Chapter 1

# Introductory Chapter: Applications of Design for Manufacturing and Assembly

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## 1. Introduction

The occurrence and development of new and highly productive technological procedures lead to the need of enhancing the efficiency of assembly procedures as well as of material and part manipulation processes (object of the so-called logistics).

The manufacturing of industrial products involves processing the component parts, as well as assembling the individual parts in subassemblies and then assembling the final product that must fulfill all the functions for which it has been designed (**Figure 1**).

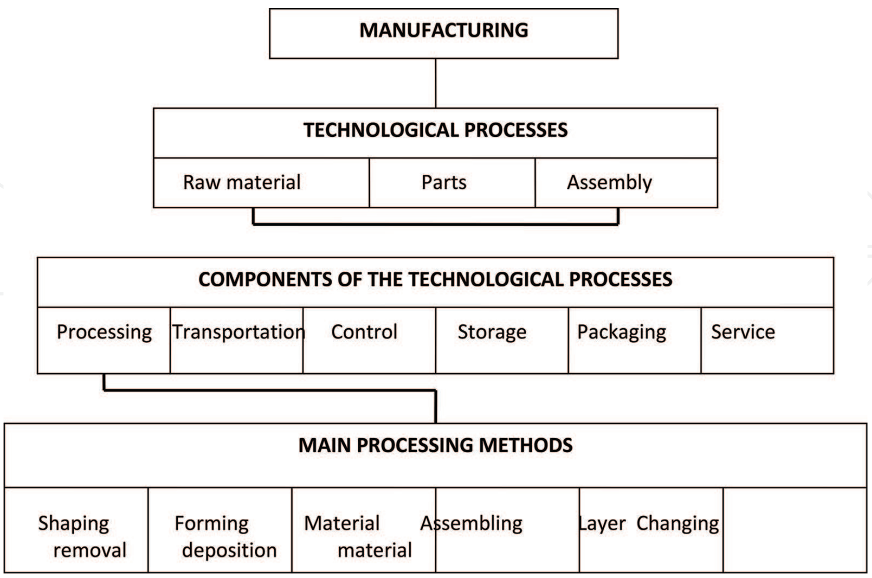


**Figure 1.** Place of the assembling in the manufacturing process.

Besides the functional characteristics of new products, the competitive design must take into account the principles of the design for manufacture (DFM), as well as the principles of the design for assembly (DFA).

The assembly process comprises the mounting procedures of tools, control devices, and jigs needed to perform the assembling operations. In view of establishing the optimal assembly method, as well as of its differentiation degree, the main factors that influence the assembly process must be analyzed (production batch, constructive characteristics of the product, and available manufacturing equipment).

In order to succeed, the researchers must design products in a right manner for optimal manufacturing, assembly, cost, quality, time, and functionality. Design for manufacturing and assembly (DFMA) is a methodology for product development or product improvement projects in which designers and manufacturing engineers work together instead of working separately. The two groups design the product's manufacturing and assembling processes; at the same time, they design the product itself. There are many CAD—integrated design for manufacturing programs—which help to identify and correct downstream issues in the design stage, leading to the reduction of the cycle time and the product development costs.

The main role of the mechanical engineer in the continuous industrial development is to be a creator by applying his/her knowledge and expertise to solve technical problems and to optimize the manufacturing processes.

The best performance in the field of mechanical manufacturing is obtained by "optimal operations" and "optimal processes." Therefore, the goal is to optimize the manufacturing procedures and their economic impact while making a product. This goal can be achieved by minimizing the manufacturing time. Within a company, certain types of cutting tools and machines characterized by certain technological parameters are used; therefore, to minimize the manufacturing time of a product, it is needed to optimize the machining method.

It is important to realize a design for manufacturing and assembly (DFMA) of the product which must provide an easy machining and assembling and also decrease manufacturing costs without having a negative impact on the quality requirements. It is important to know the fact that about 70% of the manufacturing costs of a product are determined by design decisions [1].

While product specification and costumer's requirements are important, there are other design issues to consider. The principles of design for manufacturing (DFM) are applied throughout the design process, and these affect all aspects from the design phase to the production phase. By applying DFM methods, the manufacturing costs can be estimated, while the costs of components and supporting production can be reduced.

The design for manufacturing system is a group of design principles that are structured to help the designer to reduce the costs and the manufacturing difficulties. The following rules can be mentioned: use of standard materials and components, standardized design, liberal tolerances, materials that are easy to process, avoidance of secondary operations, minimization of the manufacturing operations, and elimination of the intricate shapes [2].

The main principles that must be taken into consideration when designing for manufacturing are the selection of the adequate material; designed shape which ensures the selection of performance cutting tools with low cost; and selection of suitable tolerances for product design, which determine the type of the manufacturing. It is necessary to take into account the mechanical properties of the raw material, to be able to select the right material for the considered product. Due to the fact that the manufacturing time has a significant influence on the final cost of the part, cutting tools must be selected with the appropriate stiffness and strength, which provides a processing time as low as possible. The manufacturing cost is also influenced by the cost of the cutting tools. Therefore, the product must be designed to avoid using specialized, complex cutting tools [3].

By using these principles together with computer-aided design (CAD), computer-aided manufacturing (CAM), and finite element analysis (FEA), designers must find alternatives for the considered project, to obtain a design which assures a minimal machining time and a low-cost manufacturing.

Design for assembly (DFA) is the method of product design for ease of part assembly which involves optimization of parts or subsystems. The use of DFA allows a considerable reduction of the manufacturing costs, assembly time, and number of component parts, as well as increasing the productivity. Under such circumstances, it is possible to establish optimal assembly methods. Of course, the innovative contribution of experts is needed when using DFA software. When establishing the sequence of assembly procedures and selecting the appropriate equipment, the software users must use their expertise.

The main characteristics of DFA are listed below:

1. *Reducing the number of parts by combining or removing some of them*
2. *Improving the assembling accessibility*
3. *Improving the flexibility of components*
4. *Increasing the number of symmetric components*
5. *Optimizing the maneuverability of components (Whenever possible, stiff components are preferred instead of the flexible ones, because their manipulation is easier. Adequate surfaces are designed for mechanical gripping.)*
6. *Avoiding separate gripping elements*
7. *Providing parts having integral self-locking characteristics*
8. *Leading to modular design (Usage of standardized modules with the same functional requirements and standard interfaces that facilitate the interchange capabilities. Such an approach facilitates many options, quick design updates, as well as easier testing and servicing.)*

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## References

[1] http://www.unm.edu/~bgreen/ME101/dfm.pdf

[2] http://www.slideshare.net/NIELITA/dfm-design-principles

[3] https://www.mfg.com/sites/default/files/files/DFM%20CNC%20Machining.pdf