

Development of an Order Processing System using Google Sheets and Appsheet for a Malaysian Automotive SME Factory Warehouse

Mohamad Khairi Hassan

Sugihara Grand Industries Sdn Bhd, 42000 Port Klang, Selangor, MALAYSIA

Mohd Hazri Mohd Rusli*, Noor Azlina Mohd Salleh

Smart Manufacturing Research Institute (SMRI),

School of Mechanical Engineering, College of Engineering,

Universiti Teknologi MARA, 40450, Shah Alam, MALAYSIA

*hazrirusli@uitm.edu.my

ABSTRACT

The automotive industries in Malaysia have grown well and developed many suppliers in their supply chain including Small Medium Enterprise (SME). The order handling process at a supplier's factory has become one of the most critical areas in the supply chain. Adaptation to technology such as IoT enables the automotive supplier to better manage their customer orders and avoid mistakes that affect the supply chain. In order to improve the order processing activities, a study has focused on developing a mobile device application using Google Appsheet and Google Sheets as a cost-effective system for managing supply orders. A study was conducted in one of Malaysian SME automotive companies, which manages the orders manually by using a log book with a lot of recording and redundant work. By using Google Sheets, all the information and data involved in order processing activities is imported and digitized. Then, a mobile application is created using Appsheet so that the ordering activities and processing can be completed on a mobile device. All information gathered by the mobile app (Google Appsheet) is immediately saved in Google Sheets on an Excel-based database, allowing for further data analysis. The research conducted has managed to integrate these two applications into a system for Malaysia's SME factory to manage the ordering activities in the automotive supply chain. This system enables the user to shorten their order processing

time since data is captured in real time and mistakes due to manual error can be avoided.

Keywords: *Order Processing System; Mobile Apps; Google Sheet; Google Appsheet; Iot Warehouse*

Introduction

Massive growth in mobile device technology makes people dependent on it either in social life or for work. Mobile phones are now not just carrying out their original function as a device to make and receive a call or message as a priority, but are doing much more to fulfill people's needs in life, such as serving as a camera, scanner, recorder, and mini computer. People are carrying their mobile devices anywhere at any time and involving the device as much as possible in each of their life activities. This has also had a great impact on the work system in the world today since it has been proven to improve work effectiveness and be able to deliver quick and accurate results. Monitoring of a business operation is done by using a smartphone, which can help users get results in real-time as input for an action based on the result [1]. An appropriate mobile application is able to be developed in order to fit user requirements and improve process operation with the support of mobile devices [2].

The automotive industries in Malaysia have grown well and have created a component supply chain by involving vendors, which involve SME factories. Vendors that produce the components of automotive parts play a very important role in ensuring continuous part supply to the car assembler in the right quantity and on time. To maintain the chain of supply, the required parts or components are determined by the Automotive assembler based on their production plan, and ordering from the vendors is initiated. This order is initiated through either Delivery Instruction (DI) or Kanban.

The DI is referring to a document released by the automotive assembler describing what item is required for delivery along with information on quantity and when to deliver. While Kanban is described as a visual signal that is used by downstream processes to trigger upstream actions in the Just-In-Time (JIT) process [3], it is also used to provide information about the item's required quantity at the dedicated delivery time. Vendors that received the order information either from DI or Kanban will process the order procedures and prepare the required parts. Finally, the arrangement for delivery is made, and the order is completely filled. The flow of order processing for automotive parts is described in Figure 1.

