sustainability

MDPI

Article

Critical Success Factors for Internet of Things (IoT) Implementation in Automotive Companies, Indonesia

Inaki Maulida Hakim [1,2], Moses Laksono Singgih [1] and I Ketut Gunarta [1,*]

1 Department of Industrial and Systems Engineering, Institut Teknologi Sepuluh Nopember, Surabaya 60111, Indonesia
2 Department of Industrial Engineering, Universitas Indonesia, Depok 16424, Indonesia
* Correspondence: gunarta@ie.its.ac.id

Abstract: In 2018, the Indonesian government launched the Making Indonesia 4.0 Roadmap under The Industrial Revolution 4.0 era. This road map aims to increase industrial competitiveness and make the nation one of the world's top 10 economies by 2030. The role of the Internet of Things (IoT) in The Industrial Revolution 4.0 is important to improve work efficiency and reduce companies' costs. Although several manufacturing companies in Indonesia have successfully implemented this technology, so it is important to identify the critical success factors in its application for other companies. Therefore, this study discusses the essential factors of success for implementing IoT in automotive companies in Indonesia, which have differing specific application characteristics from the conditions in other countries. The Delphi method obtained data from 8 dimensions and 32 sub-dimensions. These included the finance, regulatory, people and management, operation, technology, innovation, ideas, and resource dimensions. Other automotive companies can use the results as a reference in implementing IoT and evaluating and improving their business performance, as well as formulating the right strategy to achieve excellence in the long term.

Keywords: critical success factors; IoT; automotive companies; Delphi method

check for updates

Citation: Hakim, I.M.; Singgih, M.L.; Gunarta, I.K. Critical Success Factors for Internet of Things (IoT) Implementation in Automotive Companies, Indonesia. *Sustainability* **2023**, *15*, 2909. https://doi.org/10.3390/su15042909

Academic Editors: Juan Miguel Navarro and Muhammad Shafiq

Received: 7 November 2022
Revised: 24 January 2023
Accepted: 2 February 2023
Published: 6 February 2023

1. Introduction

The government has realized that the rapid development of internet technology to facilitate production activities needs to be controlled and managed efficiently. Currently, various devices, including the Internet of Things (IoT), can connect and communicate with each other and exchange data through an internet connection. IoT technology is one of the innovations predicted to change the order of human life [1] and the manufacturing industry. The launch of the Industry 4.0 Roadmap [2] formulated by the Indonesian government has shown that technology can change the business processes of the manufacturing industry from traditional to modern [3]. The Industrial Revolution 4.0, marked by the use of IoT technology in cyber-physical systems [4], is an important factor that will significantly change global economic performance. IoT is useful for monitoring production and scheduling in companies [5]; therefore, it can achieve increased efficiency, save costs, and make companies more competitive [6]. Moreover, this technology is important in formulating the Making Indonesia 4.0 Roadmap [7]. The use of IoT is non-negotiable and important for the following reasons: first, services connected to production comprised of intelligent manufacturing processes [8] with efficient technicians to provide proactive and predictive assistance; second, IoT is the future of industrialization [9] because its presence in the manufacturing industry will promote the birth of future smart factories to achieve industrial sustainability through increasing employee skills in artificial intelligence (AI). An example is in the production of autonomous quality management systems (AQMS) [10] used to drive operational activities, detect defects, and solve production problems in real-time; third, by creating a smart supply chain [11], the manufacturing industry will be facilitated in synergizing to achieve sustainable performance improvement [12].

IoT is a technology capable of turning devices into something more valuable, including monitoring and analysis [13]. Currently, its ecosystem still needs to improve compared to other technology industries in Indonesia. The obstacles to growth range from policies regarding data devices to the use of frequency. The IoT ecosystem expects the active role of many parties involved, including regulators, to support accelerating its presence in Indonesia. The government's role in preparing the road map draft and IoT framework starts with determining critical success factors, followed by research on its development and structure for manufacturing companies. Therefore, it is expected to become the most important emerging technology factor because of the potential to increase lives and save time and money [14–16].

For companies to achieve a good IoT ecosystem, they must identify critical success factors to achieve innovation management in products, processes, and services [17]. Important success factors required in business must be identified and evaluated to achieve predefined goals [18]. The ability to meet these factors will lead to success because it is important to support the companies' long-term success in achieving sustainable development [19]. Moreover, IoT is a way to prioritize activities that need to be carried out while running projects in the companies [20]. Critical success factors can help clarify the activities that need to be carried out or require special attention to enable the companies to achieve project goals [21].

The scope of this study covers automotive companies in Indonesia. The interviewees were academic and practitioner experts in automotive companies. By using a literature review, an in-depth questionnaire survey, and expert interviews, this study analyzed and summarized critical success factors (CSFs) implementation of IoT in the automotive companies in Indonesia. In addition to innovation and Industry 4.0, a successful automotive company should be able a continuously improve and develop its business and scale up its companies and have critical success factors (CSFs), which is the topic of this study. The findings of this study provide recommendations to the manufacturing industry, specifically in automotive companies in Indonesia, by identifying critical success factors (CSFs) that can be used to evaluate and improve their performance.

2. Material and Methods

2.1. Critical Success Factors

Critical success factors are among the most important information in system planning because they are based on the use of key factors to evaluate data companies [22]. This process was developed through five organizational theories: stakeholder, resource-based view, relational view, innovation diffusion, and contingency (fit) theory [23]. Critical success factors are needed for companies to achieve their missions and goals within the short term. They are also among the sources for determining companies' future strategies [24].

IoT implementation needs to consider several factors to determine success and business growth in companies [25]. This is necessary to achieve sustainability in the long term for the companies to compete with others. Cost is the main factor considered [26] during the implementation process because some technologies require complex network systems to improve companies' performance. The design of a new system using IoT implementation will later support data storage and access to information for all departments, thereby speeding up the process in real-time [26]. Furthermore, system formation, maintenance, integration, and training costs are important for implementing IoT in companies.

There are six crucial factors in implementing IoT in the manufacturing industry [27]: business benefits, strategic alignment, business process focus, operational model changes, improvement of workers' ability, and end-to-end security. First, business benefits. Initially, IoT discussions focused on technology and what it can offer while excluding its business value. However, the discussion has shifted to the various business benefits that can be provided. For example, innovation led to the manufacture of smart data to support decision-making and trigger actions automatically, which can be monetized. Second, strategic alignment. For IoT to positively impact organizations, the goal, and objective should be aligned with the overall business and technology strategy. Third, business process focus. This is at the core of any organization and used to determine how the operating model is structured. An emerging focus in manufacturing is integrating IoT solutions into business processes. Fourth, operational model changes. One of the main challenges companies face when trying to implement IoT to generate revenue is the disruption to current business models. The convergence of information and operational technology is required, which means business system management and factory automation technology will meet to optimize collaboration between the office and factory floors. Fifth, improvement of employees' abilities. With the continuous change in the technological landscape and operating models, employees need to learn new skills. In addition, individuals need to understand the concepts of IoT and Business 4.0 from a business and technology perspective, establishing a common language to reduce the risk of misunderstandings. Sixth, end-to-end security. The cyber-physical system on which IoT is based poses a security risk because intruders can compromise internet usage. Therefore, cyber-physical systems should include authentication and encryption capabilities built into the hardware, real-time network traffic analytics, and an IoT gateway that acts as a protective shield for factory equipment, like how firewalls work.

