The Design of IoT-based Business Process for SME Digital Transformation: A Case of Unofficial Car Service Workshop

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Abstract

The Internet of Things (IoT) offers innovation processes that transform industry, finance, healthcare, agriculture, hospitality, and other sectors through process automation. Integrating IoT into business processes will transform an organization for better time, cost efficiency, and customer satisfaction. While the advantages of adopting IoT in the business process are widespread, the precise guidelines for implementing IoT for SMEs are limited. SMEs often do not recognize the potential of digital transformation and do not receive the necessary assistance to undertake critical development activities. This paper addresses this issue by focusing on IoT solutions for a car service workshop as an SME. This study aims to analyze the current business processes and design an IoT-based business process model for a car service workshop. The system development life cycle was adopted partially to design IoT-based business processes. The proposed business process model is designed with Business Process Modeling Notation to minimize time, effort, and cost inefficiencies. The concept and design of IoT systems were validated by managers, mechanics, and customers of some car service workshops. The managers perceived the transformation of car service using IoT as innovative, potentially increasing their business competitiveness. The respondents suggested the implementation was executed gradually because of human resource readiness and investment costs. The mechanics believed this IoT system was necessary to enhance the competitiveness of unauthorized car service workshops and their work as mechanics. Customers appreciated the proposed systems because of the shorter service time, the new experience, and the assurance. Technology, cost assessment, implementation stages, and key performance indicators are discussed. The proposed design of an IoT-based business process could become the guideline for car service workshops to transform the business into Industry 4.0. era.

Keywords: Business Model, BPMN, Automotive, IoT, SME

1. Introduction

The role of technology in industrial development is described in the stages of the Industrial Revolution, namely Industry 1.0 to Industry 4.0. Industry 4.0 is primarily associated with the interconnection of sensors, social networks, the Internet, and computer software, which create processes and deliver information with added value in real-time [1]. Industry 4.0 is characterized by automation that utilizes Internet of Things (IoT) systems to run business processes. The application of IoT in an industry that integrates machines, devices, data, and information systems is often called the Industrial Internet of Things (IIoT). A survey study established that integrating IIoT in SMEs improves organizational performance [2]. However, IIoT adoption among SMEs is still low. The generic term IoT is more popular than IIoT; therefore, the remainder of this paper will use IoT.

IoT is an environment where everything, whether human, animal, or non-animal, has a unique Internet Protocol (IP) capable of detecting, controlling, sending, and transmitting data to others and their respective databases [3]. In a simple definition, IoT is a network of interconnected devices that can communicate with each other and perform a wide range of functions. IoT consists of sensors (e.g., camera, RFID, and GPS sensors) and actuators (e.g., LEDs, DC motors, servos, and others). Each device in an IoT network is connected to sensors that send and receive data from nearby devices. IoT works by connecting via a network, collecting data from sensors, and sending the data to the cloud. The cloud will process the data, including entering the data into a database and making decisions. The data will be processed and sent back to the actuators by commands.

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The potential benefits of implementing IoT in an organization will emerge when the IoT technology is integrated with the information systems to improve business processes. Information systems play an essential role in organizational survival in the era of digitalization [4]. Implementing Information Systems in business may extend from one functional application software to a complex Enterprise Resources Planning (ERP) package. By integrating information systems with IoT, devices related to business processes, such as RFID, sensors, and actuators, can take direct responsibility for specific process tasks. [5]. The absence of this integration makes organizations lose opportunities to streamline their business processes.

A systematic review summarized that implementing IoT impacts SMEs' performance in emerging economies [6]. While the advantages of adopting IoT in business processes are widespread, the precise guidelines for implementing IoT for SMEs are limited. SMEs often do not immediately recognize the potential of digital transformation and do not receive the necessary assistance to undertake critical development activities [7]. If SMEs do not adopt new technologies such as IoT to optimize their businesses, provide better products and services, and reach customers more effectively, they will fall behind the competition. This paper addresses this issue by focusing on IoT solutions for SMEs.

Adopting technological innovation, such as ERP or IoT, will change business activities or processes. The change in business processes could change the business model (e.g., e-commerce) as an essential concept in information systems [8]. The business model defines how an organization creates and captures value [9]. The limited literature on IoT-based business models for SMEs might come from the limited IoT solutions for SMEs [10]. This industrial problem requires IoT solutions that change SME business activities, processes, or models. This study addresses the problem by designing IoT-based business processes for SMEs.

IoT has been implemented in various sectors, such as the automotive industry, agriculture, health care, and environmental monitoring [11]. In the automotive industry, IoT is implemented in everything from car manufacturing to automotive services. The implementation of IoT in the automotive sector is widely documented, including linked automobile and automated transportation systems [12], smart automobile parking systems [13], smart garages [14], and vehicle tracking systems [15]. In automotive maintenance systems, opportunities are focused on predictive maintenance, which provides more benefits than periodic maintenance of vehicles [16]. Predictive maintenance adopts machine learning approaches to predict the need for maintenance based on the current status of some devices monitored. It applies to contemporary vehicles with substantial operational data; machine learning can subsequently analyze the data and propose maintenance requirements [17].

