Improving Production Efficiency Using Sensors

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Abstract

This paper presents the outcomes of an ongoing project carried on in a manufacturing company. This company manufactures aluminum parts for the suppliers in automotive industry. Due to higher quality standards expected by their customers, company is currently applying POKA-YOKE approach for quality improvement. However, the company is facing high return rates for some of the orders sent to their customers as they are facing some challenges in their quality control processes. Recently 2800 items from an order of 4000 parts are returned and this incident has led us to propose a project to improve their quality control levels. Currently Industry 4.0 approach has been widely accepted in the automotive industry as well as many other industries. Industry 4.0 provides an underlying theme for this project.

Keywords
Quality Control, Poka-Yoke, Digital Sensors, Control Fixture and 8D Report.

1. Introduction
The main objective of this project is to solve quality related problems faced recently by a manufacturing company. It is made to reduce the large error rates detected after quality control.

1.1 Objectives

In order to solve quality related problems, two different proposals are suggested.
(i) A quality control approach that targets zero returned parts; (ii) Using digital sensors to improve the quality control process in production.

2. Literature Review

In the literature review, several keywords are looked into existing work in the area of (i) quality improvement, and (ii) digital sensors. This article is prepared by reading over thirty different related articles.

2.1 Quality in Manufacturing

Quality 4.0 corresponds to the growing digitisation of industry, which uses advanced technologies to enhance the quality of manufacturing and services. This fourth quality revolution is envisaged to digitize the entire quality systems and subsequently improve the existing quality approaches. Innovative industries adopt cloud-based quality 4.0 innovations in the controlled production process (Javaid et al., 2021).

2.1.1 Improving Quality

Quality improvement is one of the most important factors in the ending of a product as an idea until the end of the sale. It is very rich in terms of quality application techniques and can be adapted to any type of production. Many organizations are in great competition in the market and are doing the necessary research and studies to meet the market needs in the most optimum way. Many companies use quality as a better competitive tool in this market, and quality is always on the hot agenda in most organizations, product quality (Pascu et al., 2020). They conduct research and studies on low-quality costs and high customer satisfaction [(Chin et al., 2002)]. As a result of these research and studies, many Techniques for quality improvement have been logically and practically tested over time and brought to optimum levels. To give examples of quality techniques, Histogram, Control Chart, Flow Chart, Poka-Yoke, etc. Many techniques have been developed.

2.1.1.2 Poka-Yoke

The main quality technique of our project is the Poka-Yoke quality technique. Poka-Yoke plays an important role in detecting errors that occur in manual transactions in a system and is the only purpose of sending an error-free product to the user, no attempt is made to eliminate or prevent errors in this system, but if corrections and improvements are made in the systems feeding the Poke-Yoke line in line with this system, Poka-Yoke -Yoke indirectly plays an effective role in the development of the system. Understanding quality in manufacturing starts with learning why errors happen and this could be improved by analysis with root causes related to human errors. Human reliability influenced by equipment design or working environment will come to the concept of poka-yoke (mistake proofing), and various means to reduce mistakes that have been greatly improved recently with latest sophisticated technology (Widjajanto et al., 2020). If the Poka-Yoke system is implemented in the right place and in the right way, it is possible to avoid all factual errors. If users detect an error in the product they purchased, they can impose sanctions on the manufacturer by the contract rules and as a result of these sanctions, a positive result from the manufacturer can be obtained from the manufacturer. When they do not receive a response, they may terminate the contract between them and start looking for another supplier [Shahin and Ghaemmaghami 2010]. The Poke-Yoke system was invented in 1961 by Toyota employee Shigeo Shingo. He defined this system as preventing errors caused by production errors, in other words, covering up the errors [Dudek-Burlikowska 2009]. While it is impossible to confirm the faulty product in the Poka-Yoke system, it is close to impossible for products with minor mistakes, which also saves a lot of time supporting a situation to reduce costs, because if a product is sent to the user incorrectly, it is extremely possible to return the product. Imperfections and errors can occur for many reasons, but they can be avoided with Poka-Yoke. The use of quality tools or technologies such as Poka- Yoke is necessary to maintain a quality level that meets or exceeds the customer's expectations, besides avoiding high costs with rework, waste of productive material, recall among others and dirty the image of the company(de Souza et al., 2018).