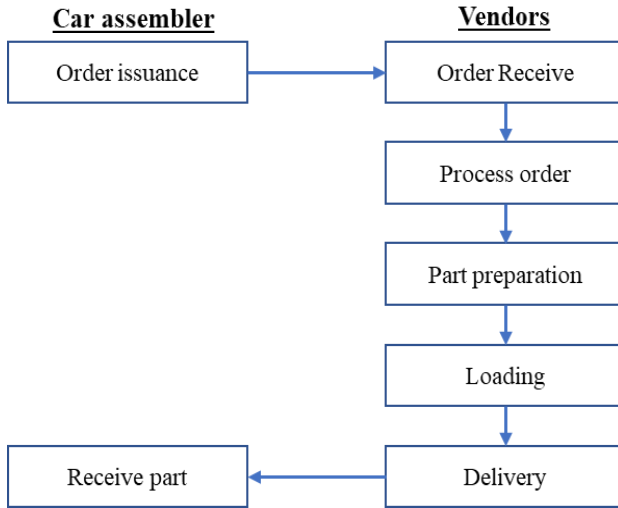


Figure 1: General process flow of ordering parts in the automotive supply chain

This research has been initiated to find and develop an alternative method of managing an order from a customer in the warehouse of an automotive SME factory. System development is focusing on Google applications, which are Appsheet for mobile device software customization and Google Sheet for data collection and analysis. This paper explains how to create a mobile application using an Appsheet for processing warehouse orders step by step. It serves as a reference for users creating applications using the Appsheet's fundamental features. This paper provides a clear understanding of developing a system for mobile devices by using Google Appsheet and Google Sheets for a systematic order processing activity applicable to automotive SME factory warehouses.

A case study has been conducted at one of the SME automotive factories, named PSB Sdn Bhd, that supplies interior parts to a few automotive suppliers as a second tier in the chain. Their warehouse is occupied with determining which item the customer needs for the day and delivering it in accordance with the quantity and time. Entering orders from their customers is referring to a task that takes place before actually filling the order, where the challenge is in establishing clear communication throughout the logistical or warehouse operation [5].

An order from the customer is received through email containing an order document that is Kanban in the early morning and the delivery has to be completed within a couple of hours. Due to this time limitation (from order receipt until delivery), a single step of order handling processing is critical, and

even small mistakes will lead to delivery failure and can affect the customer assembly line. Details on manual order processing activities conducted at the PSB can be described in Figure 2.

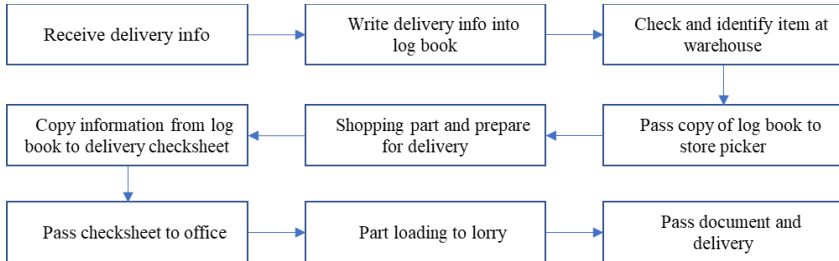


Figure 2: Flow chart of order processing activities at PSB Sdn. Bhd.

All the steps as stated in the above figure have not been fixed on their timing since the process will depend on the customer's order type as well as the order quantity. However, it is supposed to be conducted in order to set a standard and a key performance indicator (KPI) for future improvement [5].

In a single cycle of delivery activities, a lot of specific information must be recorded. Table 1 below describes the information needed for the item that is going to be delivered. Each of these pieces of information is important for both parties to ensure the item delivered meets the order requirement. Besides, the information will become more important if the item is found to not meet the standard requirement, such as having quality issues that require tracing the root cause of the issues for a countermeasure.

Table 1: Item information required for delivery

No.	Item	Purpose / Importance
1	Item name	Product identification
2	Item number	Product identification
3	Quantity	Informing how many actual items
4	Shipping batch order	Tracing for which receiving batch
5	Size	Informing actual item dimension
6	Lot number	Tracing for the production batch at the

This makes the order processing and part-picking activities costly and shall be considered in the total operation factors [6]. Processes that are conducted manually are identified as waste in a Value Stream Mapping (VSM) analysis and will just increase the logistical cost of the operation [7]. There is a risk of error due to a typo or mistake when the information is written manually

and then copied to another check sheet. Since this process is critical, only a competent person with a high focus is able to perform the task.

A process that is carried out manually with paper-based practices will lead to common issues that are normally faced by the logistics industry, such as inventory that is not visualized, shipment processing errors, space underutilization, a lot of paperwork, and observation of existing manual order processing activities, a risk factor was identified that can lead to a failure at the customer's place, as described in Figure 3.

