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Research paper

Real Time Productivity Monitoring System for Small and Medium Size Manufacturing Industry

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Abstract

This paper attempts to propose a real-time knowledge management system to monitor productivity for production lines of small and medium size enterprises (SME). The proposed system hopes to empower managers in meeting the target of daily production output. The uniqueness is it provides real time productivity level to enhance visibility and control in the production lines. The system automates the process of data collection by using bar code scanners at the input and output stations. Productivity is calculated based on cycle time of each product and display in real time. Colour coded display indicating productivity level enables the line foreman to take immediate action. Apart from that, it can also send alert in the form of Whatsapps messages to relevant personnel in case of loss time issues. The system consists of two main modules, which are, data collection module and reporting module. It is developed as a web-based knowledge management system to ease setup, access, and maintenance to facilitate future upgrade into mobile application. The system can be implemented in any production line to monitor the line performance and helps to reduce loss time by providing an instantaneous response to solve issues.

Keywords: *Knowledge Management System; Monitoring system; Productivity; Real time; SME.*

1. Introduction

A production line is a complex system and is the core operation of a manufacturing plant. In order to stay profitable, productivity and quality have to be optimum. The data essential for monitoring line performance, production rates and loss time is thought to be inaccessible or too expensive to obtain. Thus, a real time Knowledge Management System is designed, which monitors production output for providing a solution for management to tackle these issues. The real time Knowledge Management System is called "production output monitoring system", which is a cost-effective system that will collect and monitor the data output of a specific product line automatically and display it to the personnel [1, 2]. Ideally, the system should improve the overall performance and efficiency, and must reduce the unwanted loss time by providing real time information to the respective personnel. All data collected in the system will be archived in the database and made available to reporting module and will assist the manager in proactive decision-making. This enables the manager to have a better visibility on the real time performance of production lines [1]. Moreover, the real-time information can be shared securely and conveniently to all management level. The management and line managers can view the real-time data at anytime and anywhere.

In the market today, there are various existing production monitoring systems to monitor production line performance in real time and allow for in-depth analysis. These systems usually targets the large enterprises that have sufficient resources and capability to handle advanced technology [1]. SME however, do not have such resources to monitor production line loss time, productivity and analyse the performance of the entire production lines from one central location. The traditional method used in manually recording the data is less accurate and prone to human error. Manual data collection is slow and not real time. In the current dynamic environment, viewing the data "after the fact" is insufficient [3]. Often, the data is first written down by the personnel and later entered into the system (often in Excel). There is a high possibility for inaccuracies. Typographical and transcription are common methods of manual data collection. Once these errors become part of the data set, it is hard to detect and eradicate as there are huge number of data in the system [3]. The data will eventually affect the manager in effective decision making and risk overall performance.

Low productivity and high machine downtime will lead to unwanted and undesirable outcome, which will affect the organization performance. Nonetheless, the current system does not allow manager to know the causes for delay and it will be impossible for the manager to take immediate action to tackle the problems. Most of the time, production manager would like to know when the line is down and how long it takes the maintenance personnel to respond. Without accurate and real-time information about the production status, the manager is not equipped to solve the issues immediately and that might drag the overall performance and efficiency of the entire production line. Furthermore, manual data is hard to share and measure as there is no measuring tools for measuring production performance and no database build up for in-depth analysis. Therefore, this paper aims to assist SME to obtain competitive advantage by rendering an affordable monitoring system. Real time data can be provided to management for cutting overall production costs, improving productivity, minimizing loss time and increasing operational efficiency. Moreover, analysis report can be created that is ultimately useful in decision-making. Finally, security features can be presented to allow data to be shared across the organization securely.

The first section of this paper focused on the introduction, problem, and objectives of this study. Existing systems are explained and compared in the second section. The proposed solution is a web system to monitor the output of production line in real time. The requirement analysis for the proposed system is mentioned in the third section followed by system design, implementation, testing and evaluation respectively. Finally, the findings are discussed and concluding remarks are made.