2.1.2 Digital Sensors

It has been integrated into quality control with the increasing use of digital technology along with large-scale heterogeneous sensor networks and machine learning methods (Eichstädt et al., 2021). There is currently an explosion in the number and range of new devices coming onto the technology market that use digital sensor technology to track aspects of human behavior (Seedhouse & Knight, 2016).

In a comprehensive way, a sensor is a device, module, machine, or subsystem whose purpose is to detect events or changes in its environment and send information to other electronic devices, usually to a computer processor. It is also known as the sensor. Sensors are used in a number of applications that people would never guess.

The sensor was first used in 1987. The first sensor discovered is the compass. Later, magnetic sensors are developed and used in various wars. With the development of technology, many sensor types have been developed, but basically, there are two types of sensors; Analog Sensor and Digital Sensor. They have heat, optical, sound, magnetic and pressure sensors as subheadings.

2.1.2.1 Optic Sensor

Analog sensors give a current or voltage output that varies in proportion to the physical magnitude they detect.Digital sensors, on the other hand, usually talk to a computer (microprocessor) via a communication protocol such as I2C, SPI, OneWire, etc.

The areas of use of photoelectric (optical) sensors are very wide. For example, it is very important how many pieces of products produced in factories engaged in mass production in industry are produced. Or, in order for the automation process steps to be operated in a healthy way, the products produced must be counted correctly while passing through the conveyors (Teucke et al., 2018).

Increasing digitalization in the context of Industry 4.0 offers the potential to increase the level of transparency in supply chains. Optical sensors can be used in quality control in production. Especially in the automotive industry, with the integration of optical sensors, production and transportation can be made without disrupting the supply chain. Late delivery or incorrect delivery can be avoided as much as possible. Because a problem that may occur in quality control leads to deviations, sometimes it is detected only at a late stage in the supply chain, which leads to costly compensation measures (Young et al., 2020).

2.1.3. Control Fixture

For serial part manufacturers such as Control Fixture, plastic and sheet metal parts, the most important issue is the verification of product quality. Especially in the automotive sector, parts have a complex structure that cannot be measured with hand tools such as calipers and micrometers. In this case, equipment is needed. Check fixtures are equipment produced for the verification of this type of parts. For the application of SPC in automotive, multiple measurements must be made from the points specified in the control plans. Control fixtures are used for this purpose in automotive. This type of fixtures contain structures on them to take measurements from SPC points with a comparator. In short, the fixture enables sheet metal molds and parts to be made faster and easier in the production, measurement and control stages. Although analysis programs are developed, there is no one who produces zero errors.

In the automotive industry, the production line for assembling mechanical parts of vehicles must place and weld hundreds of components on the right positions of the platform. The accuracy of deploying the components has a great impact on the quality and performance of the produced vehicle. To ensure the assembly accuracy, a critical task in the production process is the so-called dimension quality control. The current state of practice in automotive industries is mainly based on a manual process where experienced engineers use production data to identify accuracy problems and suggest solutions for corrections on fixture adjustment in the assembly line. It is an extremely inefficient process, which typically takes the engineers around ten days for one batch of vehicles and a year to achieve the required assembly accuracy for final production. In this article, we present an automatic technique for dimension control. We formulate the dimension control problem as a constraint programming problem and present a refinement method to prune the exploration space. Our technique can not only identify the wrongly deployed parts leading to dimensional defects, but also provide high-quality fixture adjustment decisions. Experiments conducted on industrial production data from BMW Brilliance Automotive demonstrate the significantly improved efficiency and effectiveness of dimension control in automotive industries with our approach (Ma et al., 2021).