The literature lacks documentation of IoT adoption in car service workshops, especially in Indonesia. A prior study indicated that the application of IoT in automotive companies in Indonesia shows specific characteristics that are different from those in other countries [18]. The IoT implementation is likely to be industry-specific and country-specific due to the specific applications for different business environments. Large and modern companies in Indonesia may have the resources to implement ERP and IoT integration, but small and medium enterprises (SMEs) face limited resources. Car service workshops are mostly SME-sized unofficial car services because they do not belong to automakers such as Honda, Toyota, Hyundai, or Mercedes. Those car workshops could deploy IoT in less complex applications. This study focuses on IoT applications in car service workshops.

Unofficial car workshops generally implement limited information systems. Those businesses could gain a competitive advantage by transforming their business process, supported by information systems integrated with IoT. Implementing the integration of information systems and IoT among SMEs might be considered unaffordable, expensive, and complicated. This study departs from the argument that integrating information systems and IoT suits SMEs. This concern leads this study to provide a case for designing a business process model with an information system integrated with IoT for a car service workshop.

The objectives of this study are:

1) to analyze the current business processes of an unofficial car service workshop

2) to design an IoT-based business process model for an unofficial car service workshop

3) to discuss the technical aspects and costs to implement the proposed business process model.

The result provides a new opportunity to improve business processes more efficiently by utilizing affordable integrated IoT and Information Systems. The urgency of this study is that the subsequent implementation of the proposed business process model could help SME car service workshops gain a competitive advantage.

The remainder of this paper is structured as follows: Section 2 describes the methods. Then, Section 3 presents the analysis of the current business process, the proposed IoT-based business process, technological aspects, investment costs, validation, and some issues in the implementation plan. Finally, Section 4 describes the implications, limitations, and further studies.

2. Method

The problem and object addressed can be viewed as a system containing business processes, hardware, software, and people that work together to satisfy customer needs. Therefore, this study adopts the System Development Life Cycle (SDLC) methodology. SDLC is defined as "the overall process of developing, implementing, and retiring information systems through a multistep process from initiation, analysis, design, implementation, and maintenance to disposal." [19]. The term SDLC is often used for the Software Development Life Cycle, which refers to developing software applications or programs. In contrast, the system development life cycle refers to a system that may include hardware, software, networks, processes, people, and data. As its name suggests, SDLC refers to the 'development' of an information system, but this term could be extended to acquiring an information system by modifying SDLC stages [20]. This study partially follows the SDLC initiation, analysis, and design steps. The detailed research steps are presented in Figure 1.

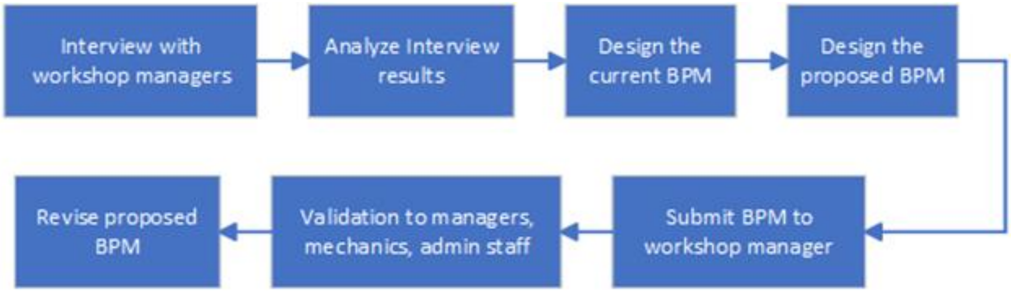

Figure 1. Research methods

This study interviewed the owner/manager of a car service workshop in Semarang. The interview aimed to identify the current business process in the workshop, covering the activity from when a customer arrives until the customer leaves the workshop after the car service is completed. Then, this study works on designing and analyzing the current business process. Analyzing the current business processes is the first step for an organization to implement integrated IoT and information systems for business process transformation. A business process comprises a set of interrelated and organized activities or tasks that generate a distinct service or product for a specific customer. These activities must be modeled or mapped to make it easier to analyze business processes. Business process modeling helps analyze existing business processes. Various business process modeling techniques are used in business process management, software engineering, or industrial engineering, such as Business Process Modeling Notation (BPMN) or Unified Modeling Language (UML) [21]. BPMN is a notation standard used to display a business process as an activity node connecting from the start node to the end node [22]. BPMN defines the notation and semantics of process, collaboration, and choreography diagrams [23]. Process diagrams model a business process as a sequence of activities. Collaboration diagrams are extensions of process diagrams that can be used to model the interaction between two or more business processes. Finally, choreography diagrams are used to model message interactions between participants. BPMN has become the factual standard for modeling business processes in IoT [24], [25]. This study created business process models using the BPMN 2.0 standard. The software tools used for creating the models are Lucidchart, a web-based diagramming application, and Bizagi Modeler, process mapping and modeling software.

