptive analysis

The sample size for this study was determined using a general guideline from (Kock and Hadaya, 2018). Since the demographics and profile of the respondents were unknown, this study was carried out. The greatest number of arrowheads pointing to the latent variables of the constructed model was used to determine the minimal sample size required with 80% statistical power. This made it possible to calculate the minimal sample size that was needed. In this study, there were twelve arrowhead pointing at the latent variables; six from the cultural dimensions construct (collectivism, masculinity, power distance, uncertainty avoidance, long term oriented and indulgence), and six from the factor of the development of online monitoring for inventory control; (real-time tracking, enhance data analytic, cost efficiency, customer service, human error and flow of product). A total of 47 different responses were collected using questionnaires with minimum of 0.10 R^2. Since the minimal conditions were exceeded, it may be concluded that there were enough responders in the sample to support the measurement.

From the result, 19.1% of the respondents were in the age of 16 to 24 years old, follow by the highest respondents with 44.7% in the age of 25 to 34 years old, followed by 12.8% in the age of 35 to 44 years old and lastly 23.4% in the age of 45 to 54 years old. There is no respondent from the age 55 and above. The descriptive result show that most of the respondents were males with 31 of 47 that equal to 66% and 16 females, 34%. Table below includes details on the respondents within marital status, academic qualification and their income per month.

Table 4.1 Demographic profile of respondents

Demographic		Response	
		Freq	%
Gender	Male	31	66
	Female	16	34
Age	16 – 24	9	19.1
	25 – 34	21	44.7
	35 – 44	6	12.8
	45 – 54	11	23.4
	55 and above	0	0
Marital status	Single	26	55.3
	Married	21	44.7
Academic qualification	Diploma	19	40.4
	Bachelor's Degree	25	53.2
	Master's	2	4.3
	PhD	1	2.1
Income per month	Less than RM1000	6	12.8
	RM1001 – RM2000	6	12.8
	RM2001 – RM3000	9	19.1
	RM3001 – RM4000	5	10.6
	RM4001 – RM5000	9	19.1
	More than RM5001	12	25.5

4.2.2 Confirmatory analysis

The Partial Least Squares (PLS) technique was applied to do the confirmatory analysis (CFA). The Smart-PLS program was used to do a statistical analysis of the data. Reflective measures are a structural component of the measurement model. The relationships between the constructs (as the LOC) of real-time tracking, enhance data analytic, cost efficiency customer service, human error and flow of product to the factor of development of online monitoring for inventory control construct (as the HOC) were determined by applying the high-order component model (HCM).

4.2.2.1 Convergent validity

The convergent validity test a procedure that needs to be carried out in order to ensure that a reflective measurement model possesses the required degree of precision. With

considering convergent validity, it is very necessary to conduct an evaluation of the factor loading, composite reliability (CR), and average variance extracted (AVE). It was advised that the factor loadings should be between 0.4 and 0.7 or higher, that the AVE should be larger than 0.5, and that the CR should be greater than 0.7. All of these requirements should be met without fail. Even though the CR falls somewhere in the range of 0.6 to 0.7, it is still suitable for use in any exploratory studies that may be conducted (Kock & Hadaya, 2018). Additionally, if AVE and CR can be improved by removing specific factor loadings, it would be preferable to eliminate the items with the lowest scores from the assigned construct. Figure below shows the computing procedure have been used to check if the data have convergent validity.