2. Related Works

The main task of Production Monitoring System (PMS) is to collect and distribute real time data of the events. The data must be useful and understandable for decision-making. The data must assist production team for timely response of the events that may affect the results [4]. Customers expect accurate and high-quality products in today's competitive world and there should not be any room for error. In order to sustain in the business, SME need to deliver on time with high quality. In order to meet the changing market requirements, production process must be continuously improved and monitored [2]. In the literature, many models were developed to manage production performance of SME [5-10]. The development of SME sector is important in strengthening the leading industries especially in developed countries [5-10].

Over the past decade, production line monitoring systems were labour intensive, time consuming and depending on line foreman to walk around the plant to gather information from each production line. The collected data was then manually keyed in to the database system for further analysis. The information was rarely leveraged or shared within an organization for decision-making.

Today, as the evolution of technology, remote monitoring production system has evolved considerably as well. However, the current solution to the production monitoring system is not capable to handle all the problems encountered by the managers. Most of the existing systems in the market heavily emphasized on real time data and using proprietary technology [4, 11, 12]. It will be great if there is a web based system that address the business needs and highlights the top loss time reason based on the historical record over the specified time span. Web based architecture not only allow the system to be accessible within the organisation through network connection, it is much more affordable. The proposed web based system is known as The Insight. The following is a review of existing systems in the market and comparison to The Insight.

2.1. EnterpriseIQ RealTime™ Production Monitoring

EnterpriseIQ's RealTime Production Monitoring is a desktop software that follows jobs in real time as they move from the schedule through production [13]. It allows the manager to view overall enterprise or specific work centre performance from any computer on the network. Instantaneous feedback on critical parameters such as total parts created, production time, downtime, rejects and parts remaining to be produced, and cavitation changes is provided to allow manager to have better control on their production lines. Besides, the system also used colour coded for fast, easy readability to instantly identify late, slow, standard and fast running machines, as well as downtime machines. Each production machine is attached with a light indicator to identify machine and job status and are visible by anyone from anywhere on the shop floor. Reports can be created to provide accurate and timely production information [13].

2.2. CC+I's Production Line Monitoring System (PLMS)

The PLMS is an automatic real-time data collection system that helps to improve performance on the production floor. It utilizes handheld applications to scan components, enter downtime events and get real time feedback. It is accurate to the second measurements for run time, down time and product change over time. To aid in improving production performance, standards based performance measurements including Overall Equipment Effectiveness (OEE) is available by analysing the captured data. The system uses Pareto analysis to allow manager to identify the downtime issues that have the larger payoff [14].

2.3. Husky Shortscope NX

Shotscope NX automatically stores processing parameters on every shot in real time. It is web-based architecture and makes information available across existing internal network. The machine status is displayed by using color-coded plant floor layouts. It consists of statistical process control (SPC) charting for both process variables and dimensional measurements. Shortscope NX simplifies reporting via standard graphical and tabular reports. It also allows the user to customize their own reports based on the organization requirements [15, 16].

2.4. Intouch Monitoring System

Intouch is a real-time production monitoring, reporting and planning system, which enhances the visibility and control in manufacturing operation. It removes the costs and errors of manual production data collection. By using Intouch monitoring system, key production information such as scrap and downtime will be constantly available in real time, which allows action to be taken to rectify problems as they happen. Key personnel's time will be used efficiently using automatic data collection. Therefore, the factory utilization will be improved that leads to much faster response to stoppages. The high visibility encourages production staff to keep machine operational [2].

2.5. Evocon

Evocon is a cloud-based production efficiency software for manufacturing companies, which is used as a production efficiency and visualisation enthusiast for over 8 years. It aims to assist manufacturing companies to learn and become more efficient by uncovering the unproductive resources in their manufacturing processes. It will increase transparency, improve employee participation and it is a move towards industry 4.0 [17]. Evocon tracks and compares production in real-time. Furthermore, it reduces downtime with preventive maintenance and runs quickly with cloud technology.