In quality control, it is very important that the control fixture gives an error-free output, and control fixtures have developed in parallel with the development of quality control. Analyzes are made on control fixtures. To better understand the importance of the control fixture, let's examine a study by BMW. The assembly process of a car body (BIW) in a body shop is a crucial link in the complete vehicle manufacturing process, and BIW dimension quality control is the most important part of BIW quality control. The problem of quality-related fixture failure diagnosis has been proposed in the intelligent dimensional control loop [established at BMW Brilliance Automotive company (BBA)], which aims to detect the armature defect that can seriously affect the BIW dimension quality. It introduces a new diagnostic method related to statistical quality by generating and establishing a hypothesis test between the fixture-free model and the fixture-free model to detect it. potential fixture failure, meanwhile predicts fixture failure occurring at the station with maximum probability estimation. The fixture fault diagnosis flow chart is created to reduce the rate of false and missing alarms in the actual production process. The case study, based on real BIW component assembly process data from BBA, demonstrates that this diagnostic method can accurately broadcast the luminaire failure alert and send the correct order to onsite workers to continue placing the luminaire in a product line (Fu et al., 2023).

Control fixtures used in part control are of great importance in terms of product quality. Correct positioning of the sheet metal piece on the control fixture is crucial for measurement. Accordingly, it is of great importance to position the closing sequence written on it and to insert the pins in the correct places. Parts with complex geometry are difficult to control. Especially when connecting the mold to the first press, setting the mold and catching the size is a very time-consuming task.

In relation to the advantages of the fixtures, numerous advantages associated with its use are identified: increased production, cost reduction, interchangeability and high accuracy of parts, reduced need for inspection and quality control expenses, reduced accidents with increased safety, significant automation of the machine tool, easy processing of complex and heavy components, as well as ensures that the manufactured products are of consistent quality.

First of all, unless otherwise specified, the surfaces are processed with an offset according to the sheet surface to be controlled. In order to control the trim, that is, the cutting of the part, the side surfaces must be processed in the normal of the part trim, that is, vertically, which is the feature that makes fixture processing the most difficult. In order to achieve this, sometimes it is necessary to design the fixture in parts, and sometimes it is necessary to connect it more than once and process the reversed parts. To connect objects requires precise drilling perpendicular to the surface, which is a difficult task. These probes are taken as reference so that the fixture can be measured. Also, if they are very close to each other, your job is more difficult. In order to get Okey, it is necessary to process the fixture many times and have it measured in 3D many times. Developing and constantly renewed technology brings with it a lot of convenience. It is possible to give the best example of this from our country. While molds are made by hand 10 years ago, now they are easily produced in CNC. This minimized the working time of the mold maker.

It provides repeatability in the measurement and control of parts in the fixture. Fixture making is a difficult and laborious job. Because there must be zero error in the thousandth measurement system. That means we have to deal with it for days. But it is easy and practical to use after its production is finished. We do not encounter any problems when we apply what is written in the instructions for use in order to be able to measure and control correctly. Our job is easy if there is a control fixture while executing the mold and checking during production (Chikwendu Okpala, 2015).

As a result, due to the increase in the production of parts with complex geometric shapes with the developing technology, the fixture has become an indispensable part of the mold industry and fixtures are produced after almost every mold production.

2.1.4. %100-%200 Quality Control

Quality control plays an important role in the automotive industry to impose product standards on the customer. In order to be permanent in the competition, companies must adopt a perspective that is integrated with today's conditions. The conditions brought by today's conditions make it necessary to develop and improve production methods and to be able to make a continuous development and improvement in quality together. There are several types of quality control methods in the automotive industry. 100% Quality Control and 200% Quality Control studies are carried out in the factory where our project is worked on. When our project reaches the feasible level, it will not be necessary. Given that the quality is not static, it is constantly being changed, and because customers are increasingly demanding, any business organization that aims to be competitive has to innovate. In the competitive environment in which we live organizations increasingly seek to produce quality at the lowest possible cost, to ensure their own survival (Godina et al., 2016).

Quality control in the automotive industry played a significant role in an ever growing need to implement continuous improvement methodologies in automotive companies. Every company sets up higher quality standards to attract customers into purchasing their product and maintain the customer expectation. The selection and application of quality control and continuous improvement methods depends on companies structuring the quality system, classification of faultless operation methods and techniques. Each company need to establish and follow quality system methodologies to help ensure their product consistently meet applicable requirement and specifications.In order to remain competence and survive in the business, each company focus on improving product quality and reduce rework to save time and cost subsequently fulfills customer needs From product development to final product delivery to the customer (Hafizi et al., 2019).