Risk 1	Risk 2	Risk 3	Risk 4	Risk 5	Risk 6
Error copying info from kanban	Error in reading information from hand written log book info	Entering wrong data of picked item	Copying wrong info from log book to customer checksheet	Wrong calculation of total quantity delivery of item	Delay of delivery
Create mistake when copying order info (order number, item number and quantity)	Info written in log book not clear. Interpreted wrongly while copying info Lead to wrong pick item	Item details wrongly wrote in log book. Difficulties handling the log book and pen while assessing the parts in the warehouse	Data wrongly entered into checksheet. Impact of wrong billing and other documents	Wrong count for total quantity by using a manual calculator. Will give impact as per risk 4	Next process to wait until the previous process is completed before start. Total process time increased.

Figure 3: Risk of conducting a manual ordering process

Based on the risks observed, a systematic approach is proposed to address these issues, which is to digitize the whole ordering process as a solution. A digital solution will have an obvious impact on the warehouse operation through a Warehouse Management System (WMS), which improves the warehouse operation's effectiveness [9]. Efforts in waste reduction in a warehouse's operational activities will improve the overall warehouse performance, which will either directly or indirectly improve a company's business performance [10].

A cloud-based database system is introduced with a custom Graphical User Interface (GUI), which enables the user to interact with the data from their mobile device at any time and anywhere, as long as there is an active internet connection by using Google Appsheet. The data is then saved in Google Drive and made available for free use in Google Sheets for further data analysis.

Literature Review

A warehouse operation using a manual method is facing a problem with operation data that is not able to be updated in time. Although Enterprise Resource Planning (ERP) is used, it still isn't able to meet business and customer needs because of things like the person in charge's delayed updating of data, a lack of communication, and information about activities that aren't synchronized [11]. A mobile application was found to be widely used in assisting an operation in the supply chain, such as in order entry and processing (communication), stock ordering (inventory), order picking and assembly (unitization and packaging), and order delivery (transportation) [12].

Google Sheets is a cloud-based application that provides a similar function to Microsoft Excel but offers more benefits than just a spreadsheet. Google Sheets provides online document sharing, so multiple users can interact on the same page at any one time by using supporting devices such as a laptop, phone, or tablet. Users have no worries about their data every time they update since it is online, the data will automatically save to the drive as long as the internet is connected. Additionally, previous revisions can still be found by using the version history feature, allowing users to go back to a specific starting point whenever necessary. The file can also be accessed at any time with an internet connection by using an internet browser without requiring specific software installation [13].

Appsheet is an application that provides a no-code development platform for application software, that allows users without coding experience to create mobile, tablet, and web applications using data sources like Google Drive, DropBox, Office 365, and other cloud-based spreadsheet and database platforms [14].

A few studies have been conducted on a real business operation in which the mobile application was developed in order to smooth the operation and minimize risk. A pediatric clinic in Colombo South Teaching Hospital, Sri Lanka has successfully used an electronic database management system (E-DBMS) which was developed using Google AppSheet and Google Sheets [15]. This application (Google Sheets and Appsheets) has also been used by a lecturer at Politeknik Sultan Mizan Zainal Abidin to develop an application for their student coursework marking system. From the study, it was highlighted that developing the application for mobile devices by using Google Appsheets is easily understandable even though the system developer does not have a computer programming background and is able to produce effective outcomes that meet the objective [6]. In Sri Lanka, AppSheet is used to create a clinical database, and it has proven to be a cost-free, user-friendly solution to digitization [16].

One study conducted on application development for yoga activities also used the Appsheets for mobile user interaction, and it was proven successful [17]. Besides using a function of medium for input data, Appsheets has also been

applied for rendering information from Google Sheets documents that enable data to be visualized and referred to [18]-[19]. Various sectors have proven that Google Sheet, partnered with Google Appsheet, is able to manage data collection and storage, such as in the fields of education, hospitals, and health, as well as COVID-19 data [15]-[20].

Data that is captured by the mobile application (Google Appsheet) is saved in a Google Sheet, which is ready for further analysis and on the right platform to be visualized using visual management tools [21]. This will finally digitize a part of the warehouse operation that is able to add value to the company's business, which includes improving productivity, seamless electronic communication, a dashboard, and real-time inventory [22].