As shown in Figure 1, the next step is to design a new business process based on IoT and information systems. Next, the business model proposal is submitted to the car service workshop manager to obtain responses and input considering the workshop limitations. The business process model is then revised. Furthermore, the proposed business process model is validated for workshop managers, mechanics, and customers in Surabaya and Semarang. Finally, the proposed business process model is revised.

3. Result

This section describes the analysis of the current business process, the proposed IoT-based business process, technology aspects, investment cost, validation, and implementation plan.

3.1. Analysis of Current Business Process

Based on the information from interviews and observation, a business process model for the car service process was developed. Figure 2 presents a car service process crossing four lanes of function: customer, service advisor, admin staff, and mechanics. First, a customer could make a reservation with admin staff by telephone or at the workshop. The admin staff enters data about the car and the customer. When a customer comes to service the car, a service advisor will serve him/her.

The service advisor will perform the car-checking process. The output of the checking is passed to the admin staff. Next, the admin staff will estimate service cost and present it to the customer. The customer approves the estimated cost, and then the admin staff will check the availability of spare parts in the warehouse. If the spare parts are not in stock, the admin staff will create a spare part order form and present it to the customer for approval. In this condition, the service process will be postponed till the order is fulfilled.

A mechanic will repair the car according to the queue if all required spare parts are in stock. After repairs, the mechanic will drive and test the vehicle on roads in the area. Testing can be carried out on toll roads depending on the required test for the newly repaired/replaced parts. After the service process, the customer will receive a notification that the service has been completed. The customer then makes a payment to the cashier. After the entire transaction process is completed, the service advisor will prepare the car, and the business process is closed with the customer leaving the workshop, as shown by the right end of Figure 2.

Analysis of the business process model in Figure 2 found several activities that could be improved. The primary improvement is to transform manual processes using technology. Manual activities include recording car reception, inspecting the car body, recording damaged parts, and checking spare parts stock. Therefore, this paper proposes modifying current business processes by implementing information systems integrated with IoT.

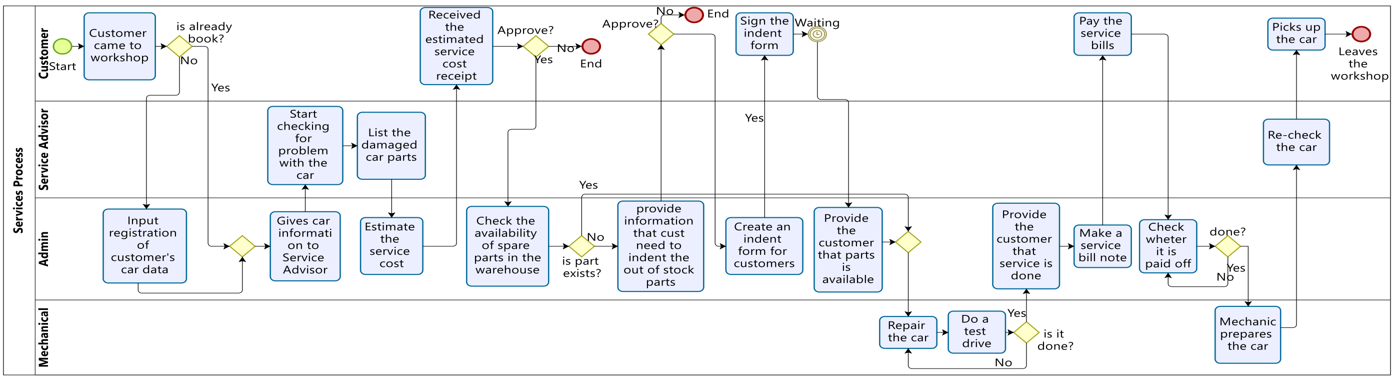

Figure 2. Current business process model

3.2. Design of Proposed Business Process Model

Based on the existing business process analysis, the IoT-based business process was conceptualized and drawn using BPMN, as shown in Figure 3. The three lanes from the existing business process model are retained: customer, sales advisor, and mechanic. The admin lane is substituted by four lanes: IoT devices, cloud, ERP systems, and databases for process automation. In this context, an ERP system refers to a fully or partially integrated information system. The IoT-related technologies required and their functions are as follows:

1) The camera sensor captures the customer's car license plate and converts it into a string data type.

2) Machine learning is used to process images into strings.

3) RFID is used to get an ID from the service advisor so that each car has a person in charge from the workshop.

4) The GPS sensor tracks the car's location during service, especially the drive testing outside the workshop.

5) The cloud is a medium for sending data from IoT devices to the database.

