International Journal of Latest Engineering Research and Applications (IJLERA) ISSN: 2455-7137

Volume – 02, Issue – 03, March – 2017, PP – 10-14

MINIMIZING PART COUNT IN ASSEMBLY USING DFA METHOD

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Abstract: In today's global environment, most of the companies try to minimize the manufacturing cost of the product at the same time planning to increase the profit. In order to be more competitive in the market the product should quickly reach within the time and available at reasonable price. Assembly cost is also one of the major operations in manufacturing considered to be the most important factor because the product simplicity mainly based on the assembly of components. In this paper design for assembly procedure is applied for product named pneumatic press. Then comparison is carried out to note the time variations between current design and redesign of assembly components by minimizing the number of part counts in the assembly operation.

Keywords: DFA (Design for assembly), Part count, Assembly cost, manufacturing cost.

Introduction:

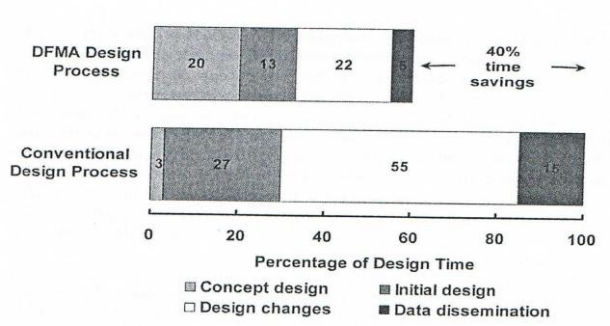
Design for analysis or design for assembly was done in the early 1970. These designs actually are done in several stages and include several persons. This process starts from designers who are design the product and follow up by making prototype. After prototype was been construct then the process is follow up by testing it and wait for the approval. These designs for analysis not only finish until there but it continues by manufacturing team by conduct the manufacturing plant. These plans are to make sure the product have same functionality and produces in large amount of production. Designs for assembly also are the integration of product design and process planning into one common activity. The goal is to design a product that is easily and economically manufactured. The importance of designing for manufacturing is underlined by the fact that about 70% of manufacturing costs of a product are determined by design decisions, with production decisions responsible for only 20%. Design for assembly is important in improving the quality in design, cut of cost of manufacturing of product and increase efficiency of product.

The following parameters are considered as major objectives in this paper as given below:

1. Minimizing the number of part count in the assembly operation by redesign the assembly systems.
2. Comparing the redesign assembly along with original or actual assembly design.
3. Maintaining the assembly efficiency to be standard.

Literature review:

The development of the original design for assembly method is early on 1960s on automatic handling. A group technology classification system was developing to catalogue automatic handling solutions for small parts. This shows that classification system could help the designers to design parts that would be easy to handle. Also in the 1960s there was much talk about designing product so they could be manufactured so easily. Recommendations commonly known as predictability guidelines were develop. Design also would be detailing of materials, shapes, and tolerances. Therefore, not only is it important to take manufacture and assembly into account during product design, but also these considerations must occur early as possible in the design cycle. This is illustrated qualitatively in Figure 1.1 which is showing that extra time spent early in the design process is more than compensated for by savings in time when prototypes takes places. Thus, in addition to reducing product cost the application of design for assembly shortens the times to bring product to the markets.



Comparison of assembly methods*:*

Assembly methods can be divided into three major groups. In manual assembly, parts are transferred to workbenches where workers manually assemble the product or components of a product. Hand tools are generally used to aid the workers. Although this is the most flexible and adaptable of assembly methods, there is usually an upper limit to the production volume, and labor costs. Fixed or hard automation is characterized by custom-built machinery that assembles one and only one specific product. Obviously, this type of machinery requires a large capital investment. Graphically, the cost of different assembly methods can be displayed as in Figure 1.2.

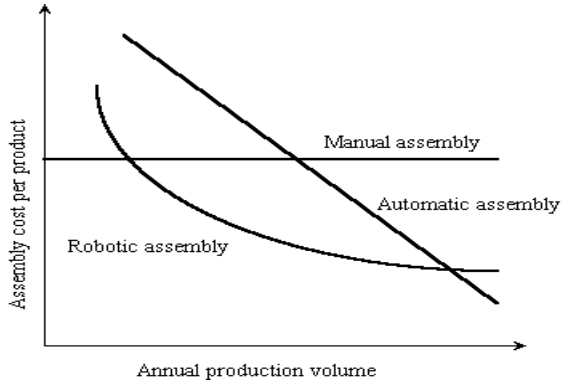


Fig 1.2. Comparison of assembly methods

Literature gap:

As per the above literature survey it is clearly noted that assembly operations have brought major changes in the product cost as well as minimizing the burdens in the assembly by reducing the obstacles present in the conventional assembly systems by following modern approaches such as DFA (Design for assembly) suggested by boothroyd.