Furthermore, 10 factors are very decisive in the application of successful IoT in corporate organizations [28]. First, IoT should be aligned with the overall organizational strategy, guides, goals, and objectives. Second, the success of Industry 4.0 is highly dependent on the commitment and support of top management financially and politically within the organization. Third, employers need to be intentional about the success of Industry 4.0 by ensuring employees learn new skills as their roles change. Individuals need to understand the concepts of IoT and Industry 4.0 from a business and technology perspective by establishing a common language to reduce the risk of misunderstandings. Fourth, intelligent products or services must be created using IoT to enable automation, flexibility, efficiency, and independent production processes. Fifth, supply chain digitization efforts must be conducted to survive in the market. Sixth, organizational digitization, is the percentage of assets equipped with sensors that need to be connected in real-time for greater transparency in planning, directing, organizing, controlling, and coordinating various tasks automatically through self-regulation using algorithmic intelligence. Seventh, the change management implementation of Industry 4.0 companies will change the companies' organizational structure both vertically and horizontally. It is referred to as a radical change achieved by implementing Industry 4.0 as the basic assumption regarding the companies' business. Eighth, the existence of project management through Industry 4.0 makes organizations have plans to create business process activity projects. Therefore, the project management concept should be applied critically to determine its success. Ninth, cyber security should be managed between people, products, and machines using intelligent data processing, digital value-added services, and business processes. Therefore, it is necessary to develop a standard for implementing IoT structures based on the reference architectural model Industry 4.0 (RAMI 4.0) [29] and the industrial internet reference architecture (IIRA) [30]. In addition, there is a need for cybersecurity policies, directives, and laws to be accredited and certified. This is to maintain strict security controls to reduce the risk of vertical, horizontal, and end-to-end Industry 4.0 integration attacks. The successful implementation of Industry 4.0 will depend on the cybersecurity strategy. Tenth, Industry 4.0 and sustainability in business are increasingly being used because of the demands of society. Sustainability emphasizes the balance between economic, social, and environmental dimensions. Therefore, for the implementation of Industry 4.0 to be successful, it should balance the three dimensions of sustainability and provide economic, social, and environmental benefits for corporate organizations.

Companies need to evaluate and identify the success factors of IoT implementation [31]. The research determines the success variable of IoT implementation using internal variables from the marketing dimension, such as feasibility, positioning analysis, and profit plan [24]. The external variables include the use of technology dimensions related to identification and protection, as seen from the optimal operating system that works in the manufacturing industry, specifically in automotive companies. Companies achieve sustainability and stability using the PRIMOF_F (people, resource, innovation, marketing, operation, and finance) model, which has identified dimensions where sufficient results can guarantee success for the company [25]. Important factors that affect the implementation of IoT literature were obtained from previous research by grouping the dimensions in the manufacturing industry based on the technology dimension [24], people and management dimension [26,32–35], resources dimension [36], innovation dimension [26], marketing dimension [17,24], operations dimension [26], and finance dimension [17,26] in addition to the regulation dimension [17,25].

Based on the literature study, there are several methods used to obtain success factors (CSFs), including using the AHP [17], SEM Method [19], SLR Method [20,28], Grounded Theory [24], Regression Analysis [26], Literature Review [31,35], and MDM [36]. This study uses the Delphi method to identify critical success factors (CSFS), specifically in automotive companies in Indonesia based on a literature review and interviews with an expert. The comparison of the current study with relevant studies is shown in Table 1 to highlight the contribution.

Table 1. Comparison of relevant studies with this study.

Reference	Methods	Context	Region of Study	Main Contribution
[17]	Analytical Hierarchy Process (AHP)	General Organization	India	Identification of critical factors of the effective transfer technology process and evaluation of identified critical factors of the effective technology transfer process from an Indian perspective.
[19]	Structural Equation Modeling (SEM)	Small and Medium-Sized Enterprises (SMEs)	China	Provides practitioners with profound insights into the enterprise's digital technology (DT) and suggests that enterprises attach importance to the improvement of organizational capabilities and use strategy and talents as important resources to promote the success of enterprise digital technology (DT).
[20]	Systematic Literature Review (SLR)	General Organization	USA	Classify the 11 CSFs identified into the phases of the ERP implementation life cycle from the literature review.
[24]	Grounded Theory	High-Tech Enterprise	China	Collects and analyzes the implementation information and data from three related IoT companies. Then this study identifies 40 key success factors and establishes a key success factors model for the innovative application of IoT in the view of technology, market, and implementation. The purpose is to improve the success rate of IoT application implementation.
[26]	Regression Analysis	Small and Medium-Sized Enterprises (SMEs)	India	Measure improvement in performance by considering different measures related to customer service and satisfaction, innovation, growth, financial performance, and internal business. Results are analyzed by testing research propositions using standard statistical tools.

Table 1. *Cont.*

Reference	Methods	Context	Region of Study	Main Contribution
[28]	Systematic Literature Review (SLR)	Manufacturing	India	Identity CSFs can be used by organizations as a guiding factor while implementing Industry 4.0 in their organizations. Focusing on these 10 factors will help organizations to be sustainable during the implementation of Industry 4.0.
[31]	Literature Review	General Organization	USA	Develop a research model for RFID success to facilitate future research integration and variable selection. The model is general and allows new factors or success variables, when identified, to be added easily.
[35]	Literature Review	Manufacturing	Brazil	Contributes to updating digital manufacturing CSF discussion in the new context of Industry 4.0 and it provides a guide to checking the organizational readiness for digital manufacturing.
[36]	The Modified Delphi Method (MDM)	Corporation	Taiwan	Identify CSFs for ERP systems in a corporation. Moreover, provide helpful information regarding selection standard for the corporation.
This Study	The Delphi Method	Automotive Companies	Indonesia	Identifying critical success factors (CSFs) and providing recommendations to the manufacturing industry, specifically in automotive companies in Indonesia during the implementation of IoT, and guidance for managers in automotive companies planning the implementation of IoT in the future.

Table 1 lists several studies on critical success factors (CSFs) in technology (IoT, ERP, RFID, etc.) implementation at the SME, corporation, manufacturing, and general organization levels. While most research focuses on descriptive analysis and normative discussion of the practice of CSFs alone, the total number of large-sample empirical studies on CSFs is still limited, and those that have been conducted do not uniformly identify the same CSFs. On the other hand, the previous study mainly focuses on general organizations, ignoring the specific situation of companies, especially automotive companies, in connection with the important position of the company in increasing business growth and achieving sustainability related to the implied implementation of IoT to support the company's business processes to achieve effectiveness and efficiency. We believe that taking automotive companies as research objects and exploring the identification CSFs in implementing IoT is not available in previous studies, especially in Indonesia.

This study identifies CSFs for IoT implementation in automotive companies using existing literature and expert feedback. Therefore, we did a literature review in the initialization phase using some fundamental terms: "Critical Factors for the Successful Implementation of Industry 4.0" OR " Critical Success Factors For Implementation of IoT in the Manufacturing Industry". We use two popular scientific databases, "Google Scholar" and "Science Direct", for this review. Based on preliminary literature, this study used eight dimensions that are critical success factors in the implementation of IoT in automotive companies. These dimensions consist of finance, innovation and ideas, marketing, operations, people and management, regulation, resources, and technology. Each dimension comprises sub-dimensions, which are important factors in the application of IoT. According to the literature and data processing in previous research, there are 36 sub-dimensions of the critical success factors; 27 were from the literature presented in Table 2, column number of sub-dimension numbers 1 to 27. This research found nine new sub-dimensions, obtained from the results of interviews with a panel of experts, that are presented in Table 2, column number of sub-dimension numbers 28 to 36. The new sub-dimension from the interviews are (1). value proposition, (2). consumer behavior, (3). system efficiency, (4). employee training consistency, (5). companies' image and network, (6). companies' policy, (7). internet network support facilities, (8). internet connections, and (9). backup systems. The new sub-dimension is fundamental to the situation, and the characteristics related to the critical success factors of IoT implementations are automotive companies in Indonesia. This is further classified into critical success factors later validated by a panel of experts, as shown in Table 2.