Many methods have been developed for quality control methods, but the methods we will concentrate on are those developed for the automotive industry that concern our project. In order to better understand the methods in the automotive sector, it is necessary to exemplify this literature part of our project. Weibull has had a study on quality control. Distribution in analyzing characteristics patterns of product reject data. This method aims to pinpoint the root cause of the defect product and provide statistical value and distribution plotting graphs from analysis to determine level of production performance. This method divides the most common root cause into four groups. This group are design reject, manufacturing reject, lack of warning and instruction reject. Material, design and processing method is the most common factor contributing to product defect in every manufacturing. The result from this method could identify the inconsistency and abnormality practice in the production line. This inconsistency of working is mostly caused by human error. The data must include item specific failure (times to failure) for the population being analyzed, data for all items that did not fail must also be included and the analyst must know all experienced failure-mode root causes and be able to segregate them (Hafizi et al., 2019).

Statistical Process Control (SPC), another method developed, has been a tool in the continuous improvement of quality, even though it is about not having problems in product production. Because every company that wants to stay strong in competition has to strengthen its quality control methods as much as it wants to strengthen its product line. You can understand that the processes are well-executed from the data after the quality control of the result.

SPC, by using statistical tools, this method monitors the performance level of the manufacturing process. It will be able to predict if any significant deviations occurred that can lead to defect products. It is a statistical method regularly used in monitoring and control of a process to ensure it operates at full capabilities. In order to prevent problematic products passed on to the customer as well as reducing waste product, variation in the process that may affect the quality of the end product need to be detected and corrected. Implementation of SPC Techniques in Automotive Industry: A Case Study by [5] conclude, SPC analysis has the capabilities in improving the efficiency of the production process (Hafizi et al., 2019).

As can be seen in the examples, improvement is aimed at every period in quality control. With the development of technology, these developments have both come to better levels and accelerated. The aim of minimizing manpower, time, speed, logistics and warehouse costs has been observed in each project.

In the quality control methods used in the factory where the project is worked, the person working on the part coming from the production line first checks it with the help of hands and eyes. Then it goes to 100% quality control. This control is done by factory personnel. The defective products that pass the quality control here go to 200% quality control and are checked again by the personnel who do not work in the factory. The aim here is to pass through a different eye and quality. The aim of the project is to reduce labor costs and not to waste time by controlling without the need for this control method. By developing our project with the logic of Industry 4.0, we can achieve smart factory systems by benefiting from the benefits of new technological developments integrating Industry 4.0, hardware (sensors, actuators, cloud computing technologies and Internet of Things) and software (intelligent data collection, analysis systems and artificial intelligence techniques). It is an innovative approach to), to achieve autonomous, self-learning and optimized production systems (Zaidin et al., 2014).

100% quality control is the control of all manufactured products one by one. Although it is considered to be one of the most ideal control forms, its cost is high. There is no degree in this method. The product is either good or bad as a result of the quality inspection. Therefore, defective products that pass the inspection are encountered in the last part of the supply chain, and this is reflected in the factory as an expense and means that the desired number of products could not be supplied to the supplier.

The 200% control is carried out by the personnel of the buyer company. The purpose here is to have the control done by another eye. Providing high quality products, not covered by defective products, is an important part of the supply chain between the automotive parts manufacturer and the final assembly company. Upon detection of nonconforming products in its factory, the Buyer contractually requests the supplier to initiate Controlled Shipment Level 1 procedures. The Controlled Shipment Level 2 procedure is performed on the basis of outsourcing by a specialist outside company at the supplier's factory as a result of no significant improvement. The research, which is also confirmed by expert interviews, shows that automotive companies aim to make their business more flexible in order to respond more quickly and easily to internal and especially external factors. It provides outsourcing for quality control in the opinion of production and quality managers (Ulewicz, 2018).

