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Product Design Related to Assembly Process Manufacturing Strategy

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Abstract

The article presents product design related to assembly from the point of view manufacturing strategy. Manufacturing strategy is key for product design and development together with impacts on manufacturing firms. The paper first describes the generally assembly process and important decisions in early product design and how an existing product works in detail. The next sections are analyzed of point view manufacturing strategy for changing production and impacting on manufacturing firms. Finally, the manufacturing strategy is focused on product design and development addressed on decisions related assembly.

Keywords: assembly, assembly process, product, product design, manufacturing strategy

Introduction

Assembly process is a set of design activities that takes place within the larger context of product design and development. This is the integration of all the different demands on any product that arise from marketing, financial, engineering, manufacturing, assembly, after-market service, upgrading, and recycling. It brings together all the upstream processes of design, engineering, manufacturing, and logistics to create an object that performs a function. In the past, product development and order handling were regarded as primary processes where order fulfillment and distribution were seen more as auxiliary functions. But nowadays, reliable delivery of customized products has the highest priority in globally distributed markets. This priority increasingly determines the development of products, processes and production facilities.

The paper is organized as follows: Section 2 provides formalization of assembly process; Section 3 presents determining role decisions to product design and local and global categories related to product in assembly; Section 4 provides how could be impact manufacturing strategy content vs. process of product design and development; Section 5 concludes the paper.

Formalization of Assembly Process

Assembly is the capstone process in manufacturing. Assembly is more than putting parts together. It is process of deciding how to deliver quality and functionality at the assembly level by designing and producing parts and subassemblies in a top-down fashion. Many aspects of product design and development are strongly related to assembly or make themselves felt when assembly-related issues are brought into the product design process. The most important of these is product architecture, which defines the physical relationships between elements of the product and relates them to the product's functions. A suitable architecture is an enabler of many important processes from product development to management of variety [1], [2].

A great deal is known about the unit processes that are required to fabricate and inspect individual parts. The structure of the item must be defined, including all the interrelationships between the parts. Then each of the parts must be defined and given materials, dimensions, tolerances, surface finishes and so on. Before computer aided systems existed, design followed a top-down process in which the most skilled person, a layout man, put down the basic boundaries and centerlines of a concept on black paper. Detail men, the least experienced in the profession, were assigned to design each part,

providing detailed geometry, dimensions, and tolerances. A more experienced person took these detail designs and built up an assembly drawing, while a checker looked for errors and interferences by adding up all the dimensions and tolerances [2]. The structure of the item must be defined, including all the interrelationships between the parts. The whole cycle depends largely upon the design process which, regardless of its structure, must be guided by a strong knowledge of design engineering, material and manufacturing [3]. At any stage in this process, economic or technical evidence may appear that forces a reconsideration of product design, selection of subassemblies or assembly sequence, timing requirements, and so on. If all of the required information is not available, or if system design reveals knowledge gaps, then additional product or process design effort, engineering, or experiments may be necessary [4]. The alternative is a system design with less robustness and predictability than desirable.

Product quality, delivery, or cost may suffer, or the time to reach full production may be prolonged, as a result [5].

Determining Role Decisions to Product Design

Product design and development involves determining customer needs and deciding how to meet them. This includes the technical aspects of designing the product as well as business issues such as determining how many varieties will be offered, who will manufacture the product, where it will be made, how many units will be made per year, and whether the product is a member of a family that shares parts, processes, suppliers, and business practices [6], [2].

A sketch of the early phases in a typical product design is given in Figure 1. This figure illustrates a market-driven process, in which means are sought to meet a set of existing or emerging customer needs. These decisions define the product is basic functions, operating concept, architecture and assembly [2], [5]. Technical and business issues are involved. Subsequent steps of detailed design, realization of the manufacturing plan, including design for manufacturing and assembly, plus integration of these plans, are not shown.

Local and Global Categories Related to Product

Any analysis of the product from a broad assembly/drives point of view will have to take these choices into consideration.

Architectural and technology choices like those discussed in the previous few sections have large implications for how a product will be assembled. Implicit in the discussion about concurrent engineering, however, is the idea that assembly analysis can reveal problems or opportunities that need to be considered when architecture and technology choices are being made. The discussion needs to take place early in product development, when basic business, architectural, and technological decisions are being made.