2.6. Factbird

Factbird is one of the Blackbird Smart Data Collection product that can access data in real time anywhere. Data from sensors is collected and visualized over secure cloud server. Production status can be monitored anytime and anywhere. Historical data such as number of units produced per minute, number of rejects, temperature of the process, can be shown by Factbird. using an application called 'app.blackbird'.online. Furthermore, key performance indicators for manufacturing efficiency can be customised accordingly using Factbird [18].

2.7. Comparison with Existing Systems

The Insight is proposed to empower managers in meeting the target of daily production output. The uniqueness is it provides real time productivity level to enhance visibility and control in the production lines. The system automates the process of data collection by using sensors at the input and output station. Productivity is calculated based on cycle time of each product and display in real time. Colour coded display indicating productivity level enables the line foreman to take immediate action. Apart from that, it can also send alert in the form of Whatsapps messages to relevant personnel in case of loss time issues.

Comparison of The Insight and existing systems is as shown in Table 1.

Table 1: Comparison between The Insight and existing systems

Systems	Features					
	Real Time Data	Web Based Architecture	Information Sharing	Report	Loss Time Alert	Tracking Unfinished Products Causes
Enterprise IQReal Time	Yes	No	Yes	Yes	Yes (Via Light)	No
CC+I PLMS	Yes	No	Yes	Yes	No	Yes
Shortscope NX	Yes	Yes	Yes	Yes	Yes (Via Email)	Yes
Intouch	Yes	No	Yes	Yes	No	No
Evocon	Yes	Yes	Yes	Yes	No	Yes
Factbird	Yes	Yes	Yes	Yes	No	Yes
The Insight	**Yes**	**Yes**	**Yes**	**Yes**	**Yes (Whatsapp, or Email)**	**Yes**

3. System Requirements and Analysis

The proposed system, The Insight is a web based real time production monitoring system that encompasses several useful features that provide a comprehensive solution to the user. The Insight is divided into two core modules namely Data Collection and Reporting (Fig. 1). The system scope and capabilities of The Insight will be elaborated in detail by going through each sub-module, one at a time.

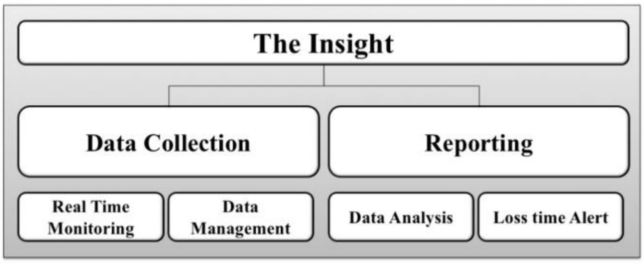

Fig. 1: The Insight module diagram

First, the Data Collection module is responsible to collect the production line data. It consists of two sub-modules to provide real-time monitoring and store collected data in database. Data collected will be displayed in a tabular format. Colour coded display is used to provide fast and accurate visualization of production status.
The second module (Reporting Module), is to do in-depth data analysis that turns information into knowledge. There are two sub-modules in reporting module. The Data Analysis module is to produce report based on the data collected. Report can be configured for any selected periods with three key performance which are productivity, loss time and cycle time. Meanwhile, it also highlights the top loss time causes for the past selected periods to enable user to be alert on the likely reoccurrence of loss time issues in future. The production line productivity is computed based on real time data and displayed in one big screen. The Loss Time Alert module is responsible to alert the respective personnel through email and Whatsapp when loss time percentage has reached a certain level. Line foreman will be able to log the loss time activity at the same time trigger notification to send to respective personnel through the system to solve loss time issues immediately. Instead of using SMS, Whatsapp messaging is implemented to avoid extra cost charged by using SMS service.
As the system is designed in web-based architecture, it allows the user to access it anywhere, anytime within the organisation connected with Intranet. Web based system always raises security issues. Thus, The Insight will only allow authenticate users to access the system depending their access level. Before using the system, users are required to register themselves to the system. The system administrator will then process the application and assign them to their respective access level.
The real-time productivity of the production line will be displayed in a large font size on the system screen to ease visualization. Firstly, the user is required to enter production line information before real time data is collected. The user inputs include duration of shift, target productivity and target quantity. Based on these information, real time data will be collected using a bar code system, The Insight will then compute the line productivity and cycle time per unit using Equation (1), (2), and (3).