6) A centralized database is needed to support the information system.

7) The information system will include several features supporting the digitalization process of the car repair workshop.

Referring to Figure 3, when the car arrives at the workshop, the camera sensor will scan and capture the image of the vehicle registration number. Machine learning processes images and converts them into string data types. The data is sent to the cloud and then to the ERP system to get information about the car and the customer who made the online reservation. After the car data is obtained, the service advisor, as the person in charge of the service, will take over the car by tapping his/her ID card equipped with RFID. The RFID sensor will capture the data from the card and send it to the cloud. The cloud will then input it into the database. The service advisor then places the GPS sensor in the customer's car.

As shown in Figure 3, the service advisor will check any damaged parts on the vehicle and then input the data into the ERP system. The system will inform the spare parts needed. The ERP system will automatically estimate service costs and search for spare parts availability through a centralized database. The information on estimated service cost will be sent to the customer's smartphone application. The customer reviews the information and confirms whether he/she agrees to have the car serviced.

After the customer confirms, the service process begins with the Service Advisor inviting a mechanic to carry out the service process. Once the service has been completed, the car may need a test drive on the roads or highways. During the test drive, a GPS sensor as a part of IoT devices will play an essential role in car security. The device will send real-time signals in latitude and longitude coordinates so that tracking can occur wherever the vehicle goes.

If the entire service process has been completed, the service advisor will update the service status as complete. Customers will receive a notification on their smartphone that the service process has been completed. Next, the customer must pay via the application, and the system will periodically check whether the customer has made it. If so, the service advisor will receive a notification and prepare the serviced car for the customer. The car service business process ends when the customer leaves the workshop.

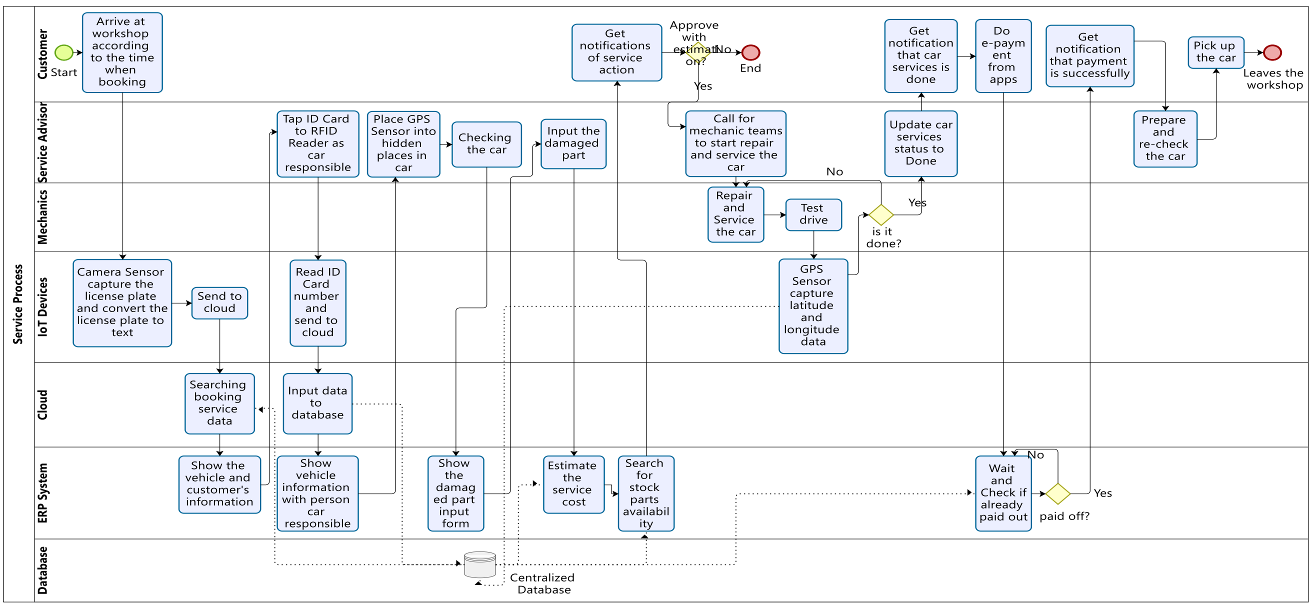

Figure 3. Proposed business process model

Table 1 compares the existing and proposed business processes, including eight processes from service booking to payment. Current activities rely on human action supported partially by information systems, such as searching car data from a database on a personal computer. Proposed activities rely heavily on technology, including RFID, GPS, databases, an online booking application, and an online payment application. The proposed activities indicate that integrating IoT technologies and ERP systems could enable business process automation in a car service workshop.