The factors discussed can be systematized by categorizing them according to whether they apply to the product or to the assembly system and according to whether they can be considered local or global (Table 1.). Local generally refers to decisions that primarily impact the item at hand, or which can be made without bringing in a wide range of constituents from other organizations. Global generally refers to decisions that have implications beyond the item at hand or which have to be coordinated with similar decisions being made about items, or which must conform to larger goals or policies set elsewhere.

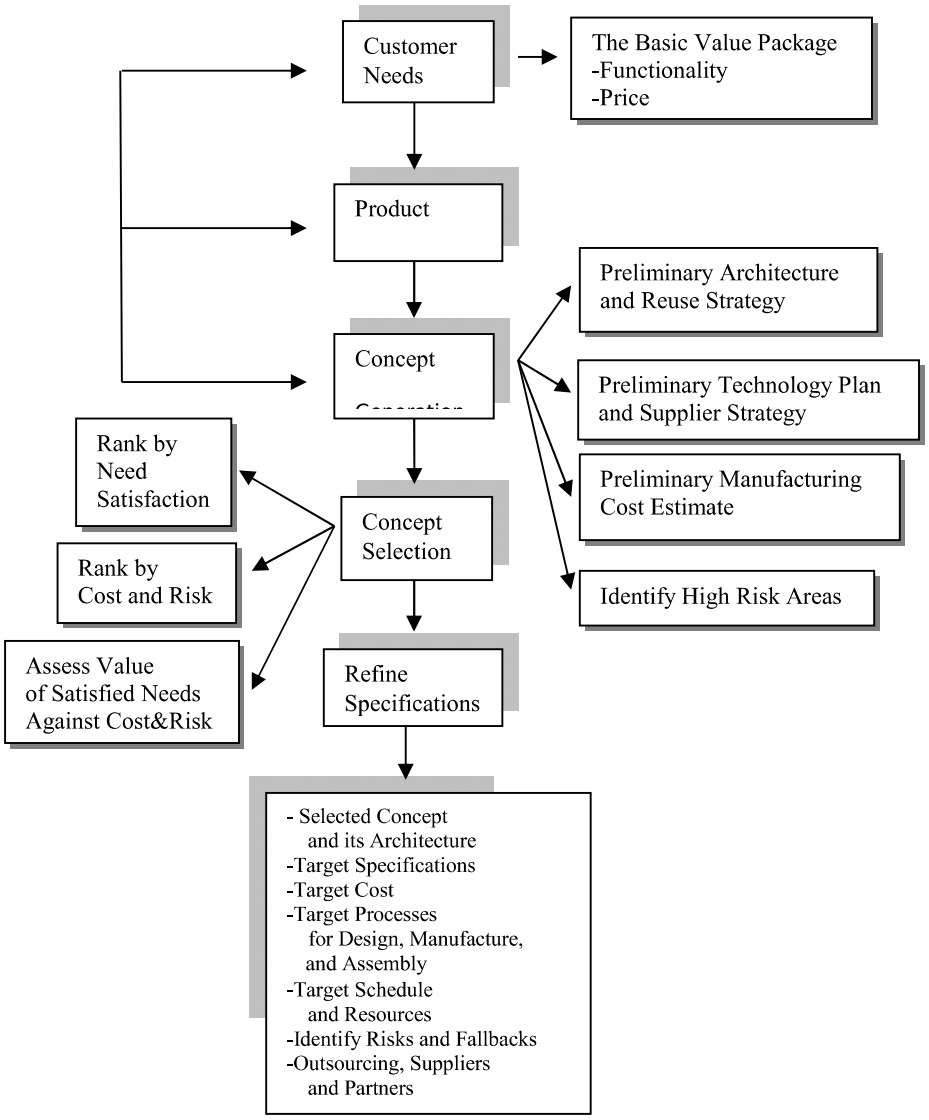

Figure 1 Important decisions in product design [2]

Table 1 Clustering of the issues in assembly into local and global categories related to product and process decisions [2]

	Global	Local
Product Considerations	-Economic and market targets -Volume growth -Model varieties -Design volatility -Quality, reliability, safety -Make or buy decisions	-Assembly sequences -Type of operations -Geometric constraints -Characteristic of parts -Tolerances and clearances -Tests and inspection
Assembly Process and System Considerations	-Cost and productivity goals -Interface to the rest of the factory -Labor policies -Failure modes and repair policies -Space constraints	-System layout -Equipment choice -Task assignment -Part logistics and feeding -Buffer -Inventory control

Impact of Manufacturing Strategy Concent vs. Proces

In the past decades, globalization has already become the mega trend impacting manufacturing strategy of a majority number of firms all over the world. In the literatures being related to manufacturing strategies, intertwined effects of manufacturing strategy will be reviewed as a foundation for the development of theoretic framework development [7]. To be successful internationally, a company needed to operate manufacturing facilities in the major foreign countries where it sold its products based on following reasons: customer's preferences to a product manufactured locally, prevention of protectionism, facilitation of understanding of local requirements, provisions of a focal point for customer visits, allowing a company to demonstrate the core and quality that go into production [8].