$$Target\ cycle\ time\ per\ unit = \frac{Duration\ of\ Shift(in\ minutes)}{Target\ quantity} \quad (1)$$

$$Actual\ cycle\ time = Scan\ out\ time\text{-}Scan\ in\ Time \quad (2)$$

$$Productivity = \frac{Actual\ Accurate\ Output}{Plan\ Accumulate\ Output}\ X\ 100\% \quad (3)$$

The Insight relies only on two bar code scanners, one at the input station and another one at the output station of the production line to collect real time data. As data are only captured at the beginning and the end of production line, process status within the production line remain unknown. When a product is not scan out after given cycle time, it could be due to several reasons such as rejected, insufficient materials or machine problem. The system is not capable enough to identify the reason automatically and it requires the line foreman to log the reason of the part that is not scanning out after given cycle time through the system.
The Insight is developed using Agile Methodology emphasizing on iterative and incremental development. The project is initiated by defining the problems and followed by the requirements of the system. The design and implementation process then take place, module by module with integration testing between each module. In other words, Real Time Monitoring sub-module is developed first followed by Data Management sub-module. The modules are then integrated and tested before moving on to the next sub-module and so forth. An analysis and review session was held from earlier iteration to obtain feedbacks and opinions, allowing the stakeholders to fine-tune requirements while the system still relatively easy to change. The feedback is reviewed and refinement incorporated during the next iteration. The cycle continues until The Insight fulfils its system requirements and proceeds to full-blown system testing such as usability testing and performance testing. Flow chart of The Insight is as shown in Fig. 2.

4. System Design

The Insight is entirely web-based, granting user access to all features using only a web browser. This architecture eliminates the need to install client software or browser plug-ins, and future enhancement is centralized and easy to deploy. The system is installed on the SME's Intranet server. Barcode scanner is required to attach at the beginning and at the end of production line to capture the item information. Each job sheet will be tagged with a barcode and travelled with the item along the production line. The collected data is saved on server database. When user wants to view the real-time data, system will retrieve data from database, process the data and display it in a meaningful way to the user. The data display is aided by colour code to enhance the users' visualization. The system can send alert to the user via email when the productivity fail rate increases every 5% each time. System architecture of The Insight is as shown in Fig. 3.