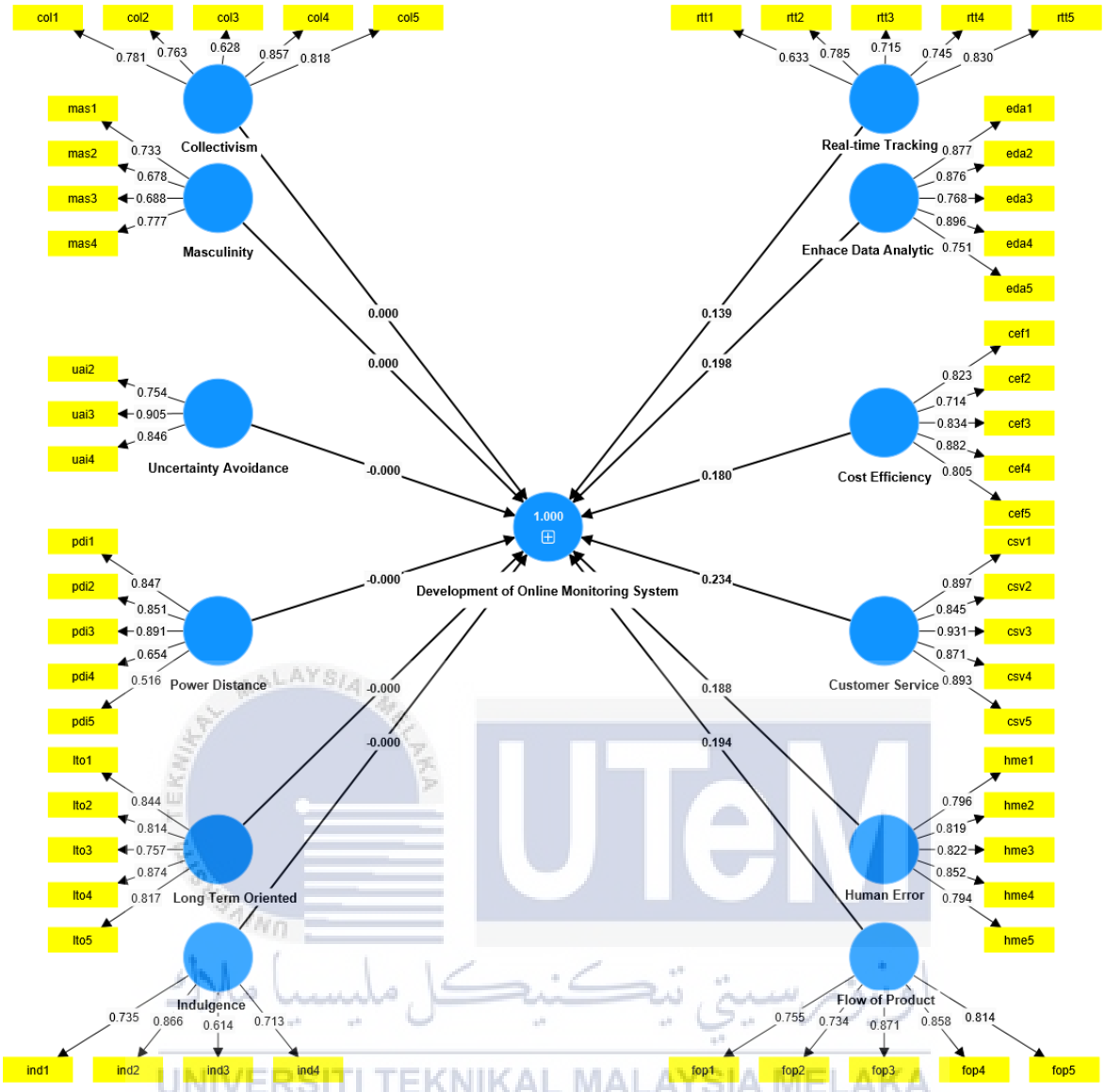


Figure 4.1 Outer loading computation

Based on the calculation present in the figure above, several items with the lowest factor loadings have been eliminated in order to ensure convergent validity. The item that have been delete are named ‘mas4’ that stand for ‘Masculinity 4’, two items from ‘Uncertainty avoidance’; ‘uai1’ and ‘uai5’ and one item from ‘Indulgence’ since its loading is below that 0.5. The AVE and CR values being below the crucial threshold would be impacted by this value. It was advisable to remove this item as opposed to keeping it. As a result, the critical value of CR and AVE satisfy the critical threshold; AVE > 0.5 and CR >

0.7 after the deletion. Factor loading, average variance extracted and composite reliability has been summarized as in table below.

Table 4.2 Compilation of factor loading, AVE and CR values

Cultural dimensions	Items	Factor loading	AVE	CR
Collectivism	col1	0.781	0.598	0.859
	col2	0.763		
	col3	0.628		
	col4	0.857		
	col5	0.818		
Masculinity	mas1	0.733	0.518	0.703
	mas2	0.678		
	mas3	0.688		
	mas4	0.777		
	mas5	-		
Uncertainty avoidance	uai1	-	0.701	0.810
	uai2	0.754		
	uai3	0.905		
	uai4	0.846		
	uai5	-		
Power distance	pdi1	0.847	0.586	0.909
	pdi2	0.851		
	pdi3	0.891		
	pdi4	0.654		
	pdi5	0.516		
Long-tem orientation	lto1	0.844	0.676	0.885
	lto2	0.814		
	lto3	0.757		
	lto4	0.874		
	lto5	0.817		
Indulgence	ind1	0.735	0.544	0.860
	ind2	0.866		
	ind3	0.614		
	ind4	0.713		
	ind5	-		

AVE is the average varience extracted (should be >0.5)
CR is composite reliability (should be >0.7; 0.6 to 0.7 is acceptable for exploratory study.

As shown in the table, the factor loading, AVE and CR values have reached the crucial criteria. Thus, the convergent validity was verified and the discriminant validity may now be verified by further calculation.

4.2.2.2 Discriminant validity

Once convergent validity had been established, discriminant validity verification followed. Discriminant validity refers to the degree to which an empirically distinct construct is actually differentiated from the remaining constructs (Hair et al., 2019). The discriminant validity was assessed applying the Heterotrait-Monotrait ratio HTMT critical threshold, which suggests a value below 0.85 (Singh et al., 2018). The result of the HTMT is present in table below.

Table 4.3 Heterotrait-Monotrait Ratio (HTMT) for discriminant validity

	Collectivism	Indulgence	Long-term orientation	Masculinity	Power distance	Uncertainty avoidance
Collectivism						
Indulgence	0.406					
Long-term orientation	0.532	0.391				
Masculinity	0.265	0.264	0.144			
Power distance	0.309	0.286	0.115	0.288		
Uncertainty avoidance	0.515	0.445	0.663	0.231	0.128	

HTMT value should be <0.85 to establish discriminant validity

Based on the result above, all of the HTMT value have met the criteria which is below than 0.85. Hence, it has been verified that the discriminant validity critical threshold has been determined. This indicates that cultural dimensions were in fact constructed in a genuinely distinct or unique format.

4.2.2.3 Formative measurement model

After completing the reflective measurements to ensure convergent and discriminant validity, the formative measurement model was evaluated. The model's formative measurement comprises six constructs which are real-time tracking, enhance data analytic, cost efficiency, customer service, human error and flow of product.

Table 4.4 Variance inflation factor (VIF)

ITEM		VIF
Real-time tracking	rtt1	1.573
	rtt2	2.032
	rtt3	1.436
	rtt4	2.084
	rtt5	1.937
Enhance data analytic	eda1	3.973
	eda2	3.538
	eda3	1.894
	eda4	3.525
	eda5	2.062
Cost efficiency	cef1	2.490
	cef2	1.602
	cef3	3.440
	cef4	4.059
	cef5	1.982
Customer service	csv1	3.422
	csv2	2.976
	csv3	4.960
	csv4	2.887
	csv5	4.033
Human error	hme1	1.839
	hme2	2.193
	hme3	2.168
	hme4	2.729
	hme5	2.398
Flow of product	fop1	1.969
	fop2	1.712
	fop3	2.665
	fop4	2.577
	fop5	2.367

VIF >5 indicates collinearity issue

For the reflective measurement to be evaluated, an analysis of both the outer loading and the variance inflation factor (VIF) is required. It is necessary for both the VIF to exceed more than 5 and the outer loading of the reflective measurement should be more than 0.5 (Hair et al., 2019). Based on the result as shown in the table, all value of VIF for the indicators of real-time tracking, enhance data analytic, cost efficiency, customer service, human error and flow of product were found to be less than 5. This suggests that there are no issues of collinearity present in the data.