Successful implementation of a mobile application in various sectors as described above, shows that the combination of Google Sheets and Google Appsheet is able to deliver a good outcome to the user, which helps in improving work efficiency. It will help in transforming manual data operations into digital ones by having a database system that uses a mobile device as a medium for data collection.

Methodology

This section will discuss the method used in conducting this study, which is generally described in terms of process flow as per Figure 4.

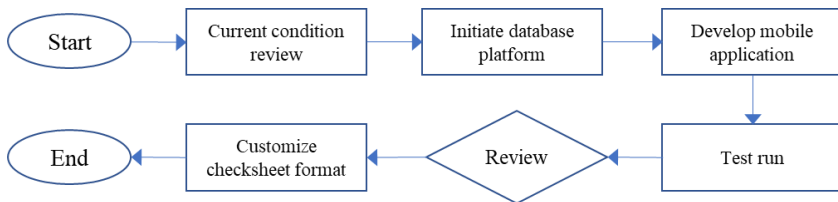


Figure 4: General process flow of conducting the study

The current practice of the PSB warehouse operation activities is reviewed to understand the flow, method, and documentation involved in managing order processing. This is basically to identify the type, source, and flow of the data for the ordering process from receiving information until delivery. Then, a database is created where all the manual data is digitized in a specific data format. A mobile application is then developed for a medium of data entry which requires a test run and fine-tuning to make it function. Finally, customization is made to the data format to initiate the customer checksheet and replace the manual format.

The development of the order processing system was divided into three phases, which are data preparation, developing mobile applications, and report customization as shown in Figure 5.

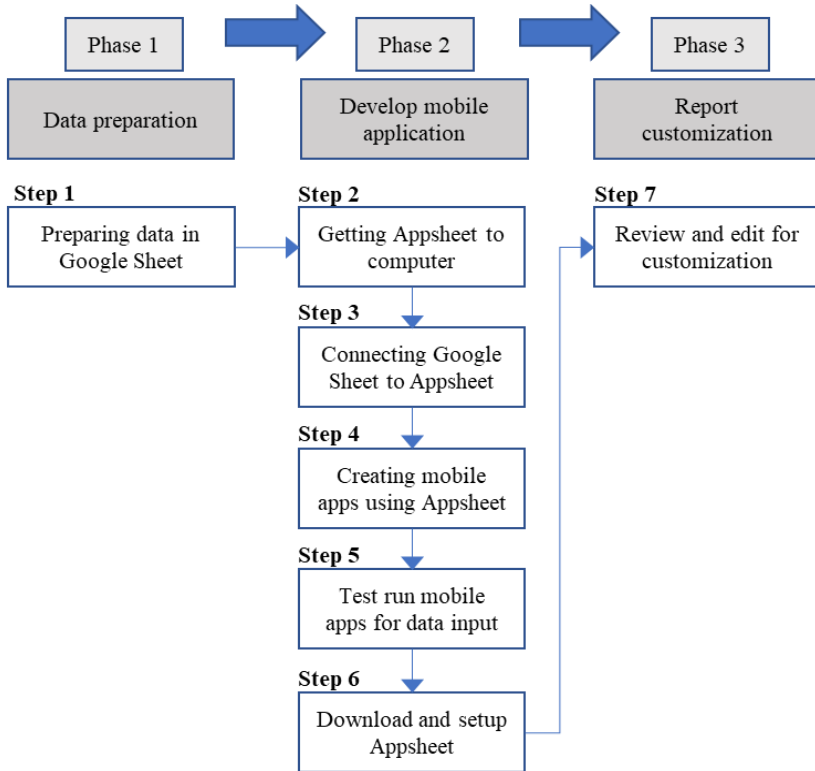


Figure 5: Development flow of order processing system

Phase 1 starts with the digitization of existing formats on manual paper into Google Sheets which requires format creation, utilizing the built-in formulation and file linkage. Phase 2 involves the development of a mobile application that will become the user interface to the database in Google Sheets. Finally, Phase 3 focuses on customization of the Google Sheets format and data reporting format which replace manual checksheets in the delivery operation activities.

Step 1: Preparing data table in Google Sheet

Google Sheets is used as a cloud database where all the data captured by the system is stored, analyzed, and integrated to produce outcome results. Besides, it also became a platform to develop a mobile application in Step 2. Storing data

into a file in Google Sheets is secure since the accessibility can be set by a specific user account with the access function of viewer, commenter, or editor. Even with editor accessibility, the file owner can still protect a certain cell or area of the Google Sheet from any data editing or manipulation.