Table 1. Comparison of existing and IoT-based business process

Process	Existing activities	Proposed activities
Booking	The booking service is carried out on-site and via telephone.	Cars that come to the workshop are guaranteed to have booked online.
Acquire car and customer data	Recording and searching for car data based on the car's license plate is done manually.	Searching for car and customer data based on car license plates is performed automatically by technology and systems.
Show car and customer data	Make a note on the service action submission form.	The system will display car and customer data automatically based on the data provided when booking online.
The person in charge of the car	The person in charge of the car still uses a manual card attached to the car.	The recording of the person in charge of the car uses RFID technology and is automatically stored in the database.
Estimated service cost form	Write a list of damaged parts and spare parts needed, then find the price of each price to calculate the estimated price manually.	Input the damaged part and its replacement parts; then, the system will calculate the estimated service costs and look for spare parts stock availability in the warehouse parts database.
Test drive security	There is no safety system when a mechanic tests the car.	GPS sensors transmit latitude and longitude data wherever the vehicle passes.
Notification	Search or call for the customer manually	Get a notification for service status on the customer's smartphone
Payment	Manual payment	e-Payment from apps

The IoT-business process model was presented to the workshop manager to obtain feedback. The manager was impressed with this technological solution and intended to implement it if the investment costs were affordable.

3.3. Technology

The development of IoT-based business processes requires technology components. This study focuses on IoT solutions for SMEs, so the costs must be affordable. Table 2 presents the technology components in four categories: gate automation, RFID, GPS sensor, and computer/accessories. Devices for each component are presented with their specifications, estimated costs, and functions. In Table 2, the gate automation section deals with the car's reception to the workshop. The GPS sensor is related to the car tracking function during a test drive. The bottom of the table shows that the estimated cost of building an IoT system is $776.

Table 2. IoT components

Devices	Specifications	Estimated costs*	Functions
Gate Automation			
Single-Board Computer Raspberry Pi 4 Model B RAM 4 GB	5V/3A (15W)	$100	As a computer that captures sensor data, sends data to the cloud, and gives a command to actuators.
Power Supply Switching	12V/10A (120W)	$10	To supply electrical power to the DC Motor via Motor Driver (L298N)
Motor Driver L298N	20W	$2	To drive a dynamo motor to open the gate

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Servo high Metal 80 kg DS5180SSG	6V-8.4V	$40	To open and close the gate with rotation based on the command of how many degrees are sent by the microcontroller
Camera Module IMX477R Sony	1.05V-2.8V	$80	To capture the license plate
RFID			
Arduino UNO R3 ATMEGA328P-PU	7V-12V	$4	As a computer to capture card ID from RFID Module
RFID Module MFRC-522	5V	$1	As a module to read the card
RFID Card Mifare Series	-	$1	As an ID card that each Service Advisor have
GPS Sensor			
Arduino UNO R3 ATMEGA32P-PU	7V-12V	$4	As a computer to capture latitude and longitude from GPS Sensor NEO-6M
Module GPS Neo 7M	3.3V-5V	$7	As a GPS module to capture latitude and longitude
Module SIM 800L	3.7V-5V	$8	As GSM Cellular data to send data over the Internet
Battery to DC port converter		$1	As wiring to supply the power to Arduino from a battery
Computer and Accessories			
Personal Computer	i5-Gen13, RAM 16 GB, SSD 250 GB, HDD 4 TB	$500	To manage all IoT devices and store sensor data
Electric socket and cable	Four-hole socket and three-phase cable	$10	As Power Supply for IoT devices
Jumper Cable Male to Female, Male to Male, Female to Female	15cm 1 set (40 pcs each set)	$3	To connect Microcontroller / Single-Board Computer to Sensor Module or Actuators
Breadboard MB-102 (3 pcs for System Gate, RFID, and GPS Sensor)	830 dots	$3	To build a semi-permanent prototype
Resistor 600 pcs	¼ W (30 Ω)	$2	To adjust signal levels
	Total	**$776**	

Note: *Estimated costs are in the Indonesian context.

The next technological aspect is the choice of servers to host the information system. Some alternative methods should be identified, analyzed, and evaluated to reach the best proposed method. The information system could be hosted in-house or on cloud servers. The cloud server applies the IoT-integrated information system using a third-party vendor that provides servers, hosting, and data delivery protocols. Conversely, the in-house server uses a local (on-premise) server.

Furthermore, Table 3 presents the estimated cost comparison for in-house and cloud servers. The in-house server requires a one-time purchase of the local server package, while the cloud server type requires a yearly subscription for IoT hub and server hosting.

Table 3. Cost Comparison of in-house vs. cloud server

Cost component	Estimated Cost*	In-house server	Cloud server
Local server package	$6250 (lifetime)	√	-
IoT Hub (Azure Cloud)	$300 (per year)	-	√
Server Hosting	$70 (per year)	-	√

Note: *Estimated costs are in the Indonesian context.

The server type selection should include technology, business process, life cycle risk, and investment cost that suit the organization's characteristics. In car service workshops, in-house and cloud servers have advantages and disadvantages, as presented in Table 4.

