



FUNDAMENTALS OF NEW PRODUCT DEVELOPMENT

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Abstract: Design and development of new product is key to success in current business scenario. Product design and development process is having few fundamental steps as well as some auxiliary step to follow for customer delight and profitability. This paper is used to demonstrate fundamental and auxiliary step including rational design, empirical design, and design for X in various stages of product design and development. Different stages of new product development are followed as per standard design practices and detailed analysis of product development activities of Indian manufacturer which makes Spray gun for construction industries.

Index Terms - Product design specification (PDS), Conceptual design, Embodiment Design, Design for X(DFX), Detail design.

I. INTRODUCTION

In the era of 3D printing and automation in production, new product design is still pain area for Indian small and medium scale industries because of nonavailability of resources of information, expertise and tooling. New product development (NPD) is always crucial for industries because it is key ingredient in concocting success in long term. It is required for organization to update their technology as per current requirement and to infuse latest technology in product. Use of fundamental of design like DFX, Quality function deployment (QFD), Modularity apart from Value engineering and Industrial Engineering play important role in success of product development which follows Product Life Management (PLM). Selection of manufacturing process, prototype testing, inspection of critical to quality (CTQ) are equally important for customer satisfaction.

II. LITERATURE SURVEY

Erwin Rauch et al [1] have discussed basics of axiomatic design guidelines for the design of lean product development process based on waste reduction and value addition. Functional requirement and design parameter are used with specific design matrix. $\{FR\}=[DM]\{DP\}$. **Mohmed Kashkoush et al [2]** presented a mathematical model of selection for optimal overall product modularity in product design and development. Modularity is used to convert complex integrated product into simple one by clustering components, with reduced cost and ease of maintenance. **Piotr Chwastyk et al [3]** have presented about product costing with different parameter of feature-based costing (FBC), and activity-based costing (ABC). Right from idea generation to product is in use cost are taken in consideration using uncertainty of various output results. **Abraham Moody K et al. [4]** have discussed about finding way of customer satisfaction with the use of quality function deployment and its matrix. Different phases like product planning, part deployment, process planning and production planning used in QFD in relation with each other provide better way to select production goal.

III. CONVENTIONAL PRODUCT DEVELOPMENT PROCESS

Product is used for making profit for organization with the help of customer satisfaction, safety as well as taking care of environment. Basic need of customers can affect product development process as under

- Performance
- Durability
- Reliability
- Maintenance
- Aesthetic
- Key feature
- Conformance
- Cost [6]

Conventional product development can be done using following basic stages in organization for better engineering purposes.