Table 2. Classification of Critical Success Factors (CSFS) Implementation of IoT in Automotive Companies.

Dimension	Sub-Dimension	Number of Sub-Dimension	Reference
Finance (4 sub-items)	System maintenance costs	(1)	[33,35]
	Minimize and streamline costs related to the use and purchase of IoT devices in the companies	(2)	[26,35,37]
	Factors and the companies' financial situation in decisions regarding the purchase (upgrade) of IoT devices at the companies	(3)	[25,34,35]
	Employee training costs	(4)	[26,36]
Innovation and Ideas (9 sub-items)	The ability of IoT devices to detect and track problems that occur in the system	(5)	[26,35,36]
	Compatibility of IoT devices with companies' operational systems	(6)	[25,26]
	IoT technology and infrastructure integration	(7)	[24,26,28]
	Timely delivery of information	(8)	[24,37]
	Quality of information (report) displayed from IoT devices	(9)	[24,28,37]
	Cooperative customer support	(10)	[24,26,37]
	IoT device performance quality	(11)	[24,28,37]
	Ease of IoT devices that can later be changed and repaired	(12)	[26,35,36]
	The ability of IoT device components to exchange and use information while operating	(13)	[27,36,37]
Marketing (4 sub-items)	The level of competition in the external scope of the companies	(14)	[24,26]
	The need for the latest market trends	(15)	[24,26]
	Value proposition	(28) *	
	Consumer behavior	(29) *	
Operations (4 sub-items)	Standardization of IoT device architecture reference to be implemented in the companies	(16)	[36,37]
	Flexible and quality service	(17)	[26,37]
	Data security system	(18)	[24,28,32]
	System efficiency	(30) *	

Table 2. *Cont.*

Dimension	Sub-Dimension	Number of Sub-Dimension	Reference
People and Management (5 sub-items)	Support and commitment from the managerial level in the companies	(19)	[17,28,31,33,35,36]
	Assessment of employee skill level in operating IoT	(20)	[24,28,35,37]
	Effectiveness of communication between employees	(21)	[32,33,35–37]
	Employee training consistency	(31) *	
	Companies' image and network	(32) *	
Regulations (2 sub-items)	Government regulations and authorities	(22)	[17]
	Companies' policy	(33) *	
Resource (3 sub-items)	The output of IoT devices focused on customer demand	(23)	[31,35]
	Resource management capability in organizing IoT implementation	(24)	[20,28,31,35,36]
	The good relationship between partners and stakeholders	(25)	[26,31,37]
Technology (5 sub-items)	Technology standardization.	(26)	[17,24,32,34,36,37]
	Cooperation with IoT technology service providers	(27)	[24,31,32,35,37]
	Internet network support facilities	(34) *	
	Internet connection	(35) *	
	Backup systems	(36) *	

Noted: The number of sub-dimensions with (*) means a new sub-dimension from an interview, confirmed by an expert.

The results of interviews with experts are shown in Table 2; in the marketing dimensions, there are two new sub-dimensions, namely value proposition and consumer behavior. According to experts, the value proposition is one of the important elements in a company's business marketing strategy. The value proposition is a tool to attract potential consumers [38]; these values must often be communicated through marketing strategy materials. If a company wants its products and services to be chosen by customers, the company must have a strong value proposition. Meanwhile, according to experts, consumer behavior is important because companies need to conduct studies on consumers and know how to make purchases. Because consumer behavior will develop dynamically and its behavior can change, companies use IoT as an application for consumer behavior studies for decision-making processes [39].

In the operational dimension, there is one new sub-dimension from experts, namely system efficiency. Because IoT can integrate smart devices with the web, it is hoped that all business activities in the company's systems can run efficiently and achieve targets, thereby increasing company performance and productivity. In the people and management dimension, there are two new sub-dimensions from the experts, namely employee training consistency and image and companies' network. Companies that have modules in implementing IoT to support the company's business activities require employees who are experts in this field of carrying out the process of setting up, evaluating, and periodically monitoring business activities in the company [40]. Therefore, the company provides training to employees to be able to monitor and control the company's business activities. According to the experts, companies that use IoT technology are companies' image and networks, which support government programs by implementing Industry 4.0 [7].

In the regulation dimension, there is one new sub-dimension, namely the company's policy. Automotive companies have a company policy related to the successful implementation of IoT. One of the reasons companies use IoT is that IoT will encourage innovation and increase production with analytical data so that data can be received in real-time related to how machines operate, and companies can easily diagnose problems. In the technology dimension, there are three updating sub-dimensions, namely internet support facilities, internet connection, and backup systems. According to the experts, three updating sub-dimensions are very important to facilitate the process of connectivity between devices or machines. With internet support facilities, internet connection, and backup systems they can run faster and more flexibly [41].

2.2. Delphi Method

The Delphi method is a reliable way of obtaining information and making decisions, as well as determining indicators and parameters by exploring ideas from experts in their fields using questionnaires [42]. Its attributes include time, number of rounds, the expert, and the expected input and output. This method generally starts with literature research, followed by discussion and feedback sessions, results formulation, and a conclusion [43].

The Delphi method was used in this study because of its importance in structuring the group communication process; hence, the discussion process runs effectively and easily provides solutions to problems. This method is suitable to be applied when expert judgment is needed, but the time and distance factor makes it difficult for experts on a panel to sit together.

The first stage is conducting literature research. This is followed by the validation stage carried out with a panel of experts through interviews related to critical success factors in the IoT implementation in automotive companies in Indonesia, which consists of three rounds. The first is asking the expert panel questions about providing critical success factors. The second is asking questions on assessing critical success factors using the geomean method. The factor is accepted when the value is above 3.5 and rejected when below [44]. The third stage is to classify the dimensions and sub-dimensions of the critical success factors. This study uses Delphi Method, the stage in this study consists of 3 stages. Figure 1 is shown steps to prepare the questionnaire by the Delphi method.