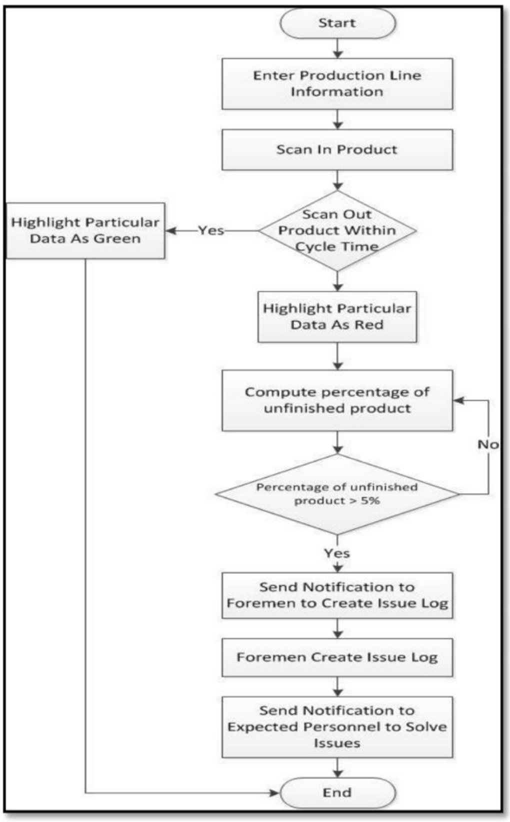

Fig. 2: Flow chart of the Insight

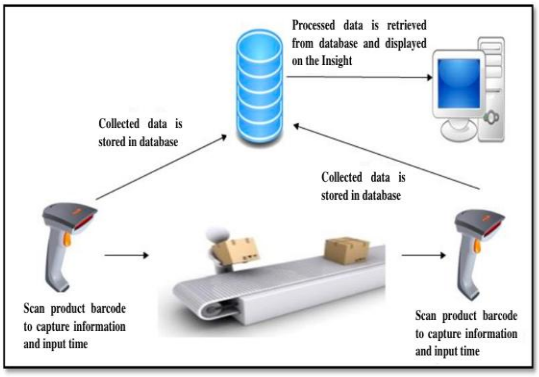

Fig. 3: The Insight system architecture

4.1. System Module

The details and specifications of The Insight in terms of module design are explained in the following sections.

4.1.1. Data Collection Module

Data Management The Data Management manages the user data and real-time data. To access the system functionality, users are required to register themselves to the system. The register application will be stored in database and wait for processing. The admin will process and manage those application data by rejecting or approving user's registration. Each user group will be assigned to different access level. Manager has full access to the functionality of the system; Foreman has limited access to the system, while, Operator can only able to access the bar code scanning function. Besides, there is an access setting feature, for example, admin can enable the access setting, then add or edit the accessibility for each user group to each Web page and functions.

Real Time Monitoring. Real Time Monitoring is to show productivity level in real time. During production, operator will scan in job sheet's barcodes at input station and scan out job sheet's barcodes at output station. The scan in time and scan out time for each barcode will be stored in database. Base on the scan in time and scan out time, the system is able to compute the actual cycle time of each product. Based on cycle time, productivity can be calculated. There are two display sections a) each individual product data and b) accumulate productivity. Colour code is implemented to enhance the user visualization on the real-time data. There are three colour codes setting for individual product data as followings:

1. Green: Product is scanned out within the cycle time.
2. Yellow: Product is scanned out after cycle time.
3. Red: Product is not scanned out after its cycle time.

While for Accumulate productivity, there are two colour code setting:

1. Green: Product is produced out of target set
2. Red: Product is produced within target set

The real time monitoring also captures the actual output of the production. When one item is scanned out, the number of actual output will be increased by one. The number of actual output will be used to compute the productivity. The user interface for real time monitoring is as shown in Fig. 4.

Fig. 4: The Insight real time monitoring interface

4.1.2. Reporting Module

Data Analysis By having the real-time data stored in database, the data are utilized by conducting in depth analysis to transform the data to information. The information as the result of data analysis is useful to the manager and allows them to make informed decision. User can configure the report based on the preference key performance and selected period. There are three periods selection available which are monthly report, quarterly report and yearly report. Three types of report are created to assist the manager on improving productivity and line balancing. The types of reports are described in details as followings:

1. Productivity Report: The report is shown in line graph by plotting the actual productivity achieved and the target productivity. User can compare the actual productivity with the target productivity and determine the line productivity performance. Example of Productivity Report is shown in Fig. 5.