4.2.3 Structural modeling

The following step involved determining the correlations that can be identified between the constructs of the six cultural value dimensions and the factor development of online monitoring for inventory control. The calculation indicates that the external loadings of the constructs related to real-time tracking, enhance data analytic, cost efficiency, customer service, human error and flow of product, as well as the relationships of the six cultural value dimensions data seem to be insufficient. These may be produced by the repetitive indications of reflective-reflective measurements for many constructs such as real-time tracking, enhance data analytic, cost efficiency, customer service, human error and flow of product, among others. As to the research conducted by Hair et al., (2019), the use of formative-formative and reflective-formative assessments in the HCM might lead to a low loading and significant connection. In certain situations, the R^2 value may even exceed 1. Two-stage HCM analysis can be employed to address this concern by deriving the latent variable scores from the construct measurements and subsequently converting the constructs into new indicators (Hair et al., 2019).

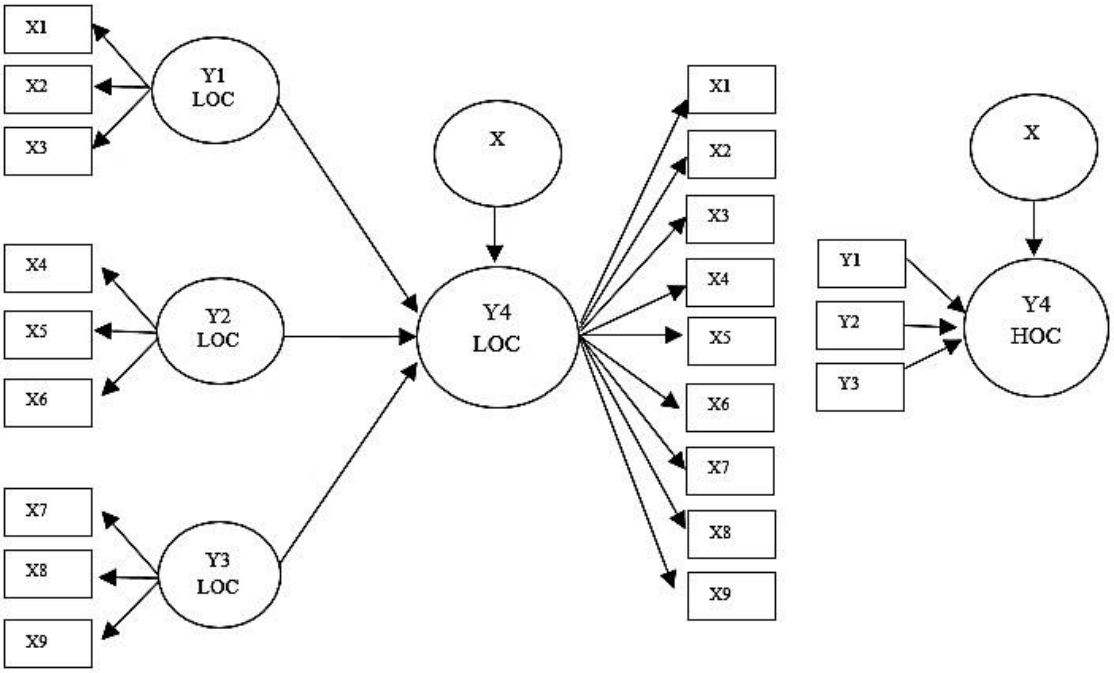


Figure 4.2 Two-stages analysis in HCM. The constructs can be tranformed to be new indicators using their latent variable score (Hair et al., 2019)

By referring to figure above, the constructs of real-time tracking, enhance data analytic, cost efficiency, customer service, human error and flow of product should be transformed into new indicators, serving as manifest variables in the initial phase, through the utilization of the extracted latent variable scores for each construct. Once these six constructs were transformed into new indicators, the subsequent task involved determining the connections between the six cultural value dimensions that were associated with development of online monitoring system. The significance of the relationships may be assessed through analysis of the t-value. The t-value is the primary criteria used to determine the significance of a coefficient. A recommendation was made to do bootstrapping using 5,000 sub-samples in order to assess the t-values.