2.1.5. 8D Report

The 8D Report is a method used by engineers and other specialists to solve product or process problems. The purpose of the report is to identify, correct and eliminate recurring problems. The 8D report sets out permanent corrective actions based on the statistical analysis of the problem as well as the origin of the problem. This type of report has been developed by Ford Motor Company and has become a standard in the automotive industry, especially used to solve customer complaints about non-compliant products. The name of the 8D report comes from "8 Disciplines". These 8 disciplines are actually 8 points that delimit the steps you take if a problem or defect is observed in a process or product. Specifically, the 8Ds are focused on: (D1) develop a team, (D2) describe the problem, (D3) develop an interim containment action, (D4) determine and verify root causes, (D5) Choose/verify permanent corrective actions, (D6) implement and validate corrective actions, (D7) prevent recurrences, and (D8) recognize and congratulate teamwork as well as individual contributions, which is a powerful method because it helps with creating appropriate activities in order to identify the root causes of a problem, and provides permanent solutions to eliminate them (Realyvásquez-Vargas et al., 2020). Solution stages are: choice 8D team identification and responsibilities, problem description, defining of the control actions, cause analysis, defining the corrective actions and demonstration of efficacy, the implementation of corrective actions and demonstration of effectiveness, Prevention of recurrence of nonconformities and completion and signing the final report 8D (Pacana, 2020).

It is generally a tool where a manufacturer methodically informs the customer that a problem reported by the customer has been correctly identified, corrective action has been taken, and preventive measures have been taken by analyzing the part of the process. 8D is used as a communication tool between companies to prevent quality errors and
can be used for similar purposes within the organization, between supplier and customer processes. It is one of the very important components of the 8D Onsite Quality approach.

It was published by Ford in 1987 as Team-Oriented Problem Solving, and in the late 90's Ford renewed it as G8D to become a global standard. 8D is also widely used in industries other than automotive due to the benefits it provides.

- Produces a permanent solution as it focuses on the root cause.
- Prevents recurrence of the problem and similar problems.
- Strengthens the control system by providing analysis of how the error escaped the control system.
- Enhances learning.
- Adopts the inadequacy of fire extinguishing.
- It creates a culture that can be a solution to different problems by developing a team approach.
- Gives customer confidence.

D1: Team building

It creates a team of people who work at the points where the problem is created and are observed, and who are in control of the process, and generally in the hands of 8 people. Teammates are expected to be able to agree on 8D's purpose, target (Muncut et al., 2019).

D2: Problem description

An attempt is made to create a short but clear and specific definition of the problem. While defining the problem;
Where and when did the problem occur?
What affected, what caused the problem
Questions such as answers are sought. In this section, besides a short and specific description, it would be good to give additional page shortcuts showing that the problem is well analyzed and handled correctly. 5W1K analysis that

shows the variables that may affect the occurrence of the problem, or analyzes such as a Pareto diagram or process flow, where the influencing factors are listed. can be accessed by these shortcuts (Muncut et al., 2019).

D3: Identifying priority corrective action

In this step, actions are taken to show that the problem is under control immediately. For example, if there is stock, there are explanations such as the total number of blocked products and semi-finished products, what kind of sorting process is done, what is done to avoid the same error in the ongoing production, what additional controls are made. In addition to these, if the products to be shipped will need to be shipped with a different label indicating that these controls are good parts, new label information is also among the shared explanations. If the defectively separated products are to be repaired, how the repair will not cause a new defect is also among the expected explanations (Muncut et al., 2019).

D4: Identify root causes and leak point

Fishbone analysis is used to ensure that potential causes identified at the time of problem identification have been adequately evaluated. This analysis helps us remember some of the factors that we could possibly miss. Before reflecting on root causes, we need to validate all the potential causes we have listed. Validation is a very important step. Not only does it prevent us from mistakenly pretending an invalid potential cause is a valid one, but also the observations and analyzes made during validation have a positive impact on the root cause quality (Muncut et al., 2019).