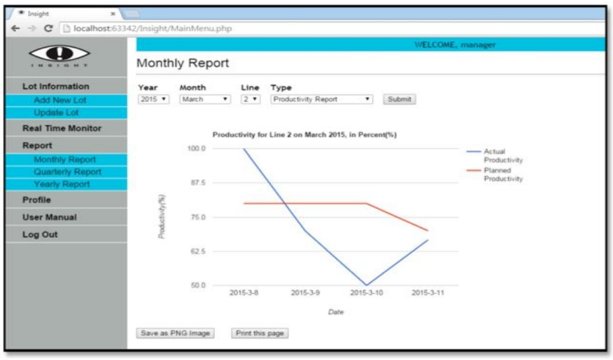

Fig. 5: Productivity report on the Insight

2. Loss Time Causes Report: The report is presented in pie chart. The number of loss time causes and its percentage will be computed. Users are able to determine the top loss time causes on the selected period and carry out investigation and prevention of possible loss time event.
3. Cycle Time Report: The report is displayed as line graph. Actual average cycle time and planned cycle time are plotted according to selected period and line number. The system is able to provide suggestion on cycle time for next production depends on the actual average cycle time computed. This suggested cycle time can help to optimum the target output of daily production.

5. System Implementation, Testing and Evaluation

5.1. System Implementation

The proposed web-based system was written in PHP scripting language and JavaScript programming language. A top down strategy was deployed during the system development and implementation process. The user interface of the system was developed first followed by the system functionality. The main application page that consists of all the major functions was developed first. It is followed by the basic functionality of the modules including real time monitoring, report creation, issues logging and alert triggering. After that, the data access layer was added to complete the whole system. By implementing top down approach, a limited working system was made available on the early stage of design process. It gave a big picture on the flow of the system. The process began with the complete view layer classes and stub was used as the functional class. The process was repeated by replacing stub with a lower level module until the whole system was completed with its expected functionality. Furthermore, top down implementation strategy is easier to manage compared to bottom-up development. Some samples of user interfaces are shown in Fig. 6 to 9. Fig. 6 is the Admin home page where functions such as user account setting, access level, edit of of new product, new line can be performed. Fig. 7 is the page where Operator scan in product using a bar code scanner. Fig. 8 shows how Foreman can create a new lot before the Operator start scanning and finally Fig. 9 shows the page where Foreman can create issue log when loss time occur.

5.2. System Testing and Evaluation

Unit testing of The Insight was performed on each sub-module individually. The goal of unit testing was to take the smallest piece of testable software in the application, isolate it from the remainder of the code, and determine whether it behaved exactly as expected. The functions of each sub-module were tested thoroughly before the integration with the next sub-module. For instance, the function of Real Time Monitoring was tested as working before the integration with Data Analysis and Loss Time Alert sub modules. Late detection of bugs and errors would bring unwanted impact to the development and modules integration. Thus, testing process was carried out as early as during the initial development stage. Integration testing of The Insight took place after the unit testing and essentially ensured the system still work as expected after the integration of a new module. For instance, the first integration testing took place after the unit testing on Real Time Monitoring and the integration of Loss Time Alert and Data Management. Integration testing then continued until all modules were completed and integrated into The Insight.