Table 4. Comparison of in-house vs. cloud server

Aspect	In-house server	Cloud server
Advantages	- Able to create the own system that overcomes limitations. - Have complete control over data and server features. - Able to directly control and maintain server conditions.	- The vendor guarantees system security. - Rapid technological development and innovation. - The service provider vendor carries out all maintenance.
Disadvantages	- High investment costs. - Require IT experts for server maintenance.	- Require additional costs for another future system. - Dependency on the server provider.
Cost	- High	- Moderate
Risk	- Moderate	- High
Time scale	- Very high	- Moderate

In-house servers, as internally managed servers, have the advantage of being able to design systems and fully control local server management. Additionally, organizations can carry out maintenance and monitor server conditions directly to take action to correct problems that arise immediately. The disadvantage of this type is the enormous investment costs, especially the purchase of server equipment, including computers, server cabinets, routers, and ethernet cables. The cost of hiring an IT specialist to maintain and run the server and network should be included.

As the second option, the cloud server offers data security that is already part of the system owned by the server service provider. Service providers compete with other providers to offer the latest technology to attract clients. Another advantage is that any errors by the server service will be fully repaired by the server service provider so that the car workshop does not need to carry out server maintenance. The downside of this type is the additional costs if the organization uses certain features provided by the service provider. Dependence on server service providers can increase that vendor's bargaining power in the long term. As a result, subscription fees and other costs may increase.

In addition to the advantages and disadvantages, Table 4 summarizes the cost, risk, and time scale parameters. In-house server options are more expensive than cloud servers, especially the initial investment costs. Besides, in-house servers will have long-term durability compared to cloud servers because of their flexibility. Choosing a cloud server is considered a higher risk because a third party owns it. This vendor-related risk is known as vendor lock-in, which is recently popular in the cloud computing area. Vendor lock-in is a situation when customers heavily depend on specific cloud providers for various reasons, such as technical aspects, contractual conditions, or other factors [26]. Vendor lock-ins appear in various types, such as pricing, data hostage, flexibility, and renewal lock-ins [27]. This condition prevents customers from switching to another vendor without significant change costs. Car workshops should carefully evaluate the vendor's reputation and use of open standards to avoid vendor lock-in problems.

A discussion with the car workshop manager was conducted to obtain his response on the IoT solution and the more suitable server type. The management stated that implementing this system could be very helpful in carrying out business processes in the workshop because it would reduce costs in the long term. The manager tends to choose the cloud server option for this small-scale business.

3.4. Cost Assessment

The cost of adopting this IoT system for a car service workshop was assessed using the Total Cost of Ownership (TCO) concept. TCO refers to the total cost of acquiring, installing, maintaining, and supporting the application system over its useful life. The estimated cost of acquiring or purchasing equipment is described in Table 2 above. The installation cost refers to the cost for an IT developer, which is estimated at $500. Table 5 presents the maintenance cost covering ongoing subscriptions, supplies, and salary. The car service workshop must hire an IT specialist to maintain the information systems. Adopting IoT systems could eliminate the frontman's job of receiving customers' cars. Therefore, Table 5 presents the salary difference between the IT specialist and the frontman's salary. The total estimated maintenance cost is $1,810.

Table 5. Estimated maintenance cost

Cost component	Estimated Cost per year	Function
Azure Cloud	$300	IoT hub
Server Hosting	$70	Hosting data
Wi-Fi Broadband up to 50Mbps	$180	Internet
Internet Packages $3 per month	$36	Internet for GPS Sensor while the car is on the road
Battery 9V	$24	To power up the Arduino
Salary difference	$1,200	Additional salary differences
Total	**$1,810**	

In addition, the workshop might incur hidden costs, which are not considered in the project's initial estimate. Hidden costs may include, for example, overtime for staff during the project, the purchasing cost, and setting up the place. For this IoT project, the estimated hidden cost is $100.

The overall investment in IoT systems is summarized in Table 6. The initial investment cost covering purchase, installation, and hidden costs is $1,376. The annual maintenance cost is $1,810.

Table 6. Estimated investment cost

Cost component	Estimated cost
Purchase cost	$776
Installation cost	$500
Maintenance cost (per year)	$1,810
Hidden cost	$100

3.5. Validation

The results of business process designs that integrate IoT and information systems need to be validated with stakeholders. A validation process was conducted by organizing unstructured interviews with managers/owners, mechanics, and customers of car service workshops in Surabaya and Semarang.

3.5.1. Managers/owners

Five respondents were obtained; three were car workshop managers/owners in Semarang, and two were in Surabaya. The respondents chose to disguise their company profiles and personal identities. The researcher presented current and proposed business process diagrams in the interview and explained how IoT-based business processes work. The respondents were asked to express their views. Here are their responses:

Respondent A: The newest proposed system will be perfect for the future and have long-term durability. So that the business can compete with official workshops, which are much more sophisticated and trusted. The system development may have to be carried out gradually. The proposed IoT-based business model may not be fully implemented in our workshop due to budget and human resource readiness.