D5: Identifying priority corrective action

One or more of the reasons between the apparent cause and the root cause that we have stated in the root cause analysis are candidates for corrective action. It may take a long time to take action on the root cause, but the process steps affected by the root cause are usually taken faster. Since it would not be highly desirable to continue the production process of 8D with a high level of attention and control, taking action to the steps that lead us to the root cause will bring the control level back to normal (Muncut et al., 2019).

D6: Implementation of permanent corrective action

Although we cannot take immediate action against the root causes, the priority actions we have determined, which will have a great impact on permanence, are implemented as quickly as possible. After these actions, which we believe to be permanent, are implemented, it is important to verify the results and monitor their stability. It should be noted that at this stage, no action has been taken against the root cause yet. In order for temporary improvement not to turn into permanent relief, it is necessary to follow the progress of 8Ds with lists and tables. Table 8D includes the planned schedule for the steps, the actual schedule, and a brief description of the next step's action (Muncut et al., 2019).

D7: Prevent duplicates

The 7th step requires taking action to the root cause as planned so that the error does not recur. Taking action to the root cause and good results does not yet mean that 8D has achieved its purpose (Muncut et al., 2019).

D8: Analysis of results and congratulations to the team

In the closing part of 8D, short notes on the completed activities and how the results are verified are shared. It's helpful to fill out a simple completion checklist to make sure nothing is missing (Muncut et al., 2019).

3. Methods

In the first stage of the project, the product coming out of the tape will be fixed to the fixture where the part is with a single operator, and optical sensors will be placed to see and see the predetermined critical points of the part. With the information from the sensors, the defective parts will be thrown into the scrap box and the correct parts will be thrown into the shipping box by a mechanical mechanism.

4. Data Collection

Date	Press	Product	Start Time	End Time	Work Time	Stop Time	Produced Quantity	Target Product Quantity	SPM(Real)	Target SPM	% SPM	Usability	Performance	Qality
5.07.2022	800	2215/17-10	15:30	16:10	25	15	530	530	21,2	0		63	0	100