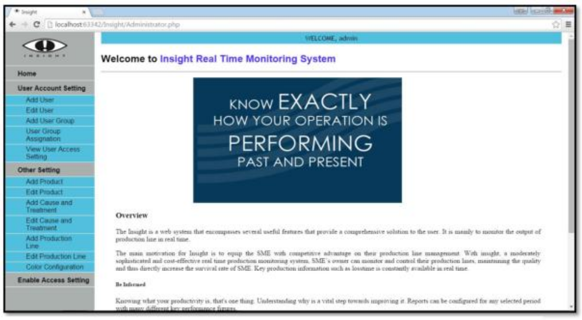

Fig. 6: Admin Home Page

Fig. 7: Operator Scan in Product Page

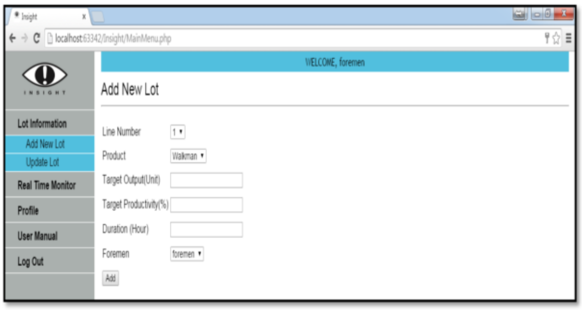

Fig. 8: Foreman Create New Lot Page

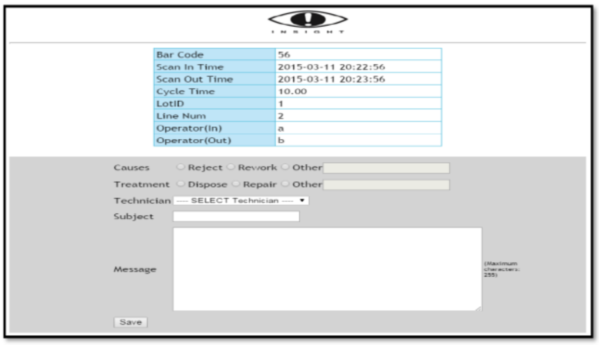

Fig. 9: Foreman Create Issue Log for Loss Time Page

Sufficient test cases were designed according to the requirement-based strategy to verify and validate the system is reliable and meet the specified requirements. After each test case was executed, the actual output of the particular test case was compared with the expected output to decide whether there is a failure. Details of the test cases are shown and displayed in Table 2 for data management, Table 3 for real time monitoring system, Table 4 for loss time alert and Table 5 for data analysis.

Table 2: Test case for data management

Test Case	Initialization	Test Input	Expected Result
STD-0001A1.1	Click on Login button	Valid username and password	User directed to expected main page and functionality
STD-0001-A1.2	Click on Login button	Invalid username and password	User is prompt to enter valid username and password
STD-0001-A2	Click button "Add"	Line number, product, duration, target output, target productivity, Foreman	New record added
STD-0001-A3	Click button "Edit"	-	Directed to Edit Form Page with existing record
STD-0001-A4	Click button "Delete"	-	Selected record deleted
STD-0001-A5	Click button "Scan"	Bar Code	- New record added. - If record exists, then this particular existing record scan out time updated.
STD-0001-A6	Set User Access Level	Enable view, User group	User able to access authorized functionality. Unauthorized functionality is invisible to user.

Table 3: Test case for real time monitoring system

Test Case	Initialization	Test Input	Expected Result
STD-0002-A1	View Real Time Table	-	- Display all line real time data. - Individual product data is highlighted as red if the product is not scanned out within cycle time. - Individual product data is highlighted as green if the product is scanned out within cycle time. - Individual product data is highlighted as yellow if the product is scanned out after its cycle time.
STD-0002-A2	- View real time table - Item Scan In and Scan Out	Line number and date	- Data with Selected line number and date are displayed - Productivity is computed - Productivity highlighted in red when less than target productivity. - Actual Output shows increment by one when item is scanned out. - Planned Output shows increment by 1 after cycle time pass

Table 4: Test case for loss time alert

Test Case	Initialization	Test Input	Expected Result
STD-0003-A1	Productivity fail rate increasing 5%	-	- System trigger notification send to foreman - Foreman receive email.
STD-0003-A2	Click Icon "Note"	-	Pop up window with particular real time data information amend with issue log form
STD-0003-A3	Click button "Save"	Causes, Treatment, Subject Message, Technician	- New Record Added - If Technician Not Null, message send to technician via Email and Whatsapp message - Technician receive Email and Whatsapp message. - Icon "Note" change colour to black indicates record saved.