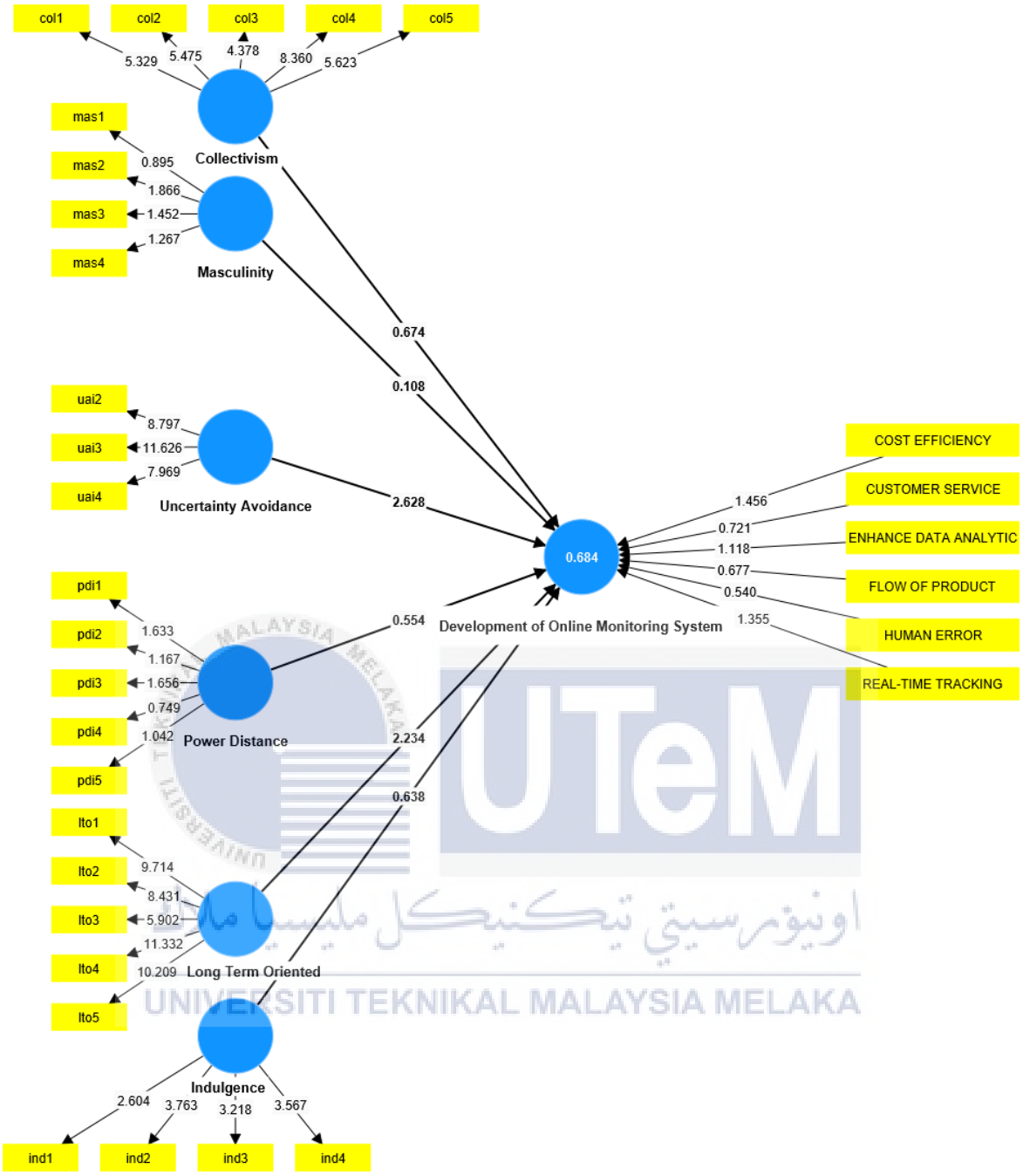


Figure 4.3 Structural modeling computation

As indicated in the figure above, the data utilized to illustrate the correlation between the cultural value dimension and the factor of development online monitoring system for inventory control construct was generated.

Table 4.5 Results of the structural equation model

Hyp.	Description	Path coefficient	Std. error	t-value	Result
H1	Collectivism → development of online monitoring system for inventory control.	0.108	0.060	0.674	Not supported
H2	Masculinity → development of online monitoring system for inventory control.	0.014	0.052	0.108	Not supported
H3	Uncertainty avoidance → development of online monitoring system for inventory control.	0.452	0.065	*2.628	Supported
H4	Power distance → development of online monitoring system for inventory control.	0.086	0.056	0.554	Not supported
H5	Long-term orientation → development of online monitoring system for inventory control.	0.367	0.069	*2.234	Supported
H6	Indulgence → development of online monitoring system for inventory control.	0.120	0.059	0.638	Not supported

**p <0.01, **p <0.05, ***p <0.1*

The critical t-values were 2.57, 1.96, and 1.65, respectively, for the 1%, 5%, and 10% significance levels. According to the table above, it was found that the factor uncertainty avoidance ($\beta = 0.452$, $p < 0.1$) and the factor long-term orientation ($\beta = 0.367$, $p < 0.1$) have significant influence towards the development of online monitoring system for inventory control. On the other hand, collectivism, masculinity, power distance and indulgence does not have significant influence on development of online monitoring system for inventory control.

4.2.3.1 Assessing R^2 (Coefficient of Determination)

Once the significant relationships of the structural model were determined, the next stage included identifying the coefficient of determination (R^2). The coefficient of determination quantifies the amount of variance in an endogenous construct that can be accounted for by its predictor constructs. The value of R^2 is based on the specific study

discipline. The possible values are 0.75, 0.5, and 0.25, which are referred to as considerable, moderate, and weak, respectively. To address the bias towards complicated models in multiple regressions, Hair et al., (2019) recommended utilizing the adjusted R^2. The formula provided below can be utilized to calculate the adjusted R2 value:

$$R^2adj = 1\text{-}(1\text{-}R^2)\frac{n-1}{n-k-1}$$

The variable n represents the size of the sample, while the variable k represents the number of exogenous latent variables used to forecast the endogenous latent variables under consideration. Starting from Smart-PLS version 4.0, the corrected R^2 value is now immediately accessible. The execution of the bootstrapping technique is necessary to generate it. Similar to the previous research conducted on the relationships among the five cultural value impacts, 5000 subsamples were examined to identify the coefficient of determination.

Table 4.6 The result for the calculation of adjusted R^2

Construct	Adjusted R^2	Std. error	t-statistics
Development of online monitoring system	0.684	0.056	4.435

According to the table, the adjusted R^2 data was recorded as 0.684. In the context of online monitoring system development, a value of 0.2 was considered to be high within the domain of inventory control. Therefore, the assessment of the coefficient of determination produced satisfactory results using the revised R^2 data.

4.2.3.2 Assessing the effect size (f^2)

The effect size (f^2) is a metric employed to assess the relative influence of a predictive construct on an endogenous component. The essential benchmarks for effect size were 0.02,

0.15, and 0.35, which, based on the magnitude, represented a small, medium, or large effect, respectively. Table below represent the summary of the effect size.