6.07.2022	500	2215/17-20	15:30	23:30	390	40	800	975	2,05	2,5	82,05	91	82	78
17.06.2022	800	2215/17-30	04:40	05:10	23	7	50	61,87	2,17	2,69	80,8	77	81	100
18.06.2022	800	2215/17-30	06:15	07:30	50	25	110	134,5	2,2	2,69	81,8	67	82	95
7.07.2022	Raster 2	2215/17-30	16:15	23:30	340	45	1020	1003	3	2,95	101,7	88	102	77
23.06.2022	Rework	2215/17-30	04:10	04:20	10	0	50	29,5	5	2,95	169,49	100	169	100
24.06.2022	Rework	2215/17-30	04:50	07:30	135	15	500	398,25	3,7	2,95	125,55	90	126	80
26.06.2022	Rework	2215/17-30	05:15	06:00	35	0	180	103,25	5,14	2,95	174,3	100	174	87
25.06.2022	Rework-2	2215/17-30	23:50	01:45	95	10	290	0	3,05	5		90		85
10.06.2022	800	2215/17-40	07:35	08:40	40	15	95	107,6	2,38	2,69	88,30%	73%	88%	100
13.06.2022	800	2215/17-40	12:20	15:30	155	25	320	314,65	2,06	2,03	101,7	86	102	84
14.06.2022	800	2215/17-40	23:30	03:25	180	30	400	484,2	2,22	2,69	82,61	86	83	68
27.06.2022	800	2215/17-40	08:30	15:30	290	80	460	780,1	1,59	2,69	58,97	78	59	81
8.07.2022	800	2215/17-40	22:00	22:50	40	10	125	107,6	3,13	2,69	116,17	80	116	100
12.07.2022	800	2215/17-40	20:00	20:45	45	0	55	0	1,22	0	0	100	0	100
11.06.2022	803	2215/17-50	12:15	15:30	150	25	280	402	1,87	2,68	69,7	86%	70%	100
15.06.2022	803	2215/17-50	00:15	07:30	320	35	510	857,6	1,59	2,68	59,5	90	59	71
29.06.2022	803	2215/17-50	09:15	10:00	30	5	57	80,4	1,9	2,68	70,9	86	71	100
30.06.2022	803	2215/17-50	12:25	14:20	110	5	195	294,8	1,77	2,68	66,1	96	66	88
4.07.2022	803	2215/17-50	15:00	19:15	185	30	320	370	1,73	2	89,49	86	86	100
9.07.2022	803	2215/17-50	22:55	23:30	25	10	45	50	1,8	2	90	71	90	100
11.07.2022	803	2215/17-50	18:05	23:30	365	20	480	760,55	1,81	2,87	63,11	93	63	59
12.06.2022	802	2215/17-60	07:30	12:15	175	55	370	453,25	2,11	2,59	81,6	76	82	72
16.06.2022	802	2215/17-60	02:00	03:30	60	30	125	155,4	2,08	2,59	80,4	67	80	85
19.06.2022	802	2215/17-60	03:30	04:00	23	7	50	59,57	2,17	2,59	83,93	77	84	100
20.06.2022	802	2215/17-60	04:00	04:30	17	13	37	44,03	2,18	2,59	84,03	57	84	100
21.06.2022	802	2215/17-60	05:00	06:15	30	25	70	77,7	2,33	2,59	90,09	55	90	100
22.06.2022	802	2215/17-60	06:20	07:30	45	10	100	116,55	2,22	2,59	85,8	82	86	100
28.06.2022	802	2215/17-60	10:05	14:10	205	10	143	530,95	0,7	2,59	26,93	95	27	98
1.07.2022	802	2215/17-60	14:25	15:30	40	15	65	103,6	1,63	2,59	62,7	73	63	100
2.07.2022	802	2215/17-60	07:30	08:30	40	20	63	103,6	1,58	2,59	60,81	67	61	100
3.07.2022	802	2215/17-60	15:30	23:30	205	215	395	410	1,93	2	96,34	49	96	85
10.07.2022	802	2215/17-60	15:30	18:00	115	25	210	0	1,83	3	60,87	82	61	50
13.07.2022	802	2215/17-60	22:50	23:30	20	20	40	65	2	3,25	61,54	50	62	31
					4013	892	8540	9964,52						