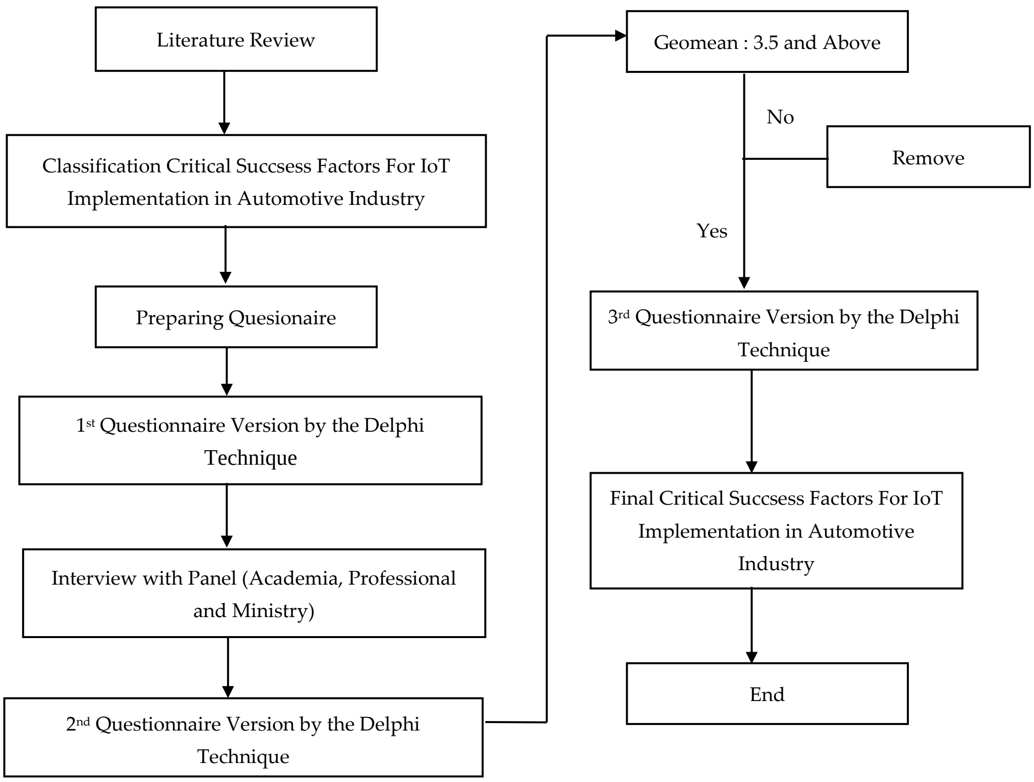

Figure 1. Steps to prepare the questionnaire by the Delphi method.

2.3. Geomean

Geomean, commonly referred to as the geometric mean, is the n- th root of positive data clusters x1, x2, . . . , xn. It is usually used in business and economics to calculate the rate of mean change, growth, and ratio for fixed or near-fixed sequential data and mean increases in percentage terms. The geometric mean is obtained using the following equation:

$$G = \sqrt[n]{x1.x2.x3 \ldots xn}$$

Furthermore, this technique reduces the average effect of outliers that deviates from a dataset. The geometric results obtained the mean for an expert opinion then the criteria were assessed using the 4-Likert scale, using 2.75 out of 4, and the 5-Likert scale, using a minimum of 3.5 out of 5, as the accepted and rejected mean in making a criterion considered [44].

2.4. Panel Selection

The most crucial stage in the success of the Delphi method is determining the recommended number of three or more panelists [45,46]. Experts or panelists are individuals who are trained [45], have significant experience [45], have appropriate knowledge [47], and have authority in their field [46]. Furthermore, panelists should have the time and willingness to participate until the end of the Delphi round [47,48]. This study was carried out using five panelists from different backgrounds and professions, including the Ministry of Industry and practitioners, academics, consultants, and advisors in the manufacturing and automotive fields. The criteria panel of experts, i.e., a minimum of 5 years of working as practitioners, academics, consultants, and in ministries with adequate knowledge about the IoT. Panelists have knowledge and expertise in IoT implementation, specifically in the automotive companies in Indonesia. This study determines the panelists according to the specified selection criteria. The determination of the expert panel is based on the triple helix synergy, which involves academics, business, and government. Furthermore, to determine panelists, researchers contacted one of the automotive organizations in Indonesia to get a panel of experts representing automotive industry associations and automotive companies that have implemented IoT in their business processes. Representatives from academia based on area research often conduct research in the field of IoT implementation. Whereas the ministry through representatives from the Ministry of Industry is the initiator of the Making Indonesia 4.0 Program in Indonesia. Table 3 describes the complete profile of the panelists used in this study.

Table 3. Profile of Panelists.

Job Title	Industry Segment or Institution	Experience (Years)
Advisor in Automotive Companies	Automotive Companies	30
Head of Implementation Industry 4.0	Ministry of Industry	15
Head of Implementation IoT Training	Automotive Academia	7
Head of Information System Laboratory	Academia	35
Senior Instructor in Automotive Companies	Automotive Companies	20

3. Results

3.1. Geomean Data Processing Results

Interviews conducted with a panel of experts to obtain data related to critical success factors in implementing IoT in automotive companies in Indonesia were analyzed after the third round using a Likert scale with a rating range of 1–5. The panelists gave an assessment, which was then carried out using the geomean method. Of the 36 sub-dimensions used to carry out this study, four were rejected. In the people and management dimension, three sub-dimensions, namely the assessment of the employees' expertise level in operating IoT, effective communication, and the companies' image and network, were not accepted. Meanwhile, in the operation dimension, the standardization of reference architecture for IoT devices was rejected. Table 4 explains the critical success factors that are accepted and rejected from the data processing results, which will later be used in the next stage for a more in-depth analysis. Furthermore, interviews with the expert panel are carried out separately at different times according to their schedule, opinions, and agreement.

Table 4. Results of Data Processing Critical Success Factors for Implementation of IoT in Automotive Companies.

Dimension	Sub-Dimension	Number of Sub-Dimension	Geomean Value	Result
Finance	System maintenance costs	(1)	4.573	Keep
	Minimize and streamline costs related to the use and purchase of IoT devices in the companies	(2)	4.129	Keep
	Factors and the companies' financial situation in making decisions regarding the purchase (upgrade) of IoT devices at the companies	(3)	4.373	Keep
	Employee training costs	(4)	4.573	Keep
Innovation and Ideas	The ability of IoT devices to detect and track problems that occur in the system	(5)	4.514	Keep
	The compatibility of IoT devices with the companies' operational systems	(6)	4.573	Keep
	IoT technology and infrastructure integration	(7)	4.782	Keep
	Timely delivery of information	(8)	4.782	Keep
	Quality of information (report) displayed from IoT devices	(9)	4.373	Keep
	Customer support	(10)	4.373	Keep
	IoT device performance quality	(11)	4.183	Keep
	Ease of IoT devices that can later be changed and repaired	(12)	4.782	Keep
	The ability of IoT device components to exchange and use information during operation ton	(13)	4.782	Keep
Marketing	The level of competition in the companies' external scope	(14)	3.776	Keep
	The need for the latest market trends	(15)	4.573	Keep
	Value proposition (M3)	(16)	4.782	Keep
	Consumer behavior (M4)	(17)	4.129	Keep
Operations	Standardization of IoT device architecture reference to be implemented in the Companies	(18)	2.993	Delete
	Flexible and quality service	(19)	3.776	Keep
	Data security system	(20)	4.782	Keep
	System efficiency	(21)	4.573	Keep
People and Management	Support and commitment from the managerial level in the companies	(22)	4.514	Keep
	Assessment of employees' skill level in operating IoT	(23)	3.438	Delete
	Effective communication between employees	(24)	3.482	Delete
	Employee training consistency	(25)	3.641	Keep
	Companies' image and network	(26)	3.366	Delete

Table 4. *Cont.*

Dimension	Sub-Dimension	Number of Sub-Dimension	Geomean Value	Result
Regulations	Government regulations and authorities	(27)	3.565	Keep
	Companies' policy	(28)	4.129	Keep
Resource	The output of IoT devices focused on customer demand	(29)	4.782	Keep
	Project management skills in organizing IoT implementation	(30)	3.949	Keep
	The good relationship between partners and stakeholders	(31)	4.782	Keep
Technology	Technology standardization	(32)	3.949	Keep
	Cooperation with IoT technology service providers	(33)	4.782	Keep
	Internet network Support facilities	(34)	4.782	Keep
	Internet connection	(35)	5.000	Keep
	Backup systems	(36)	4.782	Keep

3.2. Statistic Test

The statistical test is used to determine the consistency of the result on the items contained in the questionnaire. It also uses the reliability test to determine whether measurement results are accurate on the same sample at different times. Furthermore, a reliability test is used to analyze data from research using IBM SPSS software [45]. Table 5 shows the expert panel validation test of five people.