- Conceptual design
- Embodiment design
- Detail design

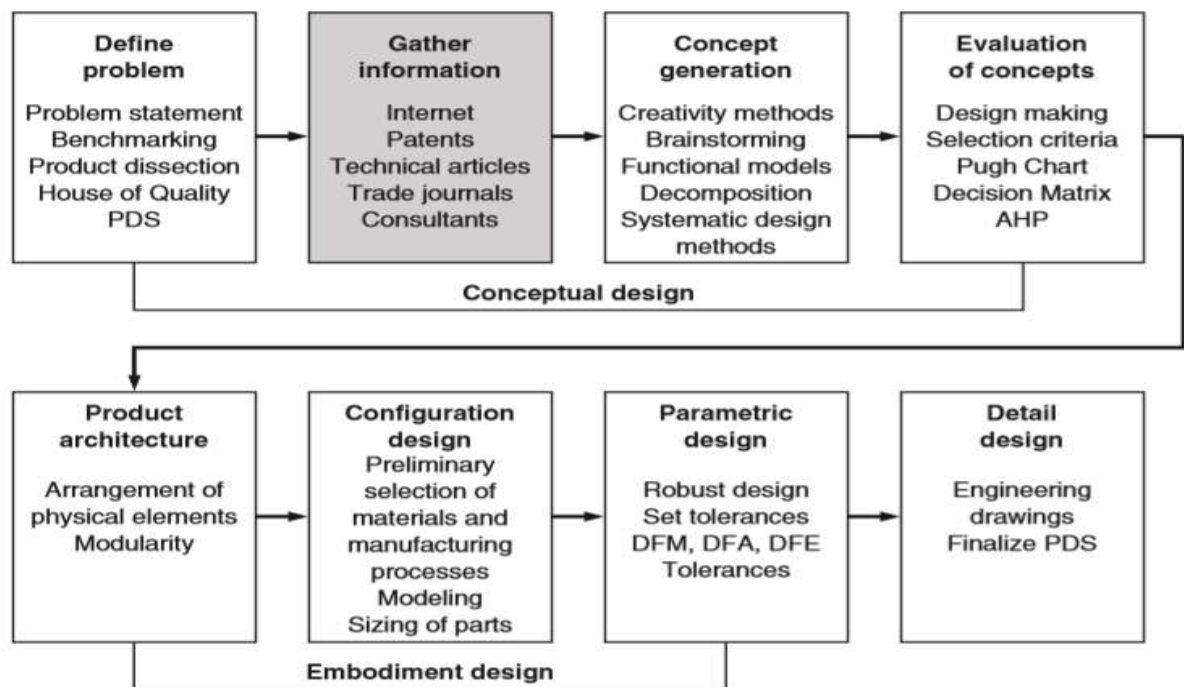


Figure 1 Engineering Design Process (George E. Dieter and Linda C. Schmidt. 2013 Engineering Design)

3.1 Conceptual Design

First stage of design is concept design or conceptual design in which defining problem by using various tools like benchmarking, house of quality (HoQ), and product design specification template are used. Information related to product, customer, legal, and environment are gathered before design process by using internet, patents, technical journal, and consultants if required. After collection of design related information ideation of concept is done by using several tools like Brainstorming, Functional models, Decomposition, Systematic design methods etc. Finalization of idea is done by evaluation based on different parameters. Pugh Chart, Decision matrix AHP can be used for evaluation of idea.

3.2 Embodiment Design

The embodiment design sum of process of product architecture, configuration design and parametric design.

In product architecture following things are to be decided

- Arrangement of components (Assembly and sub assembly)
- Modularity
- Interfaces (type)

In Configuration design of embodiment design deals with following important things as under

- Selection of shape and profile
- Selection of material
- Selection of production process based on shape and material

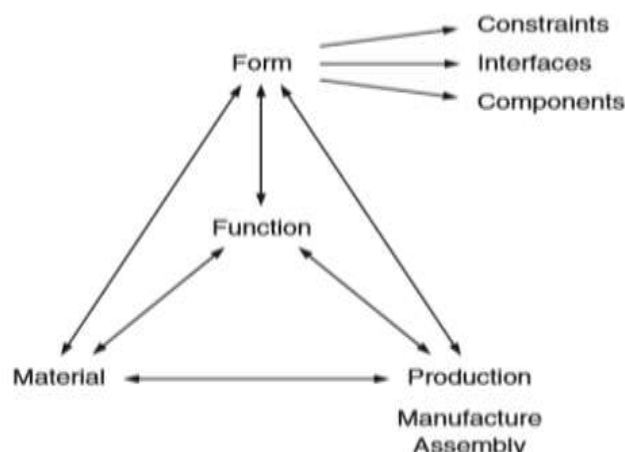


Figure 2 Relationship of variables in configuration design

Parametric Design is last part of embodiment designs generally used for all calculations including following

- Design variables
- Dimensions with tolerances
- CAD Model
- Rapid Prototyping
- Industrial design and visual aesthetics

Apart from above activity DFX comprises of Design for Manufacture (DFM), Design for Assembly (DFA), Design for Environment (DFE), Design for Manufacture and Assembly (DFMA) can be used based on specific purpose or in general basis.

3.3 Detail design

Detail design is the final process of product development. Following steps are performed during detail design process

- Finalization of product specification
- Finalization of make or buy component list
- Complete Engineering drawings
- Bill of Material
- Product cost sheet
- Design project report
- Release of drawing to production

IV. IDENTIFICATION OF DESIGN FUNDAMENTAL OF AN INDIAN ORGANIZATION

This paper is used for survey of an Indian original equipment manufacturer (OEM), which works in manufacturing sector, generally produce equipment related to construction industry for automation of work for better productivity. Development of equipment of spray gun (product) is analyzed with reference to product design and development fundamentals. All fundamental steps are tabulated below

Table 1 Fundamental step mapping of Spray Gun (Product) development

S No	Fundamentals Step	Description (activity)
1	Define Problem	Problem statement finalization. Use of Benchmarking. Use of QFD
2	Gather Information	Information from customer, journal, patent, internet, legal, use of consultant.
3	Concept Generation	Use of benchmarking, use of functional decomposition of model, Systematic design matrix
4	Evaluation of concepts	Decision making, selection criteria, Pugh chart, AHP, Decision Matrix
5	Product Architecture	Decision of assembly, modularity, interface design
6	Configuration Design	Finalization of shape and profile, selection of material, production process selection.
7	Parametric Design	Design calculation, tolerance design, CAD model, Industrial design, Rapid prototyping
8	Detail Design	PDS finalization, Bill of Material, Engineering drawing, Cost Sheet, Design project report, release of drawing
9	DFX	Design for manufacturing, Design of assembly, Design for environment

