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RESEARCH ARTICLE

DESIGN AND DEVELOPMENT OF WORK INSTRUCTION SHEET WITH CONTROL PLAN TO IMPROVE QUALITY

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ABSTRACT

Most of the leading manufacturing sectors are facing the problem of devoting more time for inspection and controlling the dimensional specifications of a product manufactured by them. This is due to the unavailability of controlling methods because most of the industries do not provide the control plan to the operator. In order to overcome this drawback, the operator at the work centre must be provided with both Work Instructions as well as Control Plan. This paper presents a method which combines both Work Instructions and Control Plan.

INTRODUCTION

The work instruction sheet is used to provide the detailed information about the sequence of operations carried out which converts the raw material into the final product. This will also provide the list of tools and gauges used in every process, tool changing instructions and the diagrammatic representation of the component. It also contains the name of the operation to be carried out, machine name and the codes for tools, gauges, jigs and fixtures, if any. But it fails to provide the Product characteristics, Evaluation and the Measurement Techniques, Control method, Sample size taken for inspection and the Reaction Plan. This is one of the major drawbacks of manufacturing sectors. So this paper focuses on the importance of providing the control plan. Control plan provides the full information about the inspection carried out in the component produced in the process. It contains the product and process characteristics, dimensional specifications of the component, evaluation and measurement techniques, control method and reaction plan pertaining to the component that is produced. This will help the operator to inspect the product by himself at the work center and reduce the intervention of the shop supervisor.

The control Plan comprises of

- Product Characteristics- It numerically represents the dimensional tolerance (or) the limits within which the product is to be made to meet the manufacturer's specification.
- Evaluation Measurement Technique- It specifies the name of the Gauge that is to be used to inspect the dimension. To easily identify the gauge, identification number is provided along.
- Sample Size- it represents the frequency at which the inspection is to be carried out.
- Reaction Plan- It is a short piece of text that describes what an operator has to do if the final dimension is not in accordance with the specification that is specified initially.

These information are inevitable to carry out the inspection process, which is a very important activity to be carried out, by the operator himself. A brief study has been made by visiting a couple of manufacturing industries. The study was mainly focused on reducing the product inspection time for a group of components. So the most optimal solution recognized by us to overcome this time lag and delay caused due to inspection carried out by the supervisor is to empower the operators itself by providing the sufficient details to inspect his product by himself. This can be achieved by providing the Work Instruction along with Control Plan at the respective work centre. Details of the existing method of Work Instruction Sheet that were observed by us in the industries are explained here.

EXISTING METHOD

As observed from the industries, the method in existence has only the Work Instructions that are displayed for the guidance of the operator at every work centre. This is sufficient enough only to carry out the manufacturing process and not the inspection of the product. So another individual or an expert has to intervene in the process and inspect every component. Only one supervisor will be allotted for a shop. If the situation is like this and he is supposed to inspect the products manufactured at all the work centre's it will cause a mess and the production has to be stopped at each work centre for a

while until the inspection is fully completed at that work centre. An added drawback to this method is, if the inspection is carried in bulk quantity by a single supervisor the probability of the number of scrapped components will increase drastically which may cause huge loss to the company. The list of tools and gauges are provided at every work centre. But this is not of any purpose because it does not specify the dimension to which the gauge has to be used to inspect. So this results in confusion and uncertainty among the operators. In order to be a competitive manufacturer in the market, the work of the industry must be precise in all the aspects as well as provide a product that is of good quality. For that reason a better way of instructing the workers is a key function of the company. So far, it is evident that the existing procedure has many drawbacks and it must be made still better for a better result.

DRAWBACKS OF EXISTING METHOD

- The existing method does not provide the information in detail about the sequence of operations that is carried out at the work centre.
- It merelyssss provides the list of tools and gauges, along with their identification code number, for every stage of the process.
- Special instructions that are required to handle unexpected situations that interrupt the production process, which is the root cause that forces the operator to halt the work for a phenomenal duration, and causes a delay in supplying the finished components.
- Unwanted movement of workers to fetch the details about the control plan from the shop floor manager who is the only person who has the authorized access to the database containing the details of control plan.