Step 2: Getting Appsheet to computer

Google Appsheet is used to create mobile applications while working on a computer. It can be started directly from the Appsheet website without having to download or install anything. The software is launched by signing into the Appsheet account via <https://about.appsheet.com/home> from a supporting browser.

Step 3: Connecting data from Google Sheets to AppSheet

Appsheet is generating an application from the Google Sheet source, so it is required to be connected. To do this, the Google Sheet that was initiated in step 1 was selected as a file to be connected with the Appsheet by clicking the “create” menu and selecting “start with existing data”. The selected file is then used by the Appsheet to generate the application.

Step 4: Customizing the Appsheet to create mobile apps

The actual mobile interface is displayed in the right-hand section of the Appsheet page, and this can be altered to suit the needs of the user. When creating mobile apps, some basic customization can be used, such as file renaming, which will eventually become the name of the application, choosing items to appear, designing the application view, and fixing a logo. The Appsheet edit page's menu on the left side can be used to start customizing, which enables users to design the application interface in a way that best suits their needs. Users can choose how data is displayed by sorting the viewed item, grouping, and header sequence in a deck, table, dashboard, or card.

Step 5: Test run input Appsheet to Google Sheet table

In order to ensure input data using the Appsheet from a mobile phone or tablet is workable and applicable for the user, a test run has been conducted using the Appsheet from a computer. Data is added using the “+” icon so the input interface appears for data entry. To confirm data capture from the Appsheet, actual data sources in the Google Sheet were checked by opening the file that is used for Appsheet reference.

Step 6: Download and setup AppSheet

The Google Appsheet is compatible with the operating systems of mobile phones and tablets, which can be downloaded from the Google Play Store for Android and the App Store for Apple devices. It is free to download and requires setting up after installation. Users have to sign in with the same account with

which they logged in previously in Step 2, and then, to start the application, the saved Appsheet file needs to be selected from the menu option. The same interface that was initiated during setup on the computer will appear on mobile phones or tablets after and this will make the installed application ready to be used.

Step 7: Review and edit for customization

The steps in Step 5 above were repeated by using the Appsheet application on the mobile device to ensure data captured from the devices was able to sync with the Google Sheet file. Some customization can be applied in order to make the mobile application more user-friendly, such as fixing the selection input, using barcode or QR code scanning, and determining a pre-set value.

Fix selection input from the list

Entering fixed data input can be done by selecting from a list that can be set in the Appsheet. The list of items to be selected can be set in the Google Sheet file by inserting a row before the data and placing a list of fixed items for selection. Then, the editing needs to be done in the Appsheet from a computer wherein the column tab, the desired item can be selected by changing the type from pre-set value to “Enum” as shown in Figure 6. After completing and saving the changes, this function can be tested by running the application from the installed mobile device.

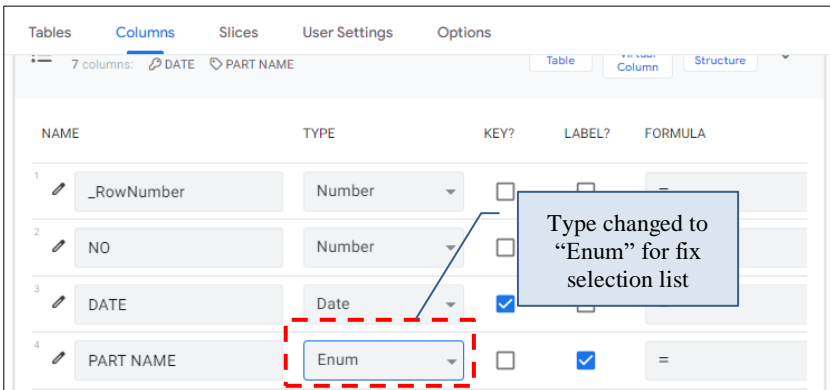


Figure 6: Assigning type to select from the list

Applying the function of scan barcode using the device camera

Input that is provided with a barcode or QR code can be scanned for data by Appsheet using the device camera. This is done by activating the “scan?” function in the desired item name as shown in Figure 7.