Respondent B: This proposed IoT-based business process is excellent to implement, especially in our workshop. It would be a pioneer if unofficial official workshops could implement this. We are already quite ready to enter the current era of digitalization. We need to improve the skills of existing human resources.

Respondent C: Implementing this integrated system will be an innovation for unofficial workshops. I don't think even official workshops have implemented a system like this. By implementing this system, we can beat official workshops and guarantee that workshops like ours will win the competition. I suggest that the implementation of the system be done slowly and gradually because it will be a problem for the workshop if there are significant and simultaneous changes to the system.

Respondent D: It will be a technological development in the workshop services industry if this system is implemented. This integrated system will streamline all costs in the long term because the system does everything. However, we need a large capital and effort to implement it.

Respondent E: This IoT-based business process will be the latest innovation for unofficial car workshops. This system will be perfect for their future development. We can increase our competitiveness against official car workshops. Implementing this system in stages is better, considering the costs involved may be large. Gradual implementation and human resource preparation are needed for this car workshop's digital transformation.

Table 5 summarizes key aspects emphasized from the unstructured interviews. All five respondents perceived the transformation of car service using IoT integrated with information systems as innovative. Two explicitly stressed that this innovation could win the competition, especially over official car service workshops. Three respondents suggest the implementation should be conducted gradually because of human resource readiness and investment costs. Four respondents expressed budget requirements, which is logical as all IT projects need financial resources. Overall, the respondents' concerns confirm prior studies among SMEs regarding IoT adoption, which emphasized the need for education and training, budget constraints, and a lack of experience among workers [28]. From a broader perspective, the IoT adoption among SMEs is influenced by technological, organizational, and environmental factors [29]. Those issues raised by the respondents focus on organizational factors. The respondents' positive impression of IoT-based systems is supported by the survey evidence among SMEs that IoT impacts firm performance [30].

Table 7. Summary of respondent's response

Respondent	Innovation	Competitive Impact	Gradual Implementation	Human Resource	Budget
A	√	√	√	√	√
B	√			√	
C	√	√	√		√
D	√				√
E	√		√	√	√

3.5.2. Mechanics

The validation process was conducted by organizing unstructured interviews with the mechanics of two car service workshops in Surabaya and Semarang. The respondents were explained about the proposed IoT-based business processes model and asked to express their views. Their views are as follows.

Mechanic#1: Unofficial car workshops will need this system to compete with official ones. The IoT-based business process diagram seems complex to operate. We need time to master it.

Mechanic#2: I find it quite difficult to understand the implementation of this system design. I need time to understand and get used to it later when it is implemented. With the development of technology, we (mechanics) believe that we must follow technological developments to not lose out on competition in the world of work.

Both mechanics respond similarly to the proposed IoT system for car service workshops. They stated that they would need time to learn if the system was to be implemented. Apart from that, they assess that this IoT-based business process is needed to increase the competitiveness of unofficial car service workshops and their work as mechanics.

3.5.3. Customers

Furthermore, the validation process was conducted by organizing unstructured interviews with five customers of car service workshops in Surabaya and Semarang. The respondents were explained the proposed IoT-based business processes model and asked to express their views.

Customer#1: It would be great if this system were implemented. If this digitalization system is implemented, many car owners may prefer to go to unofficial car workshops. This system could be a threat to official car workshops. We, as customers, will have more confidence in the unofficial car workshop with the business processes offered. Everything must be tested first.

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Customer#2: This system seems to shorten our time servicing the car because there is not much of a recording process initially. Sometimes, the waiting time for service can be longer than the time for the car to be repaired. This system can also help car owners feel safe and comfortable because we can monitor wherever the mechanic takes our car. In the future, I hope that this system will be mandatory and implemented in workshops like this.

Customer#3: This system is perfect for the future development of unauthorized car workshops. It will provide a new, different experience for me and other car owners when carrying out car repairs at the repair shop.

Customer#4: I was very enthusiastic when I heard this system would be implemented in the workshop. In the past, when my car was serviced, I always had to wait, which took a very long time. With this system, the time needed is faster, and I can leave the workshop because I can monitor my car via cell phone.

Customer#5: This technology is excellent, but I think it only suits Gen Z people. It is difficult for an older man like me to understand this technology when I want to service my car from the service booking process to completion. Maybe I need help from my children or grandchildren.

In summary, customers appreciate the proposed systems because of the shorter service time, new experience, and assurance.