Table 5. Expert Panel Validation Test.

Case Processing Summary		N	%
Cases	Valid	5	100
	Excluded	0	0
	Total	5	100

The test results in Table 4 indicate that the number of expert panelists is five people, and the percentage is 100%. This means that the five expert panelists are valid, and no expert is in the excluded category. From the calculation shown in Table 6, the next step is to test the data's reliability to ensure they are consistent at different times. Table 6 below shows the reliability testing results with the help of IBM SPSS software.

Table 6. Reliability Test.

Cronbach's Alpha	N of Item
0.778	32

Table 6 shows that this study has an acceptable level of reliability at Cronbach's alpha and a total sub-dimension of 0.778 and 32, respectively. These results can be used to conduct further research.

Based on the third Delphi method after getting a consensus among experts, in this study, a total of 8 dimensions and 32 sub-dimensions were identified as CSFs for the implementation of IoT in automotive companies in Indonesia, as follows in Table 7.

Table 7. Critical Success Factors (CSFs) for Implementation of IoT in Automotive Companies, Indonesia.

Dimension	Sub-Dimension	Number of Sub-Dimension
Finance 4 sub-items	System maintenance costs	(1)
	Minimize and streamline costs related to the use and purchase of IoT devices in the companies	(2)
	Factors and the companies' financial situation in making decisions regarding the purchase (upgrade) of IoT devices at the companies	(3)
	Employee training costs	(4)
Innovation and Ideas 9 sub-items	The ability of IoT devices to detect and track problems that occur in the system	(5)
	The compatibility of IoT devices with the companies' operational systems	(6)
	IoT technology and infrastructure integration	(7)
	Timely delivery of information	(8)
	Quality of information (report) displayed from IoT devices	(9)
	Customer support	(10)
	IoT device performance quality	(11)
	Ease of IoT devices that can later be changed and repaired	(12)
	The ability of IoT device components to exchange and use information during the operation	(13)
Marketing 4 sub-items	The level of competition in the companies' external scope	(14)
	The need for the latest market trends	(15)
	Value Proposition	(16)
	Consumer behavior	(17)
Operations 3 sub-items	Flexible and quality service	(18)
	Data security system	(19)
	System efficiency	(20)
People and Management 2 sub-items	Support and commitment from the managerial level in the companies	(21)
	Employee training consistency	(22)
Regulations 2 sub-items	Government regulations and authorities	(23)
	Companies' policy	(24)
Resource 3 sub-items	The output of IoT devices focused on customer demand	(25)
	Project management skills in organizing IoT implementation	(26)
	The good relationship between partners and stakeholders	(27)
Technology 5 sub-items	Technology standardization	(28)
	Cooperation with IoT technology service providers	(29)
	Internet network support facilities	(30)
	Internet connection	(31)
	Backup systems	(32)

Table 7 presents the results of the third round using the Delphi method; two dimensions have reduced sub-dimensions because the geomean value is below 3.5. In the previous operation dimensions, four sub-dimensions become three valid sub-dimensions based on the opinion of the expert panel. Sub-dimension standardization of IoT device architecture reference to be implemented in the companies is deleted. The company has references and priorities for the implementation of IoT in the company. In addition, companies also need to prepare resources and facilities to support the implementation of IoT. The standardization of IoT implementation in each company is different depending on the needs of the company's business processes; this is the reason the sub-dimension standardization of IoT device architecture reference to be implemented in the companies is not included in the successful implementation of IoT in automotive companies.

In the previous people and management dimension based on the Delphi method, there were three sub-dimensions deleted. They are the assessment of employees' skill levels in operating IoT, effective communication between employees, and companies' image and network, based on experts' opinion that the three sub-dimensions are not priorities in automotive companies. IoT interacts with internal activities or the external environment of the company. Companies can monitor their production progress in real-time, as well as be able to analyze historical data obtained in connection with the company's production processes. Therefore, by using IoT technology, companies focus on how IoT technology can drive strategy and generate real ROI (return on investment) for companies [49].

4. Discussion

Companies require proper planning before implementing Industry 4.0 technology to improve their business process activities. Companies need to determine critical success factors to evaluate performance to achieve their goals; hence, IoT implementation can be carried out more effectively and efficiently [50]. The Delphi method is used as a qualitative research approach [51] with expert opinion related to critical decision-making [52] to obtain success factors in the application of IoT in automotive companies in Indonesia. The first stage of this study used the Delphi method to obtain 8 dimensions and 36 sub-dimensions, which are critical success factors. Furthermore, validation was carried out based on the opinion of the expert panel from the round results, resulting in four sub-dimensions being eliminated. In the third round, 32 sub-dimensions and 8 valid dimensions were obtained, which became critical success factors in implementing IoT.

The finance dimension has two relevant sub-dimensions, namely the sub-dimensions of system maintenance and employee training costs. Companies play an essential role in regulating the information system through financial information management. Similarly, the application of financial information management can be carried out using the IoT System. The goal is to avoid financial management risk while improving its information management quality [53]. Companies' solutions in increasing competitive IoT through transitioning traditional business models to product-service systems (PSS) are by evaluating and controlling maintenance costs [54]. Moreover, system maintenance costs can be controlled by examining variable and fixed costs, including additional labor costs (ALC) and the number of machines. Fixed costs consist of device installation cost (DIC), device connectivity cost (DCC), and database and cloud support cost (DCSC) [53,54]. In the further steps, companies need to regularly conduct training to upgrade the skills of their employees and to evaluate and control maintenance costs.

The innovation and ideas dimension has two relevant sub-dimensions, namely the ease of IoT devices that can later be changed and repaired and the ability of IoT device components to exchange and use information during operation. Both are important because the implemented devices are expected to have interconnectivity characteristics with the global information and communication infrastructure [55]. This is in addition to its heterogeneity characteristics, which enable them to interact with other devices or service platforms through different networks. In the further steps, the company must maintain data management because it is a crucial aspect of the Internet of Things. Data management must be interconnected and constantly exchange all types of information needed during the operation process.

The marketing dimension has two relevant sub-dimensions, namely the need for the latest market trends and the value proposition. This is like the previous research [56], which stated that the need for the latest market trends is an influential sub-dimension for companies [57]. Moreover, the companies also look at market desires to promote consumers' perception and behavior on the value proposition to compete with others. In further steps, the company must maintain a value proposition to support the company's business process [38].

The operation dimension has two relevant sub-dimensions, namely data security and system efficiency. Companies conducting business processes need good data management to avoid security risks related to internet users who are replaceable by intruders. Therefore, companies need to implement a data security system using a cyber-physical system to anticipate the risk of corporate data leakage. In the further steps, companies must improve data security and system efficiency. Companies can maintain the main function of establishing IoT is to monitor security, privacy, interoperability, storage management, server technologies, and data-center networking to prevent easy access to information [58]. Authorized people can only gain access to sensitive and confidential data without exposure to unauthorized individuals.

The people and management dimension have two relevant sub-dimensions, namely the support and commitment from the managerial level in the companies and consistent employee training. In the further steps, companies make a framework for performance management and tend to pay more attention to the risks and deficiencies that affect the performance [59] and provide vehicle after-sales services. This is in contrast with automotive companies in Thailand and South Korea, where two factors affect organizational leadership, knowledge management, and intellectual capital [60]. Both are the key factors directly affecting competitiveness through the organizational leadership actions in these two countries.