DISPLAY NAME	DESCRIPTION	SEARCH?	SCAN?
<input type="text"/>	<input type="text"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Figure 7: Selection to activate the scanning function for the item

This function activates when the QR code icon is pressed, which triggers the device camera to be used for QR code or barcode scanning. Information from the scanned code will be automatically filled in the column, which will help to ease the data entry.

Pre-set value of input

Input values that are fixed and can be set by default are able to be set themselves by the Appsheet function. In this application's development, input for the date has been set to the current date by changing the type to "DateTime" in the row for date input.

Results and Discussions

A complete system of order processing has been successfully developed for PSB and managed to fulfill the PSB management expectation of running the order processing activities at the warehouse digitally. Compared with the current method of operating the order processing system, this system has totally eliminated the manual practice by using a log book as a record and replacing it with a digital sheet. Orders received from customers are captured directly using mobile devices through the application developed as shown in Figure 8.

Data about ordering items and actual delivery that are captured from mobile devices is stored in a Google Sheets database. By using the built-in function in Google Sheets, data has been arranged to create a specific format that meets the customer's request for a delivery checksheet. The activity of copying data from a log book into a blank check sheet that was previously conducted prior to delivery is now eliminated. Figure 9 shows a manual recording checksheet that was prepared by copying information from the log book. The total quantity of the delivery item was calculated and summarized manually and this exposed it to the risk of wrong data.

The data is retrieved directly from the database (Google Sheets), which reduces the risk of error while establishing the delivery record for the customer by doing away with manual calculation and data copying. This will cut down on some of the processing time in the ordering operations, which helps reduce operating time since records won't need to be filled out manually. Figure 10

depicts an example of a customized delivery check sheet that directly pulls data from Google Sheets.

