LOGIC
Journal of Engineering Design and Technology
Vol. 19 No.2 July 2019; p. 103 - 106

p-ISSN : 1412-114X
e-ISSN : 2580-5649
http://ojs.pnb.ac.id/index.php/LOGIC

PROPS DESIGN ON MANUAL ASSEMBLY LINES IN INDUSTRIAL ENGINEERING DESIGN PRACTICUM 3 WITH LEARNING FACTORY APPROACH

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Abstract. Industry requires educational institutions as providers of labor to continue to optimize the learning process on material that is in harmony with existing cases in the industrial world. The Industrial Engineering Study Program of Sebelas Maret University Surakarta (PSTI-UNS) has sought these demands by implementing integrated practice learning with the learning factory concept approach. Identification of design needs was obtained after observations and evaluations of the learning process on PTI Practicum 3. This study contains requirements in designing tools to accommodate lab work in linear PTI Practicum manuals. The tools needed include storage, hand trolleys, storage racks, and work stations. The selection of the work station concept was carried out with Focus Group Discussion (FGD) with specified selection criteria. The criteria for selecting a tool for practicum facilities include the suitability of learning objectives, material

Keywords : Props, Manual Assembly Line, Learning Factory.

1. INTRODUCTION

Industry requires educational institutions as providers of labor to continue to optimize the learning process on material that is in harmony with existing cases in the industrial world. The Industrial Engineering Study Program of Sebelas Maret University Surakarta (PSTI-UNS) has sought these demands by implementing integrated practice learning with the learning factory concept approach. According to Tisch et al [1]. Learning factory is a learning approach oriented to the competency of participants through a structured independent learning process in a learning environment with actual industrial problems. Learning factories provide a production environment where only small abstractions are possible from processes and technology in real industrial sites Abele et al., [2]. The application of the concept of learning factory learning was applied by PSTI-UNS through the implementation of integrated practicum with the name of the Practical Engineering Design Industry (PTI). One of the practical steps that is still being evaluated is PTI Practicum 3. Practicum PTI 3 is a third stage integrated practicum which plays a role in the assembly process on manual assembly lines to assemble the products produced on PTI 2 Practicum.

The implementation and development of PTI Practicum 3 has been started since 2015 directed at manual assembly lines for the assembly of lecture chairs. However, practicum implementation on manual assembly lines is still not accommodated with assistive devices as a practical facility. The assembly process at each work station is still carried out on the floor without tools or practical facilities in the form of work station tables and other supporting practical facilities. The condition of the work station makes the product components and assembly equipment not neatly arranged. Each work station is not equipped with standard work procedures so that in one station there are many operators who handle the assembly process.

Learning factories are based on developing competencies needed by trainees. Based on these competencies, the level of learning (teaching methods, media and learning processes) as well as technological infrastructure (manufacturing processes) are formed and harmonized to complete the learning factory design in the description of the industry [1]. PTI 3 practicum that has been running so far has not provided an overview of the form of manual assembly lines due to the lack of accommodating tools as learning media.

The design of assistive devices as a practicum facility is carried out by carrying out product development steps by Ulrich and Eppinger [3]. The design of a tool is also designed based on the learning factory concept approach. The basic principle of learning factory is to integrate equipment and materials into manufacturing systems and integrate various roles in manufacturing into effective teams in designing and producing products and processes (Lamancusa, [4]). According to Ogorodnyk [5], running a copy of the manual assembly line gives students the opportunity to see possible challenges and problems that might arise in the assembly line that is applied in the actual company.

2. METHODS

Identification of design needs was obtained after observations and evaluations of the learning process on PTI Practicum 3. Evaluation of the needs of tools in the manual assembly line practicum was previously conducted to determine the needs of any tools needed for manual assembly line practicum. Evaluation is done by identifying the needs of the tools needed in each assembly line practicum process. The results of the needs of the tools needed in each process are explained as follows:

a. Taking part in warehouse, this process requires a tool in the form of a warehouse / storage to put all the parts that will be sent to each work station. Storage function to hold all parts and group parts into the same type.
b. The process of sending parts to work stations, this process requires maternal handling transport to facilitate operators in carrying parts.
c. The process of assembling parts at work stations, this process requires a work station table and shelves as a place to store temporary parts. Work station table is used for assembling parts. The shelf serves as a place while the new part comes from the warehouse.
d. In the quality control process, the customer and PPIC places only need a table

3. RESULTS AND DISCUSSION

3.1 Preparation of Alternative Concept Tools

Before the drafting of alternative design concepts will be presented in Figure 1 regarding alternatives for the concept of work stations, the concept of storage systems, the concept of equipment transport materials and materials used as a framework for tools.