Table 4.7 Result of the effect size (f^2)

Construct	Effect size (f^2)
Collectivism	0.002
Masculinity	0.000
Uncertainty avoidance	0.143
Power distance	0.001
Long-term orientation	0.157
Indulgence	0.001

0.02, 0.15** and 0.35***; small, medium and large, respectively*

Previously, the correlation between six cultural value dimensions and the factor of development of online monitoring system for inventory control. To assess the comparative influence of each influencing factor, it is necessary to determine their effect sizes on the construct of development of online monitoring system. The effect size (f^2) calculation indicates that uncertainty avoidance has a small effect size of 0.143. The long-term orientation has a medium effect size of 0.157. Nevertheless, despite the seemingly small effect sizes, these findings validate the use of the important associations calculated in the route analysis for subsequent research.

4.3 Prototype development

A study on the real-time monitoring status of inventory management on the Thingspeak platform was carried out through the use of several experiments. To be more specific, in order to convey the status of the Graphical User Interface (GUI) data to the individual user who is adding the product, a numeric display and line graph is obtained in the process of completing the project.

4.3.1 Graphical user interface

Visualisation and analysis of live data from the cloud may be accomplished by individual users through the use of the Graphical User Interface (GUI). Through the Thingspeak platform, the interfaces may be displayed on a mobile dashboard in addition to a desktop computer.

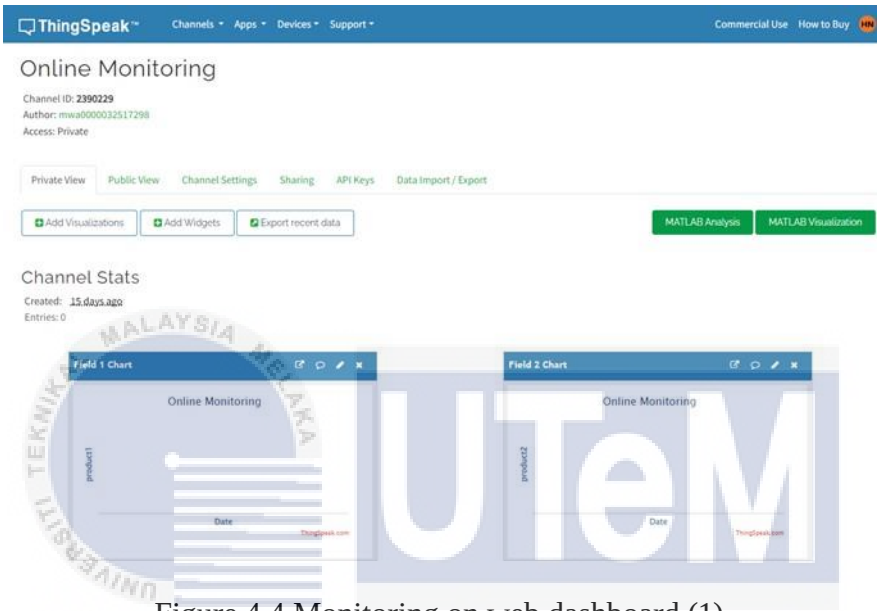


Figure 4.4 Monitoring on web dashboard (1)

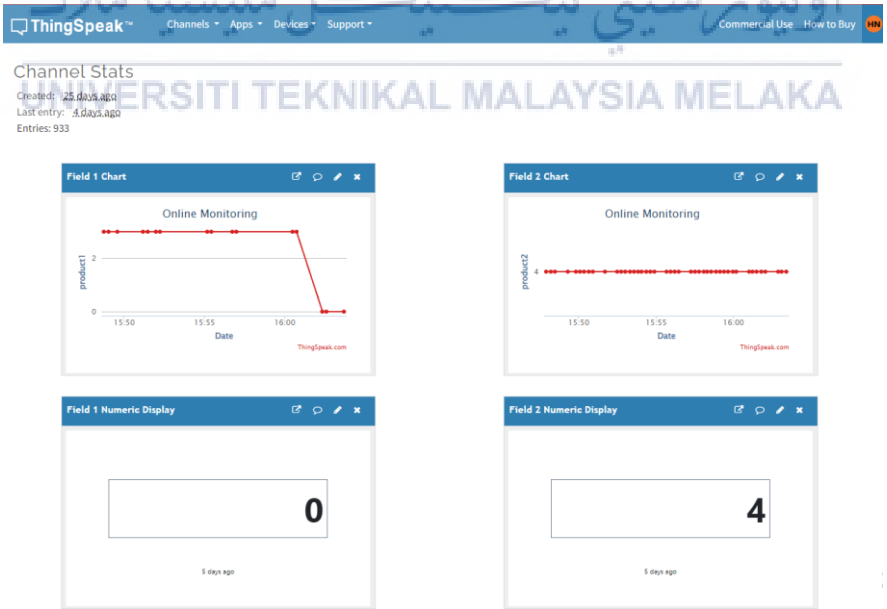


Figure 4.5 Monitoring on web dashboard (2)

A few inaccuracies have been identified in the data. This is due to the memory and processor limitations of the microcontroller. The substantial procedure of data reception from the sensor per second reading could potentially experience a delay or lag. When large amounts of data are received in excess, the transmission between them may be delayed and less precise. The data transport signal is consequently unable to be transmitted rapidly.

4.3.2 Project costing

The project costing can be view as shown in table below as the total expenses for the project is RM 48.90.

Table 4.8 Cost of project

No	Item	Single price (RM)	Quantity	Total amount (RM)
1	Male to female jumper wires, 10cm, 40pcs	3.40	1	3.40
2	Male to male jumper wires, 20cm, 40pcs	5.00	1	5.00
3	Female to female jumper wires, 20cm, 40pcs	5.00	1	5.00
4	NodeMCU Lua ESP8266 Wifi board V3	15.50	1	15.50
5	Ultrasonic sensor	6.00	2	12.00
6	Breadboard	8.00	1	8.00
TOTAL (RM)				48.90

4.4 Discussion of the Result: Overview

A correlation between the factor of developing an online monitoring system for inventory control and the six distinct cultural value influences has been established. Furthermore, the factor that determines of attribute development for online monitoring systems was identified, with cultural values' influences taken into consideration. To ensure

the precision of the results, an extensive series of testing and verification procedures have been executed. This chapter presents the findings regarding the impacts of the six cultural value dimensions and the identified preferences on the characteristics of the factor influencing the development of an online inventory monitoring system.