The regulatory dimension has one relevant sub-dimension, namely company policy through internal and external factors. The internal factors are very influential and supportive in implementing IoT. Meanwhile, the external ones are political, economic, technological, and legal factors that affect the growth of the companies [61]. In the further steps, the company must improve internal factors like communication with the other management to make decisions on IoT in their business units.

The resource dimension has two relevant sub-dimensions, namely the outputs from IoT devices focused on customer demand and the good relationship between partners and stakeholders. Companies engaged in the manufacturing sector need to evaluate the IoT implementation related to their orientation toward socio-environmental sustainability by focusing on the environment and social attributes [62]. However, this contradicts the IoT's success in managing supply-chain sustainability. The four affecting dimensions are customer demand, process stability, supply chain connectivity, and product flexibility [63]. In the further steps, companies must focus on customer demand and on maintaining good relationships between partners and stakeholders with a focus on performance measurement and assessment systems to make absolute decisions in determining the dimensions needed to evaluate the performance of IoT in achieving sustainability.

The technological dimension has one relevant sub-dimension, namely the internet connection. It is important because IoT runs with it; hence, it is always an important tool, followed by its standardization [64]. The technology standardization of companies is different depending on the needs and IoT functions to be implemented. IoT standardization consists of the architecture of the proposed system divided into five parts, which are important in determining the success or failure of companies. These include the patient (sensor) node, IoT communication protocol, IoT server, application server, and node [65]. In the further steps, the company must maintain and monitor the internet connection with no network interruptions to support business processes to ensure effective and efficient company performance.

5. Conclusions

There are eight dimensions of critical success factors obtained in this study on IoT in automotive companies. They are finance, innovation and ideas, marketing, operations, people and management, regulation, resources, and technology. Preliminary research obtained 36 sub-dimensions from each dimension, which were validated by conducting interviews with expert panels from different backgrounds to produce objective results. Furthermore, the Delphi method was used to obtain the critical success factor, and of the 36 come 32 sub-dimensions; four sub-dimensions were eliminated because the geomean value was below 3.5. So, the final result of this study is that the finance dimension has four sub-dimensions, the innovation and ideas dimension has nine sub-dimensions, the marketing dimension has four sub-dimensions, the operations dimension has three sub-dimensions, the people and management dimension has two sub-dimensions, the regulatory dimension has two sub-dimensions, the resource dimension has three sub-dimensions, and the technology dimension has five sub-dimensions.

5.1. Theoretical Contribution

This study has certain theoretical contributions applied to automotive companies in Indonesia. This study has updates related to critical success factors (CSFs) for implementing IoT in automotive companies by collecting data from literature reviews of previous research and interviews with experts. Previous literature discussed the PRIMO-F model consisting of (people, resource, innovation, marketing, and financial dimensions) to support business growth [25], technology dimension [24], and regulation dimension [14,25] to improve business models so that IoT implementation in the company is successful. This study has updated sub-dimensions of the critical success factors for the implementation of IoT in automotive companies; 27 sub-dimensions from the literature are presented in Table 2. This study found nine new sub-dimensions obtained from the results of interviews with a panel of experts. The new sub-dimension from the interviews are (1). value proposition, (2). consumer behavior, (3). system efficiency, (4). employee training consistency, (5). companies' network, (6). companies' image and network, (70. companies' policy, (8). internet connections, and (9). backup systems. The new sub-dimensions are fundamental to the situation and characteristics related to the critical success factors of IoT implementations of automotive companies in Indonesia.

5.2. Managerial Contribution

The managerial contributions of this study first guide and assist managers in determining critical success factors (CSFs) in IoT implementation more clearly. In addition, this study helps managers identify, evaluate, and correct deficiencies of critical success factors (CSFs) to achieve successful IoT implementation in automotive companies. Based on existing results, this study identified 8 dimensions and 32 sub-dimensions that affect the implementation of IoT in the automotive company from a systematic perspective, which helps managers understand critical success factors (CSFs) for the implementation of IoT more clearly and can be used for evaluations in companies and identifies and improves the area resource weakness, thus increasing the possibility successful implementation of IoT in companies.

Second, this study helps managers develop more effective strategies addressing the complexity of using IoT for their business. Companies need to measure the ability to critical success factors (CSFs) so that managers know the critical success factors (CSFs) that need to be improved. Managers create strategies to increase critical success factors (CSFs), including creating projects, periodic evaluations, and change management. Managers need to support and train employees to acquire the necessary digital skills to improve business in companies. Critical success factors (CSFs) for implementation in this study can be used in an industry that has similar characteristics, and the analysis of specific industries will have greater practical significance.

5.3. Limitation and Future Research

This study represents critical success factors (CSFs) for implementing IoT in automotive companies that are based on literature research and interviews with a panel of automotive experts with IoT knowledge in the automotive company in Indonesia. Thus, different contexts, cultural backgrounds, and environmental settings may generate different results in future studies. Further analysis is needed for the factors through an in-depth quantitative approach, such as testing the relationship between factors from the dimensions and sub-dimensions, which have previously been validated by experts through interviews. These results can still be developed for further research by determining the ranking of the dimensions and sub-dimensions of critical success factors. Therefore, a quantitative approach can be used to determine the dimensions and sub-dimensions with the greatest weight.

Author Contributions: Conceptualization, I.M.H. and M.L.S.; methodology, I.K.G.; software, I.M.H.; formal analysis, I.M.H.; investigation, M.L.S. and I.K.G.; resources, I.M.H.; data curation, I.M.H.; writing—original draft preparation, I.M.H., M.L.S. and I.K.G.; writing—review and editing, M.L.S. and I.K.G.; visualization, I.M.H. All authors have read and agreed to the published version of the manuscript.