Figure 1. Alternatives for the concept of work stations, the concept of storage systems, the concept of equipment transport materials and materials used as a framework for tools.

a. Alternative Storage Design Concepts

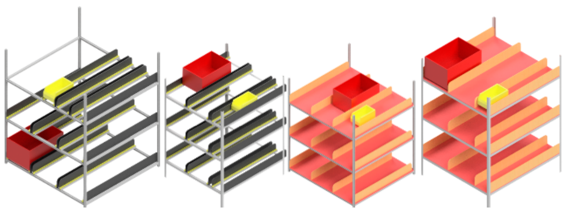

Figure 2. Alternative storage design

b. Alternative Concept of Hand Trolley Design

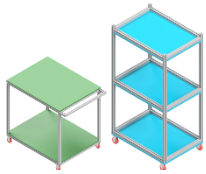

Figure 3. Alternative hand trolley design

c. Alternative Design Concept of rack storage

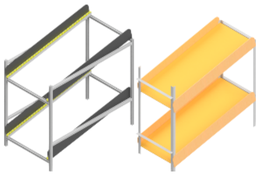

Figure 4. Alternative rack storage design

d. Alternative Work Station Design Concepts

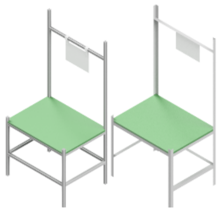

Figure 5. Alternative Work station design

3.2 Selection of Alternative Concept Tools

The concept assessment stage is carried out by assessing all alternative concepts towards the criteria that have been determined. Assessment is based on the needs and characteristics of each existing concept. Concept assessment is done by FGD (Focus Group Discussion) which involves 2 designers, 2 stakeholders, and 1 manufacturing person. Concept assessment is explained in table 1 below.

Table 1. Average, Standard Deviation, and Percentile Dimensions of the Hand

Alternativ	Storage				Hand Trolley		Rack Storage		Work Station	
Criteria	I	II	III	IV	I	II	I	II	I	II
Suitability of learning objectives	3			2		5		5	5	
Material availability				5	2	3		5	4	1
Technical quality	3		2			5	3	2	5	
Procurement cost				5	2	3		5		5
Tool flexibility	2		2	1	1	4	1	4	3	2
Ease of use	2			3		5	2	3	5	
Time allocation	3			2		5	3	2	5	
Total Score	13	0	4	18	5	30	9	26	27	8
Decission	Alternative IV				Alternative II		Alternative II		Alternative I	

Based on the results of the concept assessment, alternative concepts are chosen that have high values so that the concept of alternative 4 is obtained for storage, alternative concept 2 for hand trolley, alternative 2 for rack storage and alternative 1 for work stations.

The alternative storage concept 4 was chosen based on the availability of material and the costs needed were lower. Because the iron components are hollow and plywood is very easy and fast to get right and a cheap price. This concept is easy to use and understand for the user because each component of the assembly only needs to be placed according to its component group. The flexibility of this concept is quite sufficient where the tool can be assembled and adjustable in height, except that it requires precision in mounting between holes though. The allocation of time needed is also sufficient even though it is easier in assembly in the storagse 1 alternative concept.

Alternative hand trolley 2 concept was chosen because it prioritizes the use of aluminum extrusion as the main framework. The use of aluminum extrusion makes the quality of the hand trolley more robust and easy to install. Dimensions that are not wide or utilize dimensions towards the vertical make the hand trolley not too space consuming. This concept is also easy to understand for users as media handling material handling to make it easier to carry assembly components from rack to storage storage.

The alternative concept of rack rack 2 is chosen because it prioritizes the use of hollow elbow iron as the main framework and use of plywood as a strorage rack base. The use of perforated iron makes rack storage can be dismantled. This concept has been fulfilled as a learning medium to describe a storage or temporary placement of assembly components before being assembled. But in the manufacturing process it will take a long time because of the high accuracy needed to assemble this concept.

The alternative concept of keja 1 station was chosen because it prioritized the use of aluminum extrusion as the main framework although the cost of producing this concept was quite expensive. The use of aluminum extrusion makes the quality of the work station more robust and easy to install. The use of plywood as a base is strong enough to hold the workpiece load. This concept is also easy for the user to understand as a work station learning media to describe work stations on manual assembly lines.

4. CONCLUSION

This study contains requirements in designing tools to accommodate lab work in linear PTI Practicum manuals. The tools needed include storage, hand trolleys, storage racks, and work stations. The selection of the work station concept was carried out with Focus Group Discussion (FGD) with specified selection criteria. The criteria for selecting a tool for practicum facilities include the suitability of learning objectives, material availability, technical quality, procurement costs, tool flexibility, ease of use, and time allocation. The chosen concept is alternative 4 for alternative storage design concepts, alternative 2 for hand trolley, alternative 2 for rack storage, and alternative 1 for work stations

5. REFERENCES

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