Table 5: Test case for data analysis

Test Case	Initialization	Test Input	Expected Result
STD-0004-A1.1	View Productivity Report-Monthly Click button "Submit"	Month, Year, Line Number, Type	Display Productivity Line Graph for particular month
STD-0004-A1.2	View Productivity Report-Quarterly Click button "Submit"	Quarter, Year, Line Number, Type	Display Productivity Line Graph for selected quarter
STD-0004-A1.3	View Productivity Report Yearly Click button "Submit"	Year, Line Number, Type	Display Productivity Line Graph for selected year
STD-0004-A2.1	View Loss Time Causes Report-Monthly Click button "Submit"	Month, Year, Line Number, Type	Display Loss Time Causes Pie Chart for selected month
STD-0004-A2.2	View Loss Time Causes Report-Monthly Click button "Submit"	Quarter, Year, Line Number, Type	Display Loss Time Causes Pie Chart for selected month
STD-0004-A2.3	View Loss Time Causes Report-Quarterly Click button "Submit"	Year, Line Number, Type	Display Loss Time Causes Pie Chart for selected month
STD-0004-A3.1	View Cycle Time Report-Monthly Click button "Submit"	Month, Year, Line Number, Type	Display Cycle Time Line Graph for selected month. Display suggestion cycle time for next production
STD-0004-A3.2	View Cycle Time Report-Monthly Click button "Submit"	Quarter, Year, Line Number, Type	Display Cycle Time Line Graph for selected quarter. Display suggestion cycle time for next production
STD-0004-A3.3	View Cycle Time Report-Quarterly Click button "Submit"	Year, Line Number, Type	Display Cycle Time Line Graph for selected year. Display suggestion cycle time for next production
STD-0004-A4	Click button "Save as IMG"	-	Graph downloaded as IMG to user's computer
STD-0004-A5	Click button "Print"	-	Display Print Setting

All the modules in the project have been tested. Table 2, Table 3, Table 4 and Table 5 show the coverage of the test cases, which covers all the modules in the system.

The uniqueness of the proposed system is that it incorporates with simple input scan device which, is a barcode scanner to collect data and allow those data to be displayed as information in real time. Based on the real-time data collected, the system is capable to compute the productivity of each production line and keep the line manager informed about their production line performance. As the system is deployed as Web based, it allows user access to all features using only a web browser. This has eliminated the hassle of installing and updating client software and made future enhancement and maintenance process easier. The data collected during production can be processed and undergo analysis to generate report that can help the manager in making productive and proactive decision. Reports generated include i) Productivity Report which empower the manager accurate information to monitor their production line performance, ii) Loss Time Causes report that illustrate the main loss time causes happened in the selected period and iii) Cycle Time Tracking Report that display the average of cycle time for selected period and recommend the cycle time for the next round production to optimize the product output. Loss time event is a common but unwanted occurrence at production site. It is important to respond to an unscheduled loss time event as soon as possible before it affects the line productivity.

However, The Insight has its limitations. The cause for loss time is manually tracked. As the bar code scanners are only attached at the input and output station, the process within the production line cannot be tracked. Thus, this required the user to manually log the loss time report.

6. Discussion and Conclusion

The main contribution of this paper is a proposed web-based knowledge management system that provides real time data and enables production line manager to have better control and enhance the visibility in manufacturing operation. Results is displayed and updated with changing colour code without the need of user to manually refresh the page from time to time.

The result generated from The Insight is greatly depending on the data collection process from the production line. Thus, error prone prevention of real time data collection was taken into consideration. As the input station and output station are in charged by different operator, hence, before the scanning process starts, operator is required to input his/her employee identification number. At input station, where the scan in time is captured, if the operator accidentally scanned the same bar code twice, the system is able to differentiate the double input and abandon the latter scan in time of the particular item. The operator employee ID and scan in time is the key element to differentiate scan out time from the scan in time. By leveraging on the power of Internet and the system is accessible anytime and anywhere. The high visibility of real time productivity will lead to much faster response to loss time incident.

The Insight has a broad set of improvements as future work such as the system mobility. Mobile version of The Insight can be developed in the future. Notification can be directly pushed to the users' mobile application instead of sending email and Whatsapp message. Besides, The Insight can be improved to equip and automate some of the features and functionality such as auto record loss time causes instead of manually creating issues log. The Insight reporting system can be further enhanced as well to provide more key performance configuration that allow user to make timely decision.

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