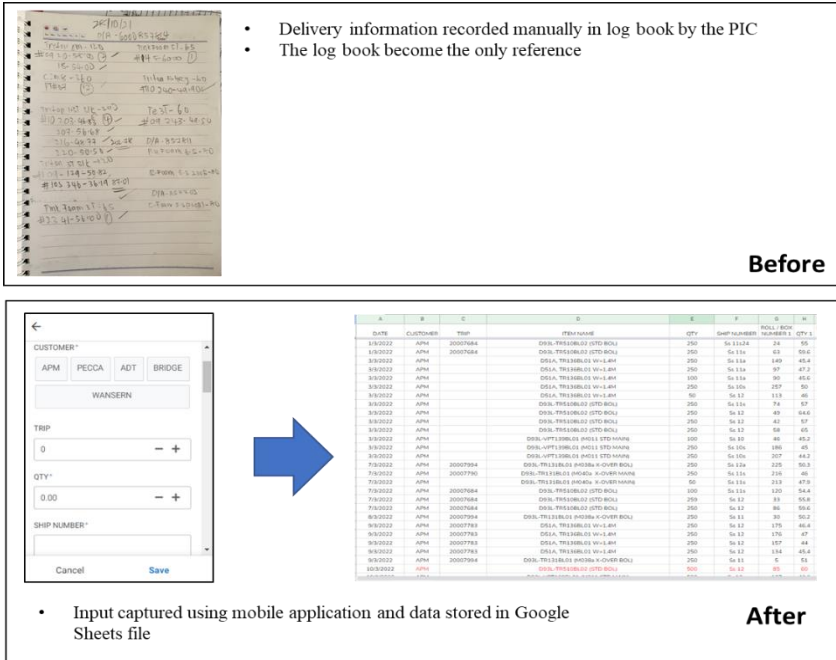


Figure 8: Before and after conditions for order capturing

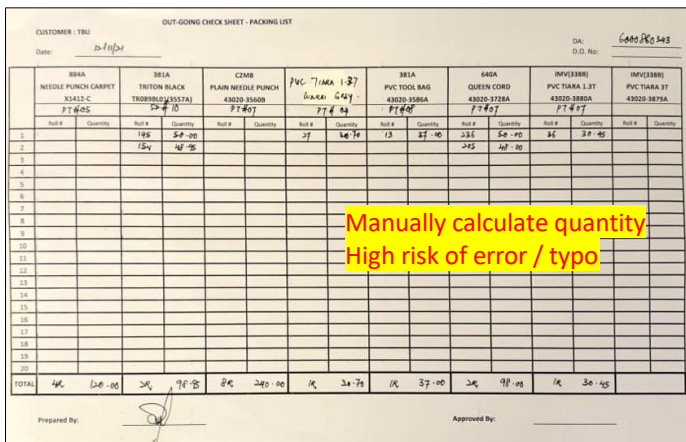


Figure 9: Manual recording checksheet for delivery

PYROCELL SDN BHD				TO APM					
OUTGOING DELIVERY CHECK SHEET				CUSTOMER : APM					
DATE 22-May-2023									
PO NUMBER	P20008469			P20009830			P20009830		
PART NUMBER	D93L-TR510BL02 (STD BOL)			D51A, TR136BL01 (4% WAX), W=1.55M			D51A, TR136BL01 (4% WAX), W=1.55M		
ITEM CODE	MT1857BK157F			MT1888BK194F			MT1888BK194F		
TOTAL ORDER	50			500			500		
SHIP NO	Ss#1			Ss#04			Ss#04		
ROLL #	Roll No	Batch No	Length (m)	Roll No	Batch No	Length (m)	Roll No	Batch No	Length (m)
1)	124	371062-0	59.80	63	373502-0	38.00	85	374115-0	35.60
2)				12	373436-0	37.60	7	373435-0	38.00
3)				27	373437-0	36.00	86	374115-0	36.00
4)				146	374174-0	30.00	81	374114-0	36.00
5)				66	373502-0	36.00	87	374115-0	38.60
6)				153	374175-0	38.00	80	374114-0	39.00

Figure 10: Delivery format from the mobile apps input

The system that allows data to be transferred and stored in real-time has reduced the total lead time for order processing. Users are able to work concurrently without being required to wait until the previous part is complete to start on the next part. The flow of ordering process activities, which is depicted in Figure 2 is used to benchmark the manual method (before condition) versus the implementation of the order processing system (after condition). Table 2 shows the comparison of time spent conducting an order processing. Compared with the previous manual method, there were six steps eliminated, which are Steps 3, 4, and 6. When the person who received the order entered the information in Step 2, the picker at the warehouse also received the order information from the second device and immediately started shopping for the item at the warehouse, which is what Step 5 is about.

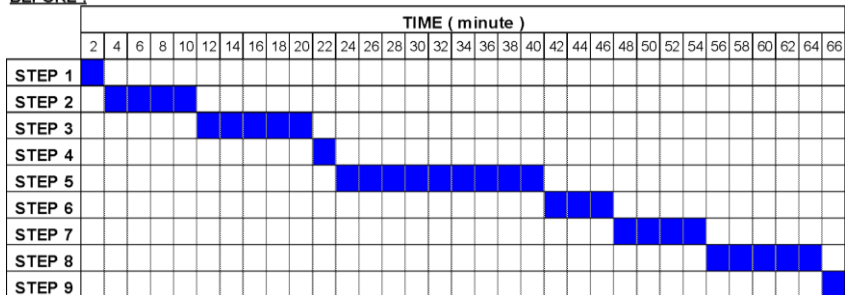
The use of the internet for real-time data transfers has eliminated the two previous steps (Steps 3 and 4). The data that is updated in Google Sheets in real time is able to be seen by the office staff for item part confirmation and printed as a check sheet, which eliminates Step 6. Step 7 starts concurrently with Step 5, so the completion time has improved. A comparison of the time taken for conducting the order processing using the manual method and the digital method is shown in Figure 11.

Referring to Figure 11, the completion time with the manual method was recorded at 66 minutes, while with the order processing system, it was reduced to 36 minutes, for a total reduction of 45% in processing time. Besides the processing time that has been reduced with the help of a new method (the order processing system), the activities that run concurrently also contributed to this reduction as per Steps 5 and 7 in Table 2.