4.4.1 Identified cultural value influences

The impact of cultural values on the factor of development of online monitoring system for inventory control enhancement has been the subject of numerous studies throughout the years. In the relevant body of literature review, the results of these research have been documented. The results of this study indicate a slight discrepancy between the scores obtained for the five cultural value dimensions and those predicted by Hofstede's model of national culture. Malaysia exhibits high levels of collectivism and power distance, while masculinity and indulgence are characterised by medium levels. In contrast, uncertainty avoidance and long-term orientation are perceived as having low levels. Table below show the cultural score in Malaysia.

Table 4.9 Scores for cultural value dimensions (Hofstede, 2011)

Cultural value	Score
Collectivism	74
Masculinity	50
Uncertainty avoidance	36
Power distance	100
Long-term orientation	41
Indulgence	57

Indulgence, collectivism, and power distance all generated scores exceeding the mean score achieved in the present research. The values mentioned above surpassed the instrument's intermediate score, which was assessed on a scale of 1 to 7. The uncertainty avoidance scores were comparatively low, as they fell below the instrument's mean score.

Culture value	Score
Collectivism	6.27
Masculinity	6.18
Uncertainty avoidance	7.57
Long-term orientation	7.00
Power distance	3.35
Indulgence	6.80

The scores provided by Hofstede's study and the current analysis demonstrate differences, as seen by the two tables above. The difference in segmentation levels is a possible reason for these inconsistencies. This study performed a segmentation analysis to assess the progress of an online monitoring system for inventory control, taking into account the impact of cultural values. In contrast, Hofstede's study did a segmentation analysis to identify cultural values from a more comprehensive perspective. The purpose of the segmentation in this study was to evaluate the influence of an online monitoring system with cultural aspects.

4.5 Summary

The objective of this chapter was to offer an in-depth presentation of the data analysis procedure. The aim of this study was to examine and assess the impact of cultural values on the development of an online monitoring system for inventory control. The process of analyzing the validity and reliability of the data involves six distinct processes. The analysis also considers the substantial effect on productivity improvement. The study revealed that the factors of uncertainty avoidance and long-term orientation have a substantial impact on the development of online monitoring systems for inventory control. However, the factors of collectivism, masculinity, high power distance, and indulgence do not have any significant influence on the development of online monitoring system for inventory control.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The objective of this chapter is to simplify the discoveries and consequences of the research. This contains the achievements of the research goals, the impact of the research on theory and practices, and the novel advancements made by the research. In section below, the achievement of the research objectives have been analyse. The final section of this chapter not only examines the constraints of the study but also explores the prospective fields of inquiry available to future scholars.

5.2 Achievement of research objectives

The aim of this study was to create a guideline that incorporates the assessment of cultural value's impact on the development of an online monitoring system for inventory control. Three objectives have to be achieved for the research aim to qualify as successful. The following is an overview of the objective of this research:

1. To identify the factor of development Internet of Things (IoT) for inventory management system.
2. To evaluate the relationship of IoT inventory management system with cultural value influences.
3. To develop a prototype of online monitoring for inventory management based on cultural value influence.

5.2.1 The achievement of objective 1

The first objective was achieved to identify the factor of development Internet of things for inventory control system. This study has effectively identified crucial variables that contribute to the advancement of Internet of Things (IoT) in inventory control systems. The study emphasises the significance of strong communication protocols, interoperable devices, data security measures, and efficient analytics for obtaining actionable insights. This is achieved by conducting an extensive evaluation of technological advancements, connectivity solutions, data analytics, and real-time monitoring capabilities. The findings, which have been confirmed through case studies and practical examples, not only add to academic discussions but also offer significant insights for businesses seeking to improve their inventory management systems using IoT technology. This accomplishment establishes a strong basis for future research and enables ongoing progress in intelligent supply chain management systems.

5.2.2 The achievement of objective 2

The second objective of this research was accomplished by evaluate the relationship of IoT inventory management system with cultural value influences. The research objective of assessing the correlation between IoT inventory management systems and cultural value impacts has been effectively achieved. This study has conducted a comprehensive analysis of the cultural influences on the implementation and efficiency of IoT in inventory management. The findings have offered useful understanding of the complex relationship between technology solutions and cultural beliefs in various organisational settings. The results highlight the need of taking cultural factors into account when creating and putting into action IoT inventory systems, emphasising the requirement for flexible and culturally aware methods.

5.2.3 The achievement of objective 3

In conclusion, the research effectively accomplished its final objective through the development of a prototype that integrates cultural value influences into online inventory management monitoring. This significant prototype not only showcases the realistic implementation of knowledge acquired through the assessment of cultural elements but also functions as a concrete resolution that accommodates the varied cultural environments in which inventory management systems function. The study enhances the development of technological solutions that are responsive to cultural details by incorporating cultural values into the prototype's design and functionality.

5.3 Research limitations and direction for future study

For future research, it is recommended to investigate the enduring effects and potential for expansion of culturally impacted online monitoring systems for inventory management. Subsequent examination might concentrate on evaluating the practical use of the created prototype in various organisational contexts, taking into account issues such as user reception, system flexibility, and long-term performance. In addition, researchers may explore the creation of frameworks or recommendations for incorporating cultural factors into the design and implementation of other technology-driven systems that go beyond inventory control. Comparative studies can be conducted to analyse the efficacy of culturally sensitive online monitoring systems compared to traditional methods, providing insights into the wider implications and potential enhancements in efficiency, cost-effectiveness, and overall organisational performance. This advice seeks to promote further progress in the convergence of technology and cultural sensitivity, offering practical insights for the continuous development of inventory management systems and related technological applications.