Special instructions viz., Tool changing instructions, Safety instructions and Tool setting instructions are unavailable. Moreover, the most important of everything, the Control Plan is not available for the reference of the operator which mentions about the method by which the quality of the component is to be checked (Inspection) to assure whether the corrected dimensions are within the specified limits and the intended tolerance is met. Under this situation, the operator having zero knowledge on the procedure of inspection will be uncertain on using the correct gauge. This demands the operator to wait for the arrival of the supervisor or the Inspection Inspector to certify it and ultimately results in the idling of the machine for a sufficiently long duration of time.

Problem Identified

From the discussion about the existing method, it is evident that there are many drawbacks with it that poses hindrance and unwanted interruption to the smooth flow of material through the various stages of operation. This results in various problems such as,

- Cumbersome in engaging the workers and using their full potential.
- Unavailability of Control Plan as well as Special Instructions which stands for the unavoidable delay.
- Unwanted movement of workers to fetch the details about the control plan from the shop floor manager who has the authorized access to the database containing the details of control plan.

PROPOSED METHOD

The drawbacks of the existing method are to be eliminated as completely as possible without much investment and most importantly within a shorter duration of time. So, a new method has been suggested to eliminate the setbacks of the current Work Instruction Sheet, provided in the shop, to modify its content and layout so that the operators can get a clear view of all the details required to carry out the process and perform as per the instructions without any uncertainty.

The proposed method is characterized by the following features

- Provides the Work Instructions along with the Control Plan contained in a single A3 size paper so that it can be displayed at every work centre, that are involved in the manufacturing of the components of Auxiliary Gear Box, within the reach of the operator.
- It provides the fullest possible information or instructions about that particular stage in the process, which is provided in a simple language. Due to both these reasons, even a newly appointed operator can also involve in the process and do the work without any external guidance.
- The list of Tools, Gauges, Jigs and Fixtures, if any, are also mentioned making it a data for the operator to fetch the required equipments (in case of batch production) when a different component is to be handled by him.
- Display of the part diagram for each stage which makes a better understanding about which dimensions is to be machined in the sequence of operations.

Name of the industry		Work instruction sheet		Issue date	Space for detail
				Issued by	Space for detail
Part number	Space for detail	Operation number	Space for detail	Work centre	Space for detail
Part description	Space for detail	Operation description	Facing and turning	Jigs/fixture	Space for detail
Space for the part diagram					
Gauges used		Tools used		Operating instructions	
List of gauges used at the corresponding stage		List of tools used at the corresponding stage			
			Planning engineer	Production engineer	Quality engineer