Figure 1 Production report for part 2215/17-10 of the plant

5. Results and Discussion

As can be seen in Figure 1 above, the quality results of some operations before rework operations are well below the desired rates. And after these products are sent to the suppliers incorrectly, there is a return to the factory. It causes both time and cost damage. Our project wants to prevent this.

5.1 Numerical Results

As in Figure 1, the numerical results are given. The conclusion can be made that the quality control results are not at the desired level which negatively affects the next steps. The project aims to improve this on the other hand, production efficiency will be increased by making facility arrangements.

5.2 Graphical Results

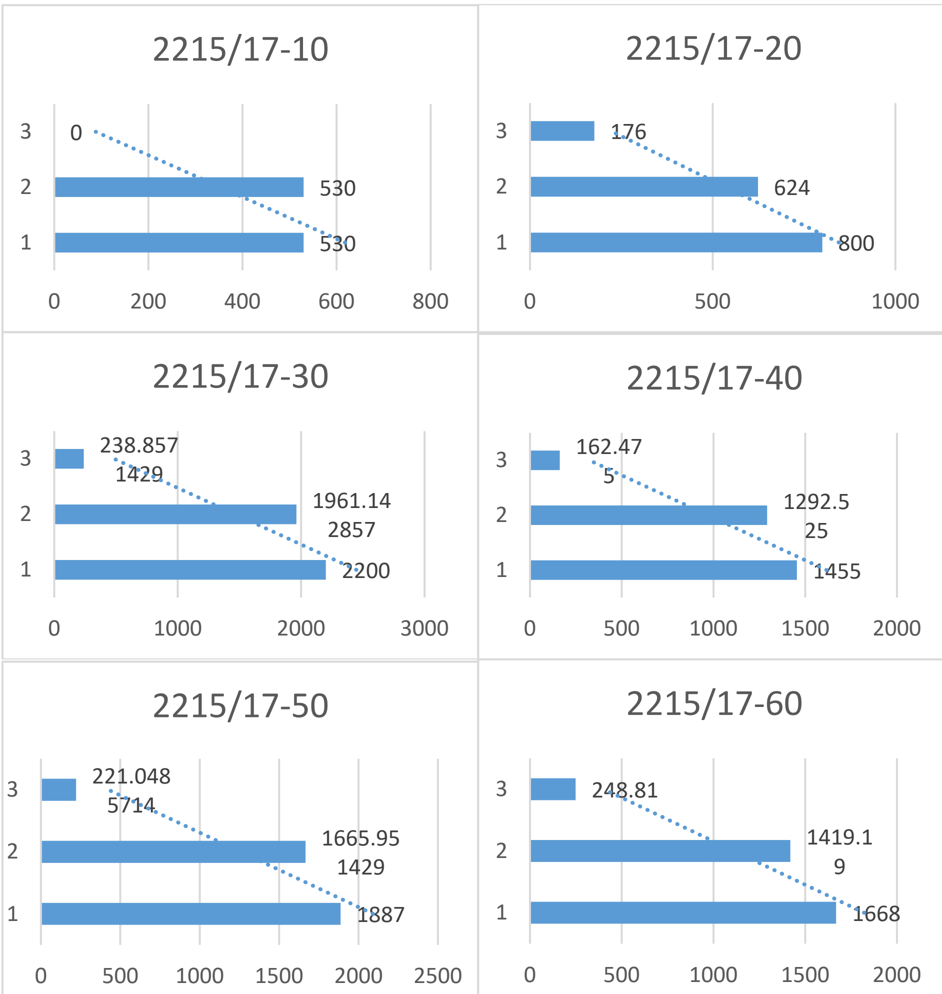

Figure 2 Graphics of production reports for part 2215/17-10 of the factory

5.3 Proposed Improvements

As it is an ongoing project, there is not a definite result, but the aim is to send a defect-free product to the supplier at the end of the project with 0 or 1, that is, full efficiency, which is also a requirement of our approach to the project, Poka-Yoke. As a result of the work done, it has an important place in both gaining the time allocated for production and preventing the factory from making a loss.

5.4 Validation

The statistical data in Figure 1 and Figure 2 are the data from the last controls and it is not at the desired level. After integrating the project into quality control and with the new arrangement in the facility, we aim to take advantage of both sending the wrong product to the supplier and a new arrangement to be made in the factory.

6. Conclusion

As a result, the solution in this ongoing project is an optical sensor supported quality control method. After measuring the distance with the optical sensor, the parts placed on the control fixture are prevented from passing even in the slightest error, and zero error is aimed.

References

(Bambharolya & Thakkar, 2015; Chikwendu Okpala, 2015; de Souza et al., 2018; Eichstädt et al., 2021; Erdem et al., 2021; Fu et al., 2023; Godina et al., 2016; Hafizi et al., 2019; Javaid et al., 2021; Kumar, 2016; Li et al., 2018; Ma et al., 2021; Muncut et al., 2019; Pacana, 2020; Pascu et al., 2020; Realyvásquez-Vargas et al., 2020; Seedhouse & Knight, 2016; Sousa et al., 2017; Ulewicz, 2018; Widjajanto et al., 2020; Young et al., 2020; Zaidin et al., 2014)

Biography

Ahmet Anıl Kaya studied at Beykoz Anatolian High School and Nazmi Arıkan Science High School between 2013-2017. He started the Department of Industrial Engineering at Istanbul Medipol University in 2018 and started the Department of International Trade and Logistics at Istanbul University in 2022. At the same time, he works as an assistant specialist in the Supply Planning department at Adil Isık Group.

Yusuf Eren Kılıç completed Electrical Security Systems which is a technical high school. Yusuf Eren Kılıç had a good education at Dokuz Eylül University in the Electrical Technician Department for 2 years. Now Yusuf Eren Kılıç an Industrial Engineering(Bachelor's Degree) and Computer Engineering(Minor degree) student at Medipol University, Yusuf Eren Kılıç worked in the planning department of Türkiye Finans Participation Bank, one of the most valuable banks in Turkey, and spare parts manufacturers in the automotive industry.