3.6. Implementation Plan

The interviews with managers indicated that implementation should be gradual or in stages. The primary reason is the learning process required for the workshop personnel to adapt to the IT application. Another reason is the distribution of investment costs. Another reason is the gradual distribution of investment costs. Therefore, a five-stage implementation is proposed as follows:

1) Stage I : Implementing Information System (Database).
2) Stage II : Implementing RFID system and integrating it with IS
3) Stage III : Implementing GPS Tracker System and integrating it with IS
4) Stage IV : Implementing car arrival gate automation

Each stage has a specific function in the IT application. The next stage builds on the functions of the previous stage. Therefore, the car service workshops could move from one stage to another when ready.

Feedback from managers and mechanics indicated the need for training. A training package is suggested for administration staff, mechanics, service advisors, and managers. Training sessions and their topics are proposed, as shown in Table 8.

Table 8. Training sessions

Session	Topics
Session I : General Overview	Overview of IS, digitalization, automation system, and its integration with IS
Session II: Information Systems (IS)	Introduction about IS, IS features, and IS user practice.
Session III: Car Responsible	Introduction to RFID Car Responsible System, RFID Car Responsible User Practice
Session IV: GPS Tracker	Introduction about Car GPS Tracking, Car GPS Tracking user Practice
Session V: Gate Automation	Introduction about Gate Automation, monitoring to car arrived.

Another issue in implementing the integration of IoT and information systems is data security and privacy. Regarding data security, the information system could implement hashed passwords, in which the original data cannot be retrieved from the hashed output. The hashing process is one-way; the original data cannot be retrieved from the hashed output. On the other hand, the encryption is reversible, where the original data can be retrieved using a decryption key. Regarding the overall database, third-party hosting service providers primarily focus on the security of their customer's data, so they implement data security features. The Indonesian law of information and electronic transactions (UU ITE) protects against misuse of credential data.

Regarding data privacy, the information system is designed so only admin staff and manager accounts can access credential customer data. In the employment contract, an agreement will be given to maintain the confidentiality of company data when the employee is still active or after resigning.

The IoT-based systems also have an impact on the environment. The environmental impact comes from the energy consumption of all electrical equipment and the disposal of outdated equipment. First, the power consumption of all equipment is relatively low. The highest power usage is a 120-watt power supply for gate automation and a personal computer with 200-300 watts. Second, when equipment has reached the end of its lifespan, it should be disposed of at an official facility managed by local governments or authorized organizations. Before disposal, all data should be wiped out by deleting or formatting data storage or performing a factory reset.

The IoT implementation should be measured to monitor its effectiveness and Return on Investment (ROI). Key Performance Indicators (KPIs) for IoT implementation should consider the timeframe: investment period, payback period, and profit period [31]. For this car service workshop, three KPIs are suggested. First, the KPI for the investment period is the decreased customer waiting time, measured from arrival until the customer is served. Second, the KPI for the payback period is the increase in the number of cars serviced. Third, the KPI for the profit period is increasing labor productivity, measured by dividing the total sales from car service by the total labor cost. ROI is measured by the profit from the investment (return minus investment costs) divided by the investment costs. ROI can be calculated when the IoT implementation has reached the profit period.

The proposed IoT-based business process was validated by managers of five car service workshops who perceived the proposed digital transformation as innovative and potentially increasing their competitiveness. The implementation was suggested gradually to prepare the human resource and investment budget.

4. Conclusion

This study designed the IoT-based business process in the unofficial car service workshop. The model has been validated by managers, mechanics, and customers of car service workshops. Technology, cost, environmental impact, implementation stages, and key performance indicators have been discussed. Gradual implementation will be suitable for SME car service workshops to increase competitiveness in this digital era.

This study contributes to the literature on IoT solutions for SME digital transformations. Specifically, the work adds knowledge in IoT for automotive industry literature by proposing IoT-based business process design for a car service workshop. Today, unofficial car service workshops face high competition between themselves and official ones as customers demand better and more innovative service processes. The car service workshop could use the design of the IoT system as a guideline to adopt IoT for improving and transforming business processes into Industry 4.0.

The design of an IoT-based business process based on the case of one unofficial car workshop limits the generalization of this research. Other workshops with different profiles and business processes might need different IoT system designs. In general, the car service business process is the same. The difference, for example, is that the test drive is not carried out in a workshop or under certain conditions, so the GPS tracking function is unnecessary. Further studies could cover more cases of car service workshops in different locations and design a more robust IoT-based business process. Moreover, further work might investigate the implementation process of this IoT system design in car service workshops.

5. Declarations

5.1. Author Contributions

Conceptualization: A.H.W. and G.; Methodology: G.; Software: A.H.W.; Validation: A.H.W., G.; Formal Analysis: A.H.W., G.; Investigation: A.H.W.; Resources: G.; Data Curation: G.; Writing Original Draft Preparation: A.H.W. and G.; Writing Review and Editing: G. and A.H.W.; Visualization: A.H.W.; All authors have read and agreed to the published version of the manuscript.

5.2. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

5.3. Funding

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5.4. Institutional Review Board Statement

Not applicable.

5.5. Informed Consent Statement

Not applicable.

5.6. Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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