Table 2: Comparison of operation time before and after conditions

Step	Details	Before (min)	After (min)	Description
Step 1	Receive delivery info	2	2	
Step 2	Write info to into log book	7	4	Manual write to digital
Step 3	Checking and identify items at warehouse	10	0	Combine with Step 5
Step 4	Pass copy of log book to store picker	3	0	Combine with Step 5
Step 5	Shopping part and prepare for delivery	18	16	Concurrent with Step 2
Step 6	Copy information from log book to delivery checksheet	6	0	Print from digital data
Step 7	Pass checksheet to office	8	2	Concurrent with Step 5
Step 8	Part loading to lorry	10	10	
Step 9	Pass document and delivery	2	2	
Total		66	36	

BEFORE :



AFTER :

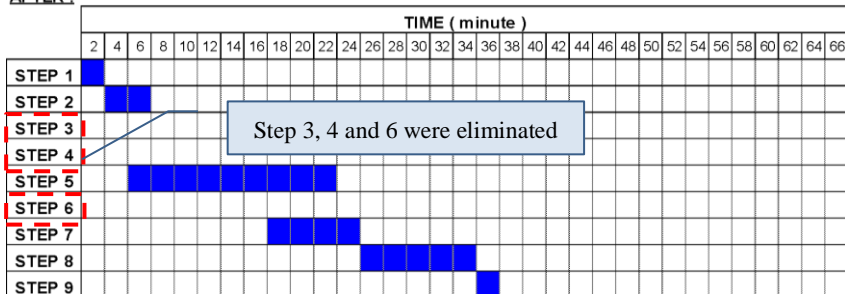


Figure 11: Comparison before and after of handling order processing

With the simple interface of the mobile device by Appsheet, users were able to key in the info into a specified box with some input data that can be captured by the function of camera scanning. This will help in avoiding the error of copying information from Kanban as per risk 1. Besides, the pre-set date value that has been set during customization of mobile application development helps in determining the actual date of the activities conducted.

The same information will be viewed by the picker, which is responsible for selecting the right part by referring to the Appsheet summary. With clear information written digitally, the risk of error in reading the order information can be avoided. Dealing with the device is also much more convenient compared with bringing a pen and book to the site to write information. As a result, the risk of making a mistake with the item is reduced.

The delivery information that has been captured from the mobile device through the AppSheet was able to be seen in the summary view. Figure 12 shows a view of the application on mobile devices, where it was grouped by the order date with a total quantity for the particular date. Each of the ordered items is listed with the quantity and it can be scrolled down to see the whole list.

Date	Total
7/26/2022	2,105.00
TR089 GY01 1.3T 3020...	48.41
TRIP 2	
TR089 3T BLK 3020-38...	48.54
TRIP 2	
TE020 BL02 5T 3020-3...	48.86
TRIP 2	
TE020 BL02 5T 3020-3...	50.78
TRIP 2	
PINK FOAM 5T+40D 30...	
TRIP 2	

Figure 12: Example of Appsheet view after grouping

The selection of the Google application in this system development was found suitable for capturing data, using it as a database platform, and as a mobile application. The Google account that was created for free has sufficient drive space for data storage. A database that uses Google Sheets has come out and offers sufficient features for free. It was easy to use even for newcomers. The use of AppSheet in developing the mobile application was found to be applicable to meeting the purpose of having a medium for data entry with the function of reviewing and editing the data. With no cost for prototype application development and a reasonable subscription price for application

deployment, Appsheet is the best choice for the SME warehouse factory to get into the system and expose itself to the IoT.

Conclusion

A simple, self-developed, and effective system for managing a customer order in an automotive supply chain was successfully established by using Google Sheets and Google Appsheet. Users have gained a significant benefit from the implementation of this system. Redundant manual recording of delivery data, which is exposed to a risk of error has been totally eliminated with the use of mobile applications. Real-time data updates into the Google Sheets have allowed multi-users to work on the same page of data, and this makes a flow of tasks that can be performed concurrently possible. Thus, the total lead time for ordering process activities can be reduced significantly. Exposure to digitization has given the associates of PSB Sdn. Bhd. the opportunity to gain knowledge, especially in the IoT, and this will enhance the adaptation of the IoT towards achieving the National Fourth Industrial Revolution (4IR) Policy.

Contributions of Authors

The authors confirm that each part of this work has been equally distributed, and the final version of this paper has been reviewed and agreed upon by all the authors.

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Conflict of Interests

All authors declare that they have no conflicts of interest

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