Problem Methodology:

DFA Guidelines:

Different books described DFA Guidelines in different ways. Some authors list many guidelines and described it with detail while other authors categorized it with few list before divided the main principle to another few principle. But surely the main objectives for all guidelines remain same, to reduce the cost of assembly. The principles of DFA are:

1. **Reduce the parts count**. The objectives of these guidelines are to minimize the total number of parts. There is two ways how these objectives can be achieved: First, design for minimum number of parts and second, minimize number of fasteners and their components.

2. **Design for minimum number of parts**. Focusing on the main parts, when number of parts is decreasing, the cost the assembly and whole product will also decreasing. There are 3 factors that should be considered. First, reduce the number of parts, second, remove non essential components with its functions still achieved and third, combine several parts into one components and manufactures as an integral multifunctional component.

3. Minimize number of fasteners and their components. Screw and washers can increase the cost and time to assembly. Other alternatives fasteners can be used to replace the screw and washers, such as snap fits, press fits and molded hinges, straps or hook. It seems obvious with this technique (reduce parts count), the assembly costs would be less, but the question remains whether the overall manufacturing costs have been reduced.
From the guidelines of DFA, design for minimum number of parts is taken for analysis to improve the assembly efficiency of all dependent components

Problem case study:

In this paper DFA approach (Design for Assembly) is applied for pneumatic press. A detailed analysis was done for each sub assembly using DFA Software.

Part details:

In the beginning we need to specify the part details of main product by choosing insert – part option from the tool bar as shown below:

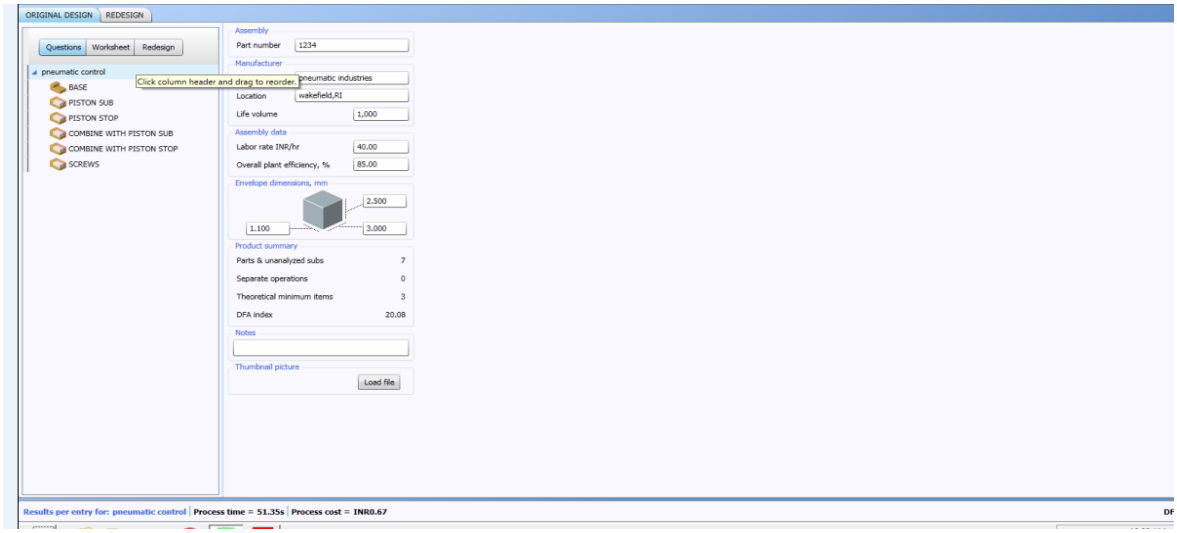


Fig 1.3. Original design of components

Like wise for each sub assembly we need to specify the part details using DFA software. Finally compute the assembly process time by overall also the assembly efficiency and assembly labor cost. In the original design components taken for designing the assembly systems are mounting base, piston, piston stop, steel cover, steel spring and screws. These are the parts are done as per precedence sequence.
Next after completing the original design start performing the task of redesigning the pneumatic press by considering the most troublesome components in the assembly sequence as given below.