Funding: This study was funded by PUSLAPDIK and LPDP with grant number 202101121054.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: The authors thankfully acknowledge the financial support provided by the Center for Education Financial Service (PUSLAPDIK) and Indonesia Endowment Fund for Education (LPDP) and also the experts for making valuable suggestions to improve the quality and content of this research.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Matta, P.; Bant, B. Internet of Things: Genesis, Challenges, and Applications. *J. Eng. Sci. Technol.* **2019**, *14*, 1717–1750.
2. Saravanan, G.; Parkhe, S.S.; Thakar, C.M.; Kulkarni, V.V.; Mishra, H.G.; Gulothungan, G. Implementation of IoT in Production and Manufacturing: An Industry 4.0 Approach. *Mater. Today Proc.* **2022**, *51*, 2427–2430. [CrossRef]
3. Wang, B. The Future of Manufacturing: A New Perspective. *Engineering* **2018**, *4*, 722–728. [CrossRef]
4. Seeger, P.M.; Yahouni, Z.; Alpan, G. Literature Review on Using Data Mining in Production Planning and Scheduling Within The Context Of Cyber-Physical Systems. *J. Ind. Inf. Int.* **2022**, *28*, 100371. [CrossRef]
5. Lu, Y. Industry 4.0: A Survey on Technologies, Applications, and Open Research Issues. *J. Ind. Inf. Int.* **2017**, *6*, 1–10. [CrossRef]
6. Qi, Q.; Tao, F. Digital Twin and Big Data Towards Smart Manufacturing and Industry 4.0: 360 Degree Comparison. *IEEE Access* **2018**, *6*, 3585–3593. [CrossRef]
7. Kemenperin: Industri 4.0 Solusi Peningkatan Daya Saing Indonesia. Available online: https://kemenperin.go.id/artikel/17432/Industri-4.0-Solusi-Peningkatan-Daya-Saing-Indonesia (accessed on 24 September 2022).
8. Kahveci, S.; Alkan, B.; Ahmad, M.H.; Ahmad, B.; Harrison, R. An end-to-end Big Data Analytics Platform For Iot-Enabled Smart Factories: A Case Study of Battery Module Assembly System For Electric Vehicles. *J. Manuf. Sys.* **2022**, *63*, 214–223. [CrossRef]
9. Nižetić, S.; Šolić, P.; López-de-Ipiña González-de-Artaza, D.; Patrono, L. Internet of Things (IoT): Opportunities, Issues, and Challenges Towards A Smart and Sustainable Future. *J. Clean. Prod.* **2020**, *274*, 122877. [CrossRef]
10. Singh, J.; Ahuja, I.P.S.; Singh, H.; Singh, A. Development and Implementation of Autonomous Quality Management System (AQMS) in Automotive Manufacturing using Quality 4.0 Concept– A Case Study. *Com. Ind. Eng.* **2022**, *168*, 108121. [CrossRef]
11. Rahim, M.A.; Rahman, M.A.; Rahman, M.M.; Asyhari, A.T.; Bhuiyan, M.Z.A.; Ramasamy, D. Evolution of IoT-enabled Connectivity and Applications in The Automotive Industry: A review. *Veh. Commun.* **2021**, *27*, 100285. [CrossRef]
12. Ghadge, A.; Mogale, D.G.; Bourlakis, M.; Maniraj Maiyar, L.; Moradlou, H. The Link Between Industry 4.0 and Green Supply Chain Management: Evidence from The Automotive Industry. *Com. Ind. Eng.* **2022**, *169*, 108303. [CrossRef]
13. Koohang, A.; Sargent, C.S.; Nord, J.H.; Paliszkiewicz, J. Internet of Things (IoT): From awareness to continued use. *Int. J. Inf. Man.* **2022**, *62*, 102442. [CrossRef]
14. Lee, I.; Lee, K. The Internet of Things (IoT): Applications, Investments, and Challenges For Enterprises. *Bus. Horiz.* **2015**, *58*, 431–440. [CrossRef]
15. Westerlund, M.; Leminen, S.; Rajahonka, M. Designing Business Models for the Internet of Things. *Tech. Innov. Man. Rev.* **2014**, *4*, 5–14. [CrossRef]
16. Sharma, M.; Joshi, S.; Kannan, D.; Govindan, K.; Singh, R.; Purohit, H.C. Internet of Things (IoT) Adoption Barriers Of Smart Cities' Waste Management: An Indian Context. *J. Clean. Prod.* **2020**, *270*, 122047. [CrossRef]
17. Kumar, S.; Luthra, S.; Haleem, A.; Mangla, S.K.; Garg, D. Identification and Evaluation of Critical Factors to Technology Transfer Using The AHP Approach. *Int. Strateg. Manag. Rev.* **2015**, *3*, 24–42. [CrossRef]

18. Gupta, A.; Singh, R.K.; Suri, P.K. Prioritizing Critical Success Factors for Sustainable Service Quality Management by Logistics Service Providers. *Vision* **2018**, *22*, 295–305. [CrossRef]
19. Zhang, X.; Xu, Y.; Ma, L. Research on Successful Factors and Influencing Mechanism of the Digital Transformation in SMEs. *Sustainability* **2022**, *14*, 2549. [CrossRef]
20. Fui-Hoon Nah, F.; Lee-Shang Lau, J.; Kuang, J. Critical factors for Successful Implementation of Enterprise Systems. *Bus. Process Manag. J.* **2001**, *7*, 285–296. [CrossRef]
21. Pacagnella, A.C.; da Silva, S.L.; Pacífico, O.; de Arruda Ignacio, P.S.; da Silva, A.L. Critical Success Factors for Project Manufacturing Environments. *Proj. Man. J.* **2019**, *50*, 243–258. [CrossRef]
22. Tran, T.M.T.; Yuen, K.F.; Li, K.X.; Balci, G.; Ma, F. A Theory-Driven Identification and Ranking of The Critical Success Factors of Sustainable Shipping Management. *J. Clean. Prod.* **2020**, *243*, 118401. [CrossRef]
23. Afolabi, A.; Ibem, E.; Aduwo, E.; Tunji-Olayeni, P.; Oluwunmi, O. Critical success factors (CSFs) for e-Procurement Adoption in The Nigerian Construction Industry. *Buildings* **2019**, *9*, 47. [CrossRef]
24. Wan, J.; Zeng, M. Research on Key Success Factors Model for Innovation Application of Internet of Things with Grounded Theory. In Proceedings of the Fourteen Wuhan International Conference on E-Business, Wuhan, China, 19 June 2015. Available online: https://aisel.aisnet.org/cgi/viewcontent.cgi?article=1047&context=whiceb2015 (accessed on 20 October 2022).
25. Kiba-Janiak, M. Key Success Factors for City Logistics from the Perspective of Various Groups of Stakeholders. *Transp. Res. Procedia* **2016**, *12*, 557–569. [CrossRef]
26. Kumar, R.; Singh, R.K.; Shankar, R. Critical Success Factors for The Implementation of Supply Chain Management In Indian Small And Medium Enterprises And Their Impact On Performance. *IIMB Manag. Rev.* **2015**, *27*, 92–104. [CrossRef]
27. Peter, K. 6 Factors Crucial to The Success of Industrial. Available online: www.dxc.technology/manufacturing (accessed on 9 September 2022).
28. Sony, M.; Naik, S. Critical Factors for the Successful Implementation of Industry 4.0: A Review and Future Research Direction. *Prod. Plan. Control.* **2020**, *31*, 799–815. [CrossRef]
29. Hankel, M. The Reference Architectural Model INDUSTRIE4.0 (RAMI4.0).” ZWEI: Die Elektroindustrie. 2015. Available online: https://www.zvei.org/fileadmin/user_upload/Presse_und_Medien/Publikationen/2016/januar/GMA_Status_Report__Reference_Archtitecture_Model_Industrie_4.0__RAMI_4.0_/GMA-Status-Report-RAMI-40-July-2015.pdf (accessed on 12 September 2022).
30. Flatt, H.; Schriegel, S.; Jasperneite, J.; Trsek, H.; Adamczyk, H. Analysis of the Cyber-Security of Industry 4.0 Technologies Based on RAMI 4.0 and Identification of Requirements. In Proceedings of the IEEE 21st International Conference on Emerging Technologies and Factory Automation (ETFA), Berlin, Germany, 6–9 September 2016.
31. Attaran, M. Critical Success Factors and Challenges of Implementing RFID in Supply Chain Management. *J. Supply Chain. Oper. Manag.* **2012**, *10*, 144–167.
32. Denolf, J.M.; Trienekens, J.H.; Wognum, P.M.; Van Der Vorst, J.G.A.J.; Omta, S.W.F. Towards A Framework of Critical Success Factors for Implementing Supply Chain Information Systems. *Comp. Ind.* **2015**, *68*, 16–26. [CrossRef]
33. Finney, S.; Corbett, M. ERP Implementation: A Compilation and Analysis of Critical Success Factors. *Bus. Process Manag. J.* **2007**, *13*, 329–347. [CrossRef]
34. Gandhi, S.; Mangla, S.K.; Kumar, P.; Kumar, D. Evaluating Factors in The Implementation of Successful Green Supply Chain Management Using DEMATEL: A Case Study. *Int. Strateg. Manag. Rev.* **2015**, *3*, 96–109. [CrossRef]
35. Carolina, S.; Alias, S. Critical Success Factors for Digital Manufacturing Implementation in the Context of Industry 4. In Proceedings of the 2017 Industrial and Systems Engineering Conference, Pittsburgh, PA, USA, 20–23 May 2017.
36. Huang, S.Y.; Chiu, A.A.; Chao, P.C.; Arniati, A. Critical Success Factors in Implementing Enterprise Resource Planning Systems for Sustainable Corporations. *Sustainability.* **2019**, *11*. [CrossRef]
37. Talib, M.S.A.; Hamid, A.B.A.; Thoo, A.C. Critical Success Factors of Supply Chain Management: A Literature Survey and Pareto Analysis. *Europe. J. Bus.* **2015**, *10*, 234–263. [CrossRef]
38. David, H. Value Propositions for the Internet of Things: Guidance for Entrepreneurs Selling to Enterprises. *Tech. Innov. Man.* **2017**, *7*, 5–11.
39. Khazaei, H.; Chng, K.; Shameer, K.; Bin, S. The Application of IoT to Study Consumer Behaviour and Decision-Making Process. *Int. J. Adv. Sci. Compt. Eng.* **2022**, *4*, 188–192. [CrossRef]
40. Janiesch, C.; Koschmider, A.; Mecella, M.; Weber, B.; Burattin, A.; Di Ciccio, C.; Fortino, G.; Gal, A.; Kannengiesser, U.; Leotta, F.; et al. The Internet of Things Meets Business Process Management: A Manifesto. *IEEE Syst. Man Cybern. Mag.* **2020**, *6*, 34–44. [CrossRef]
41. Park, K.; Kim, S.; Yun, J.; Lim, S.; Park, K. Flex-IoT: Secure and Resource-Efficient Network Boot System for Flexible-IoT Platform. *Sensors* **2021**, *21*, 2060. [CrossRef] [PubMed]
42. Grisham, T. The Delphi technique: A method for testing complex and multifaceted topics. *Int. J. Manag. Proj. Bus.* **2009**, *2*, 112–130. [CrossRef]
43. Hsu, C.; Sandford, B. The Delphi Technique: Making Sense of Consensus. *Pract. Assess. Res. Eval.* **2007**, *12*, 10.
44. Chen, D.C.; Chen, D.-F.; Huan, J.-M.; Syr, W.-J.; Chiou, C.-F. Critical Success Factors to Improve the Business Performance of Tea Drink Chains. *Sustainability* **2021**, *13*, 8953. [CrossRef]