5.4 Summary

This study was conducted with the intention of determining the impact that cultural value has on the process of developing an online monitoring system for inventory control. I have effectively accomplished all three of the research objectives in order to provide a response to the study subject. When it comes to the development of an online monitoring system for inventory management, the findings of this study give empirical proof that cultural values play a key part in the process. Taking into consideration the findings of this study, it is strongly recommended that any business that is developing an online monitoring system incorporate culture value.

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APPENDICES

APPENDIX A: GANTT CHART

No	Project Activities	Plan vs Actual	March		April				May					June				July
		Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	PSM briefing	Plan						MIDSEM BREAK										
		Actual																
2	Chapter 1: Introduction	Plan																
		Actual																
3	PSM: WORKSHOP	Plan																
		Actual																
4	Chapter 2: Literature Review	Plan																
		Actual																
5	Chapter 3: Methodology	Plan																
		Actual																
6	Chapter 4: Result	Plan																
		Actual																
7	Formatting and Grammar improvement	Plan																
		Actual																
8	Final Improvement	Plan																
		Actual																
9	Slide Presentation	Plan																
		Actual																
10	Final Presentation	Plan																
		Actual																
11	Report Suubmission	Plan																
		Actual																

No	Project activities	Plan vs Actual	October			November					December				January		
		Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Preparing questionnaire	Plan															
		Actual															
2	Arranging site visit and submit permission letter	Plan															
		Actual															
3	Company visit	Plan															
		Actual															
4	Data collection	Plan															
		Actual															
5	Compilation data	Plan															
		Actual															
6	Smart PLS simulation model	Plan															
		Actual															
7	Improvement of simulation model	Plan															
		Actual															
8	Development prototype of online monitoring system	Plan															
		Actual															
9	Correlation of chapter 4 and chapter 5	Plan															
		Actual															
10	Prepare for presentation of FYP 2	Plan															
		Actual															
11	Final presentation for FYP 2	Plan															
		Actual															

Legend

Plan

Actual

APPENDIX B: SURVEY QUESTIONNAIRE

A STUDY ON:

THE DEVELOPMENT OF AN ONLINE MONITORING SYSTEM FOR INVENTORY CONTROL COMSIDERING CULTURAL VALUE INFLUENCES

Dear Respondents,

I am Muhammad Fakhrul Haziq bin Muhamad Nazri, a final year student at Universiti Teknikal Malaysia Melaka (UTeM) who is now enrolled in the bachelor's degree project under the Fakulti Teknologi dan Kejuruteraan Industri dan Pembuatan (FTKIP). I am conducting a study on **"The Development of an Online Monitoring System for Inventory Control Considering Cultural Value Influences"**. Your replies will be kept confidential and used just for the purpose of this study.

I appreciate for your precious time in responding to the questionnaire.

Sincerely,
Muhammad Fakhrul Haziq bin Muhamad Nazri
Supervisor: Dr. Ihwan Ghazali

QUESTIONNAIRE

PART A: RESPONDENT'S BACKGROUND

To answer each question, please indicate your choice by marking an 'V' in the appropriate box.

1. Your age (years)?

- □ 16 - 24
- □ 25 - 34
- □ 35-44
- □ 45 - 54
- □ 55 – 64
- □ 65 - over

2. What is your gender?

- □ Male
- □ Female

3. What is your marital status?

- □ Single
- □ Married

4. Academic qualification

- □ Diploma
- □ Bachelor's Degree
- □ Master's
- □ PhD
- □ Other

5. Your income per month?

- □ Less than RM 1000
- □ RM 1001 – RM 2000
- □ RM 2001 – RM 3000
- □ RM 3001 – RM 4000
- □ RM 4001 – RM 5000
- □ More than RM 5001

PART B: (CULTURAL VALUE)

In this part, you will be asked about several aspects relating to **"Cultural value"**. Please state how much you agree to each of the statements of **"Cultural value"** by placing a tick (√) in the appropriate box. The number will be on a scale from 1 to 7, where 1 means 'strongly disagree' whereas 7 indicates 'strongly agree'. The cultural values will focus on:

Collectivism	:	To be a member of the group is more important than being an individual.
Masculinity	:	Achievement or targeted purpose rather than style, fashion (femininity).
Uncertainty avoidance	:	Feeling threatened and trying to avoid threats.
Power Distance	:	The consequences of power inequality and authority relations in society.
Long-term oriented	:	Focusing on the future, having perseverance and being thrifty.
Indulgence	:	An environment that lets people enjoy themselves and have fun without much trouble.

Collectivism

1 People should put the group they are a part of ahead of their own needs.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

2 Even when things are hard, people should stick with the group.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

3 The group's well-being is more important than individual gains.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

4 The success of the group is more important than the success of any one person.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

5 People should be told to stick with the group even if it means giving up their own goals.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

Masculinity

1 Having a successful career is more crucial for males than it is for women.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

2 Men are more likely to use logic and reason to figure things out, while women are more likely to trust their emotions.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

3 Men typically use an aggressive, violent approach to solving difficult situations.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

4 A guy can always perform some tasks better than a woman.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

5 In our society, being strong and tough are seen as good qualities.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

Uncertainty Avoidance

1 I need instructions that are very clear and specific so I always know what to do.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

2 It is important to follow directions and steps very carefully.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

3 Standardized ways of doing things at work are helpful.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

4 Rules and regulations are significant because they let me know what is required of me.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

5 It is important to have instructions for tasks.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

Power Distance

1 Most decisions should be made by those in higher positions without involving those in lower positions.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

2 The opinions of those in lower positions shouldn't be asked too frequently by those in higher positions.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

3 Social connections with those in lower positions should be avoided by those in higher positions.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

4 People in high position shouldn't give important jobs to people in lower position.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

5 People in lower positions shouldn't argue with what people in higher positions decide.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