Figure 1: Layout of the existing Work Instruction Sheet

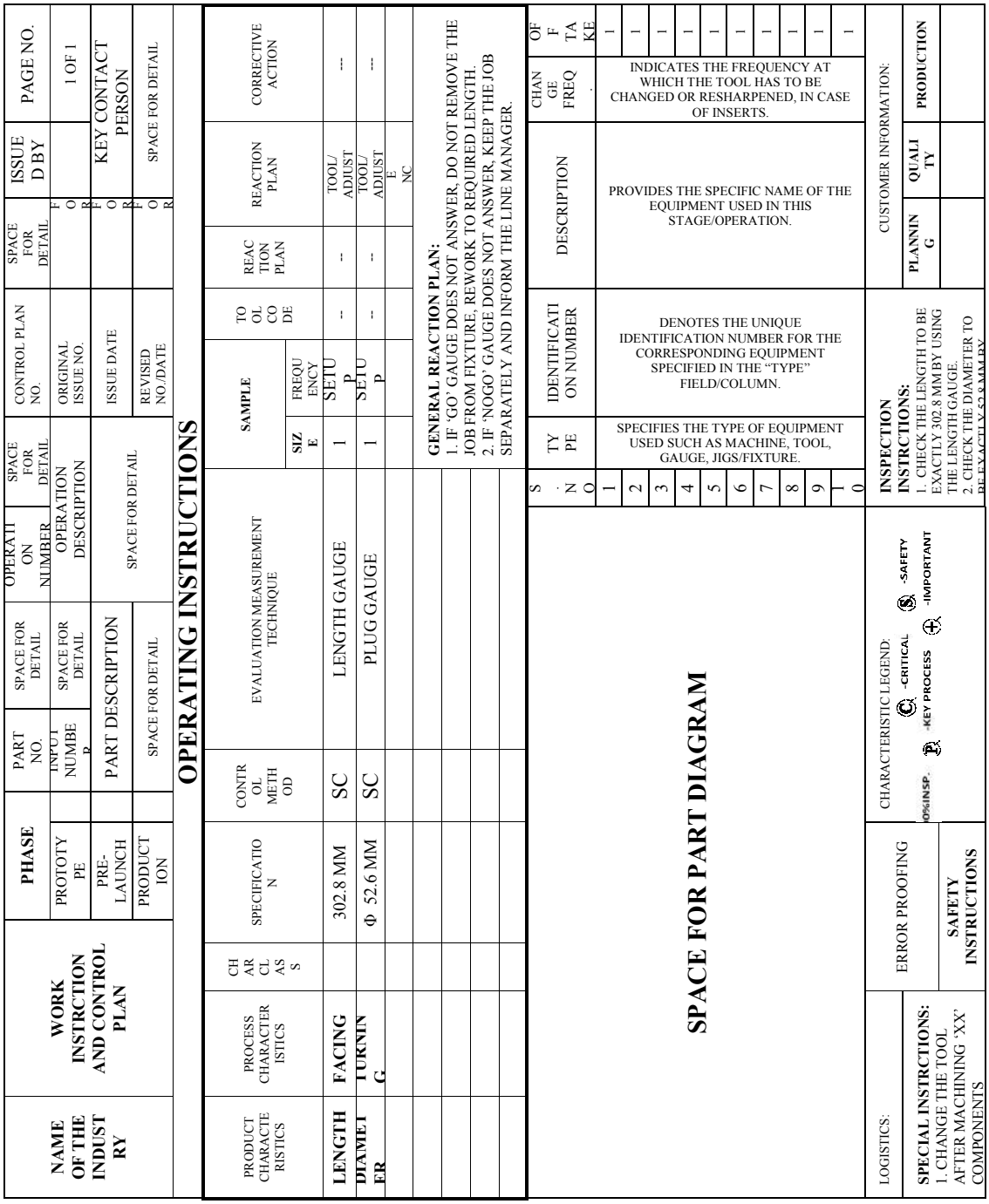

Figure 2: Layout of the proposed Work Instruction Sheet with Control Plan

- Inspection instructions are also provided which describes about the Control Plan briefly.
- Special Instructions like Tool changing instructions are also included which tells the operator when and how to change the tool or re-sharpen the inserts. Also tells about when the coolant and lubrication oil are to be replaced.
- After approval from the authorities of Production Planning and Quality Control departments the details are updated in the Enterprise Resource Planning (ERP) computer module, provided it is connected to the server by means of LAN or other forms of Network connections.

Specific Problem

To get a better understanding about the explanation we have taken up a specific problem and illustrated with respect to a product. (Note: The problem/product discussed hereafter is no way relevant or specific to any industry. It is a product chosen from general assumption) For machining of a component, like

a shaft, using a conventional type lathe the following final dimensions are required. The length of the component is to be reduced from 310 mm to exactly 302.8 mm as well as the diameter is to be reduced from a initial value of 56 mm to 52.6 mm. Taking this problem as a real industrial situation, the existing method and the proposed method are explained along with the sample sheet for each case for a better understanding. In the existing method, each Work- Instruction Sheet can be divided into three segments, top, middle and bottom segments. The top segment comprises of the details pertaining to the part such as the part identification number, part name, the description and the sequence number of that operation carried out at that particular stage. It also has space for providing the Work centre name and its unique identification number and the name of the Jig/Fixture, if any, that are required for carrying out the operation. The middle segment is fully dedicated to the part diagram of the component represented with the final dimensions to be achieved at the end of the operation/stage. But the engineers have failed to use software to generate the part diagrams.