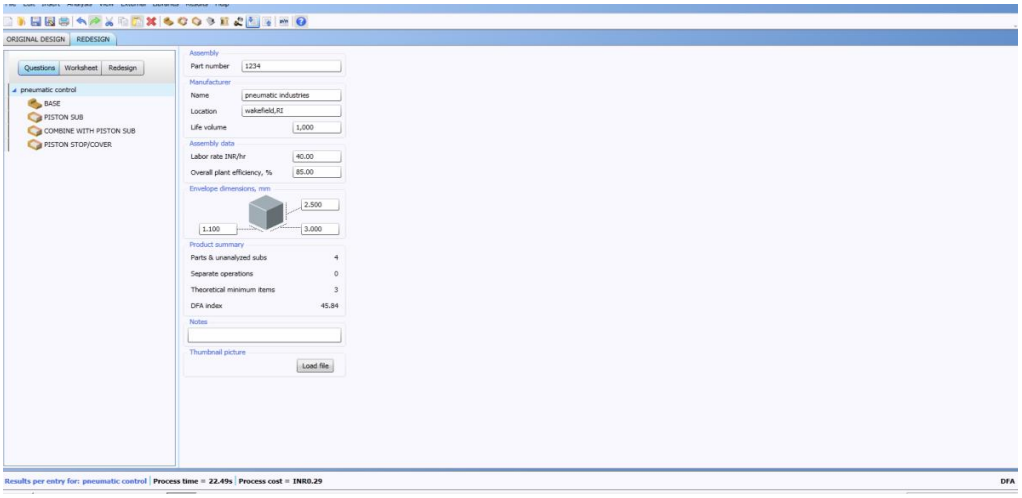


Fig 1.4. Redesign of assembly parts

In the redesigning process we need to identify the components which are considered to be a bottleneck. From the original design it clearly shows that steel spring, piston stop and steel cover are the main obstacles in the assembly operation which leads to increase the process time of the assembly operation. So these parts must be redesigned in order to improve the assembly cycle time as well as minimizing the parts to maintain the assembly process to be simple and easy to follow.

Results and discussion:

Based on the concept of design for assembly it is stated the assembly system becomes much complex when adding two or more components in the main assembly that lead to several difficulties like increasing labor cost for doing the assembly , increasing the assembly process time and decreasing the system performance efficiency as whole. As per original design the total assembly time to complete all the jobs is noted to be 51.35 seconds. So this is said to be an inefficient assembly time. So product engineer must think in alternate method to reduce the assembly time.

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Analysis Totals for Design for Assembly (DFA)

Saturday, March 04, 2017

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Entries including repeats	ORIGINAL DESIGN
Parts meet minimum part criteria	3
Parts are candidates for elimination	4
Analyzed subassemblies	0
Separate assembly operations	0
Total entries	7

Assembly labor time, s	
Parts meet minimum part criteria	15.13
Parts are candidates for elimination	36.22
Insertion of analyzed subassemblies	0
Separate assembly operations	0
Total assembly labor time	51.35

Design efficiency	
DFA Index	20.08

Fig 1.4 Total estimate of assembly time in original design

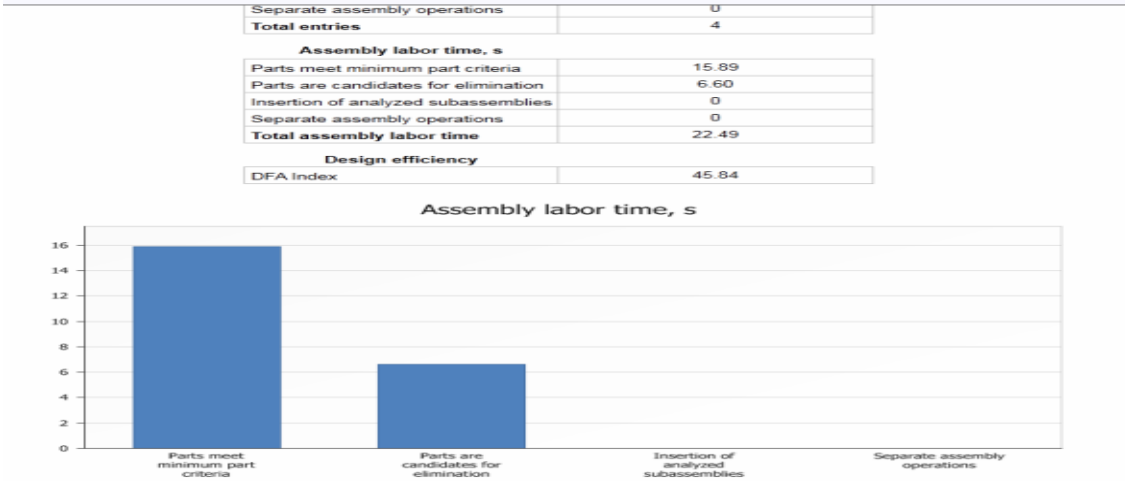

Fig 1.5. Total estimate of assembly time in redesign

Conclusion:

Based on the results it is understood that redesign assembly time minimizes to 22.49 seconds from 51.35 seconds. This leads to saving of 22.86 seconds of assembly time. So one can able to save the wastages in several forms by innovative method of solving the problem to tackle the problems faced in assembly operation. Thus DFA is a tool helps to find a quick solution to assembly related problems. As per original design the part count was 7 with assembly time of 51.35 seconds this has been reduced to part count 4 with assembly time of 22.49 seconds.

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