According to [9], [7] summarized that manufacturing strategy has been considered from two perspectives: content and process. The content of manufacturing strategy comprises the specific decisions and actions which set the operation's role, objective and activities while the process of manufacturing strategy as the method that is used to make the specific content decisions [9], [10] describe the distinction between the content and the process of manufacturing strategy in the manner shown in Figure 2.

Finally, based on literature [10],[11],[12] the best practices which way be used as manufacturing strategies for enhancing firms manufacturing capabilities include:

-manufacturing resource planning,
-optimized production technology;
-flexible manufacturing system;
-group technology;
-total quality management;
-just-in-time;
-lean production;
-concurrent engineering.

Manufacturing and distribution networks must be tightly coordinated, without redundant processes from which change must begin: product development; purchasing; production; demand management and order fulfillment [7].

The decisions as important as the design of the global manufacturing system should be made only after considering the interrelationships and trade-offs among the principal systems elements ordinate global manufacturing is to modify the conversion process through the rationalization of productive resources so that it adds the most value to the firm's product as possible [13].

Economic globalization of the past decades has had two principal impacts on manufacturing firms: intensification of competitive pressure in most manufacturing industries; economic globalization initiated a move toward the creation of global markets [13].

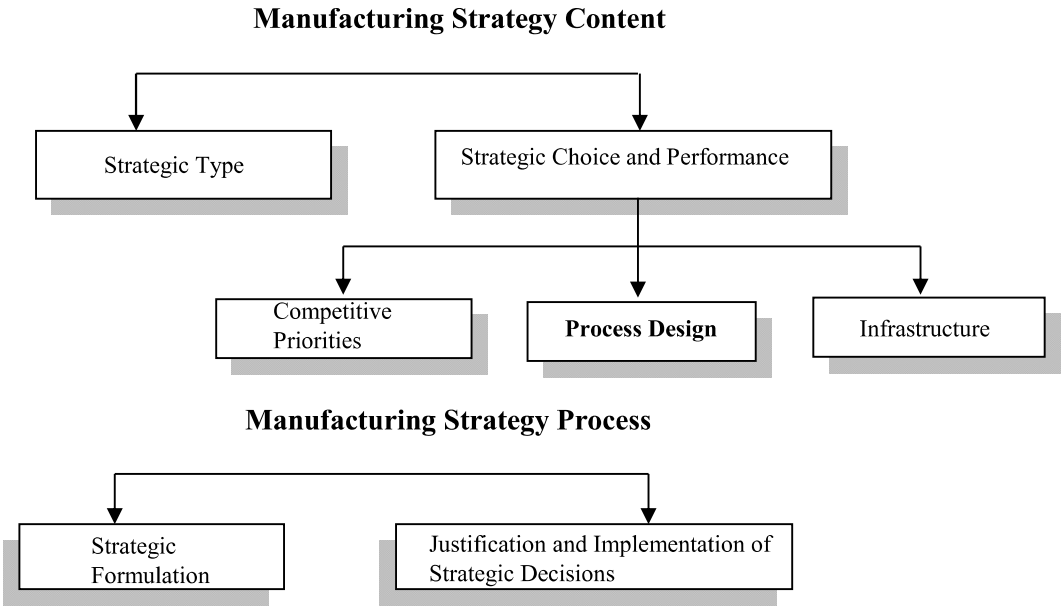

Figure 2 Manufacturing strategy content vs. process [10]

Conclusions

In the context of this paper only manufacturing strategy on product design and development and manufacturing firms will be treated further [14].

The designers of products, processes and manufacturing systems as well as production planners should be cognizant of the coupling between generations of products and manufacturing systems and capitalize on its potential benefits in improving the productivity of the whole enterprise.

Manufacturing strategy form an important link between the assembly processes/product design and development of manufacturing systems and their facilities throughout their perspective life cycles. It has been treated as an important topic for product design and development for many years [15]. With the increasing global interdependencies of manufacturing firms and markets dynamics, the whole factory including assembly, logistics and even the site and buildings have to be considered as well.

Acknowledgements

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