The hand drawn diagrams are not to scale and the pencil mark will disappear on the go due to repeated usage. So it is recommended to make a hardcopy of these diagrams from the Auto-CAD generated diagrams. The lower or bottom segment consists of two subdivisions. The left and right parts are used for listing out the tools and gauges and the operating instructions respectively. Figure.1 shows the existing format of the Work Instruction Sheet. Only the layout of the page is provided. It provides a better perception of the explanation provided on the previous page. Boxes marked with "Space for detail" will be filled with the specific details of the described field in the box preceding to its left. Moreover it should be understood that it carries the Work Instructions and other specified details for only one operation. Production process is a sequence of operations carried out to convert the raw material into the finished component. Providing the information necessary for all the operations in a single sheet is not possible and may not be clearly understood. So a separate Work Instruction for every stage of the process has to be prepared. An operation not only refers to the modification of dimensions of a component but also checking the exactness of the machined dimensions and profile, which is termed as inspection.

Only with these fields of details as shown in Figure.1 are not sufficient to carry out the entire operation. So the content of the sheet has to be extended to accomplish the entire operation by the operator himself including the inspection activities. Hence the layout along with the amount of data has to be improvised for making the operator's work easy. After carefully analyzing the events taking place sequentially in the production process, the fields of data required to accomplish the task completely were understood. Later, the layout of the sheet was modified so that all the instructions which are of primary importance can be included in it. Figure.2 shows the model of the proposed method. The major difference between the existing and the proposed methods is the inclusion of the Control Plan. The entire space bound by the bold faced border in Figure.2 is the control Plan. The difference not only lies on the inclusion of Control Plan, but many other details are included along with it such as the equipments name along with its unique identification number and the frequency at which each tool has to be replaced when the cutting edge becomes blunt. Inspection instructions help the operator to carry out the inspection for the component he has handled. After loading the next component on the machine, meanwhile when that component is undergoing the operation, operator can inspect the dimensions of the previous component. This can save a considerable amount of time. The Reaction Plan part of the Control Plan can be referred by him if the dimensions achieved are not satisfied as per the specifications. Reaction Plan can guide the operator on what he has to do under such a situation. The field titled as "Control Method" has been specified as 'SC'. 'SC' stands for Self-Certification. After inspecting every work piece, if the finished dimensions are satisfied in accordance with the specifications provided in the Control Plan, operator has to complete the Self-Certification procedure, which includes recording the details such as the batch no., date and time at which the operation was completed, name of the operator, final dimension achieved by the operation, etc. Usually Inspection and subsequently Self-Certification are carried out by the Inspection Inspector.

By implementing the new method, the involvement of appointing an Inspection Inspector can be terminated. In this method, hand drawn part diagrams are eliminated and software generated diagrams are inserted in the corresponding space allotted for it.Special instructions include the time interval after which the tools have to be changed or re-sharpened in case of inserts. Lastly, the phase of the component is also mentioned in it. This field has three choices, namely Prototype, Pre-launch or Production. By selecting the appropriate choice, it can be easy to identify at what stage is the component in the production process.

Advantages

By implementing the new method, the following benefits have been witnessed.

- Unwanted movement of the worker to fetch the details from the shop manager is eliminated.
- Idle time of the operator can be utilized for inspecting the previous component and fulfilling the Self-Certification form.
- Eliminates the dependency of the operator on his superiors for getting instructions every time.
- Direct relationship between highlighted characteristics and their controlling process setting or parameters makes the operator aware of the items in the system of controlling parts and processes during full production.
- Identify the gauges and test equipments needed for the operations.
- Identify the sample sizes and the frequencies of testing.
- Safety characteristics make the operator cautious while he is involved in the operation.

Conclusion

The Process Sheets are thus prepared for the discrete components. This is the input to the shop floor for performing the step-by-step procedure of production which is followed for every component. The first and foremost duty of the industries to ensure a quality product is to assist and provide the workers with the required instructions and data. Now, it simply implies that the foremost duty of the industry is to provide the Work Instruction along with Control Plan and not Work Instruction alone.

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