Long-term oriented

1 Taking good care of financial management.

Strongly disagree	□ 1	□ 2	□ 3	□ 4	□ 5	□ 6	□ 7	Strongly agree

2 Persistence is the quality of continuing despite obstacles.

Strongly disagree	□ 1	□ 2	□ 3	□ 4	□ 5	□ 6	□ 7	Strongly agree

3 Stagnation and stability of the self.

Strongly disagree	□ 1	□ 2	□ 3	□ 4	□ 5	□ 6	□ 7	Strongly agree

4 Long-term planning.

Strongly disagree	□ 1	□ 2	□ 3	□ 4	□ 5	□ 6	□ 7	Strongly agree

5 Putting up a lot of effort to achieve success in the future.

Strongly disagree	□ 1	□ 2	□ 3	□ 4	□ 5	□ 6	□ 7	Strongly agree

Indulgence

1 I often treat myself with enjoyable things, even if they are not required.

Strongly disagree	□ 1	□ 2	□ 3	□ 4	□ 5	□ 6	□ 7	Strongly agree

2 I believe it is important to reward myself for my hard work and achievements.

Strongly disagree	□ 1	□ 2	□ 3	□ 4	□ 5	□ 6	□ 7	Strongly agree

3 I believe in enjoying the present moment rather than worrying too much about the future.

Strongly disagree	□ 1	□ 2	□ 3	□ 4	□ 5	□ 6	□ 7	Strongly agree

4 I believe that life is too short to deny oneself simple pleasures and comforts.

Strongly disagree	□ 1	□ 2	□ 3	□ 4	□ 5	□ 6	□ 7	Strongly agree

5 I think it's important to put my own fun and happiness first, even if that means going against what society says I should do.

Strongly disagree	□ 1	□ 2	□ 3	□ 4	□ 5	□ 6	□ 7	Strongly agree

PART C: FACTOR OF DEVELOPMENT IoT IN INVENTORY MANAGEMENT

In this part, you will be asked about several **"Factor of development IoT for inventory management"**. Please state how much you agree on the statement of **"Factor of development IoT for inventory management"** by placing a mark **(√)** in the appropriate box. The number will be on a scale from 1 to 7, where 1 means 'strongly disagree' whereas 7 indicates 'strongly agree'.

Real-time tracking

1 Regular reports on inventory amounts are necessary for good inventory management.

Strongly disagree	□ 1	□ 2	□ 3	□ 4	□ 5	□ 6	□ 7	Strongly agree

2 Tracking in real time can help warehouse managers make better decisions.

Strongly disagree	□ 1	□ 2	□ 3	□ 4	□ 5	□ 6	□ 7	Strongly agree

3 Tracking products in real time can make order fulfilment go more efficient.

Strongly disagree	□ 1	□ 2	□ 3	□ 4	□ 5	□ 6	□ 7	Strongly agree

4 Stock outs and overstocks can be avoided by having up-to-date information on where products is located.

Strongly disagree	□ 1	□ 2	□ 3	□ 4	□ 5	□ 6	□ 7	Strongly agree

5 Having quick access to store info makes it easier to predict demand.

Strongly disagree	□ 1	□ 2	□ 3	□ 4	□ 5	□ 6	□ 7	Strongly agree

Enhance data analytic

1 When it comes to handling products, using data can help you make better choices.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

2 Using Internet of Things (IoT) data can improve the awareness and availability of the supply chain.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

3 It is possible to make inventory control more efficient by using info from the Internet of Things (IoT).

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

4 We can make smarter decisions about product management by using Internet of Things (IoT) data.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

5 Overall success can be better by using data.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

Cost efficiency

1 Applying Internet of Things (IoT) devices can help lower inventory control costs.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

2 Costs for things like labor and storage will decrease due to Internet of Things (IoT)-enabled product tracking.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

3 By using Internet of Things (IoT) data, warehouse management will be able to see and handle costs better.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

4 Applying Internet of Things (IoT) to keep track of goods could reduce down on stock-outs and overstocks.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

5 By using Internet of Things (IoT) to keep track of goods, you can cut down on product failure and the costs that come with it.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

Customer service

1 Internet of Things (IoT) technology could make clients satisfied with product management.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

2 Tracking goods through the Internet of Things (IoT) can help customers get their orders faster and more accurately.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

3 Internet of Things (IoT) technology will give customers proactive order status and delivery information.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

4 Inventory control with Internet of Things (IoT) may reduce lead times and increase on-time delivery.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

5 Internet of Things (IoT) technologies can make it easier to deal with customer questions and issues.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

Human error

1 In a typical inventory management system, inaccurate inventory counts might cause problems.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

2 Applying Internet of Things (IoT) would reduce inventory management errors.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

3 Employee training may decrease human error in Internet of Things (IoT)-based inventory control systems.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

4 Creating a responsible and continuous improvement culture may decrease inventory control mistakes.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

5 Real-time alerts and notifications from Internet of Things (IoT) help avoid or solve inventory control problems.

Strongly disagree □ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 Strongly agree

Flow of product

1 Internet of Things (IoT) can improve supply chain product visibility and traceability.

Strongly disagree	□ 1	□ 2	□ 3	□ 4	□ 5	□ 6	□ 7	Strongly agree

2 Internet of Things (IoT) technology may improve operational efficiency by offering full product movement visibility and management.

Strongly disagree	□ 1	□ 2	□ 3	□ 4	□ 5	□ 6	□ 7	Strongly agree

3 Internet of Things (IoT) data and analytics could improve product routing and scheduling for optimal flow.

Strongly disagree	□ 1	□ 2	□ 3	□ 4	□ 5	□ 6	□ 7	Strongly agree

4 Inventory control can be more accurate and faster using Internet of Things (IoT).

Strongly disagree	□ 1	□ 2	□ 3	□ 4	□ 5	□ 6	□ 7	Strongly agree

5 Product flow may be monitored and controlled using Internet of Things (IoT) technology.

Strongly disagree	□ 1	□ 2	□ 3	□ 4	□ 5	□ 6	□ 7	Strongly agree

---------- End of Questionnaire ----------

----------Thank you very much for your participation in this research----------