45. Cresswell, J.W. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, 3rd ed.; SAGE Publications Inc.: Thousand Oaks, CA, USA, 2009.
46. Dey, I. *Qualitative Data Analysis: A User-Friendly Guide for Social Scientists*; Routledge: New York, NY, USA, 2005.
47. Miles, M.B.; Huberman, M.; Saldana, J. *Qualitative Data Analysis: A Methods Sourcebook*, 3rd ed.; SAGE Publications Inc.: Thousand Oaks, CA, USA, 2014.
48. Tersine, R.J.; Riggs, W.E. The Delphi Technique: A Long-Range Planning Tool. *Bus. Horiz.* **1976**, *19*, 51–56. [CrossRef]
49. Houston, C.; Goorbeman-Hill, S.; Mathie, R.; Kennedy, A.; Li, Y.; Baiz, P. Case Study for the Return on Investment of Internet of Things Using Agent-Based Modelling and Data Science. *Systems* **2017**, *5*, 4. [CrossRef]
50. Zhang, S.; Li, Z.; Ma, S.; Li, L.; Yuan, M. Critical Factors Influencing Interface Management of Prefabricated Building Projects: Evidence from China. *Sustainability* **2022**, *14*, 5418. [CrossRef]
51. Hallowell, M.R.; Gambatese, J.A. Qualitative Research: Application of the Delphi Method to CEM Research. *J. Constr. Eng. Manag.* **2010**, *136*, 99–107. [CrossRef]
52. Clayton, M.J. Delphi: A Technique to Harness Expert Opinion for Critical Decision-making Tasks in Education. *Educ. Psychol.* **1997**, *17*, 373–386. [CrossRef]
53. Liu, Y. Design of Financial Information Management System and IoT Application Based on Fuzzy Comprehensive Evaluation. *Wireless. Comm. Comput.* **2022**, *2022*, 2483306. [CrossRef]
54. Osako, L.F.; Matsubayashi, M.O.; Takey, S.M.; Cauchick-Miguel, P.A.; Zancul, E. Cost Evaluation Challenges for Internet of Things (IoT) Based Product/Service-Systems (PSS). *Procedia CIRP* **2019**, *84*, 302–306. [CrossRef]
55. Patel, K.K.; Patel, S.M.; Scholar, P.G. Internet of Things-IOT: Definition, Characteristics, Architecture, Enabling Technologies, Application & Future Challenges. *Int. J. Eng. Sci. Comput.* **2016**, *6*, 6122–6131.
56. Hakim, I.M.; Singgih, M.L.; Gunarta, I.K. Critical Success Factors for The Implementation of Internet of Things (IoT) in Automotive Companies: A Literature Review. In Proceedings of the 11th Annual International Conference on Industrial Engineering and Operations Management, Singapore, 7–11 March 2021.
57. Tseng, M.L.; Lin, C.W.R.; Sujanto, R.Y.; Lim, M.K.; Bui, T.D. Assessing Sustainable Consumption in Packaged Food in Indonesia: Corporate Communication Drives Consumer Perception and Behavior. *Sustainability* **2021**, *13*, 8021. [CrossRef]
58. Yacob, A. A Review of Internet of Things (IoT): Implementations and Challenges. *Int. J. Adv. Trends Comput. Sci. Eng.* **2020**, *9*, 373–376. [CrossRef]
59. Lascu, E.; Severin, I.; Lascu, F.D.; Gudana, R.A.; Nalbitoru, G.; Ignat, N.D. Framework on Performance Management in Automotive Industry: A Case Study. *J. Risk Financ. Manag.* **2021**, *14*, 480. [CrossRef]
60. Shvetsova, O.A.; Tanubamrungsuk, P.; Lee, S. Organization Leadership in the Automobile Industry: Knowledge Management and Intellectual Capital. *Open Transp. J.* **2021**, *15*, 16–30. [CrossRef]
61. Bin, I.; Albulushi, A.; Jaza'a Irtaimah, H.; Al-Khasawaneh, M.M. The Impact of ExterIoT Environment Factors on Business Continuity Management to Promoting the Higher Education Excellence in Oman. *Eur. J. Sci. Res.* **2020**, *56*, 327–340.
62. Cavalieri, A.; Reis, J.; Amorim, M. A Conceptual Model Proposal to Assess the Effectiveness of IoT in Sustainability Orientation in Manufacturing Industry: An Environmental and Social Focus. *Appl. Sci.* **2022**, *12*, 5661. [CrossRef]
63. Pimsakul, S.; Samaranayake, P.; Laosirihongthong, T. Prioritizing Enabling Factors of IoT Adoption for Sustainability in Supply Chain Management. *Sustainability* **2021**, *13*, 12890. [CrossRef]
64. Zorkany, M.; FaIoT, K.; Yahya, A. Performance Evaluation oIoTot Messaging Protocol Implementation for E-Health Systems. *Int. J. Adv. Comput. Sci. Appl.* **2019**, *10*, 412–419.
65. Kalmar, E.E.; Kertesz, A. Investigating operational costs of IoT cloud applications. *Comput. Sci. Soc. Telecommun. Eng.* **2018**, *189*, 141–150.