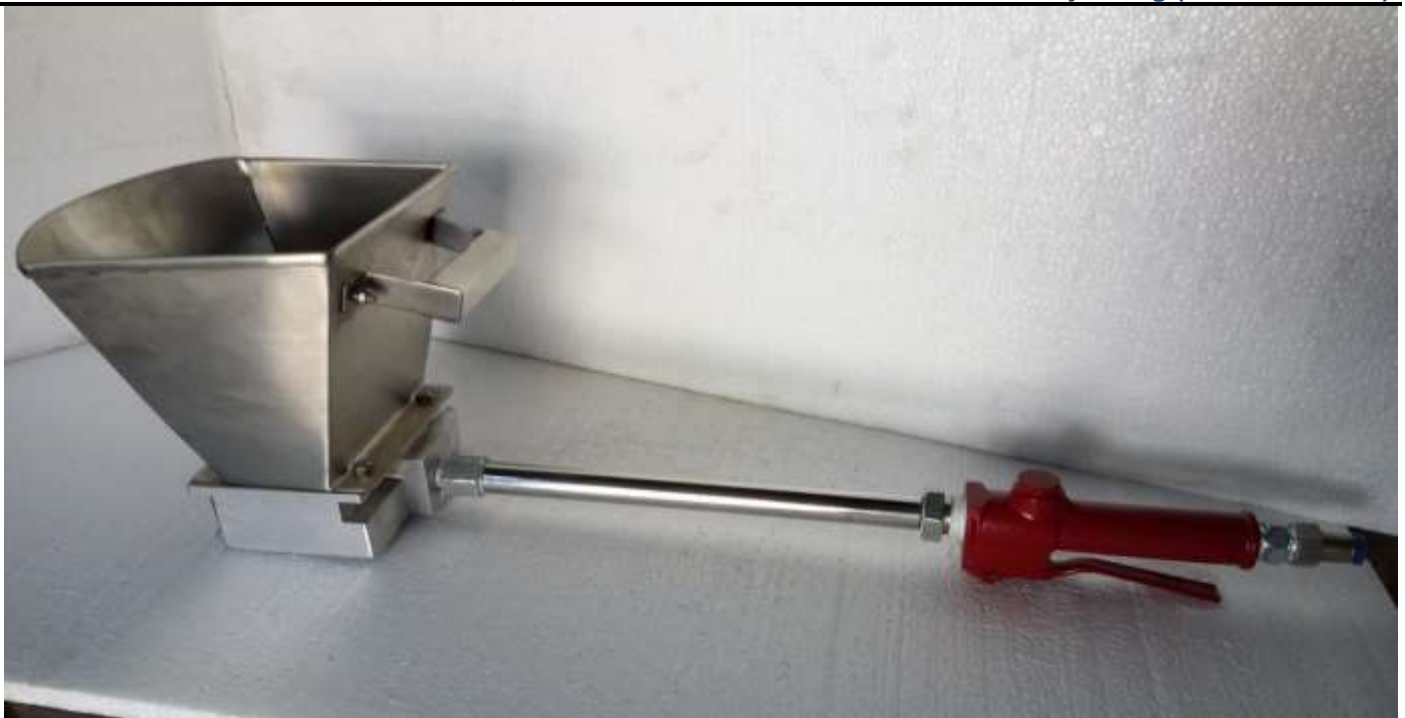


Figure no 3. Sample Product: Spray Gun (M/s Lakshmi Machine Tools, Indore)

IV. RESULTS AND DISCUSSION

This paper has provided important information of new product design and development process and activities related to those process. The relationship between design steps and activities in whole process can be understood from below table

Table 2 Relationship of fundamental steps and product development process stage

Fundamentals Step	Activity Used	Activity Missing
Define Problem	Problem statement finalization.	Use of Benchmarking. Use of QFD
Gather Information	Information from customer, journal, internet, legal.	Information from patent, Use of consultant.
Concept Generation	Use of functional decomposition of model.	Use of benchmarking, Systematic design matrix
Evaluation of concepts	Decision making	Selection criteria, Pugh chart, AHP, Decision Matrix
Product Architecture	Decision of assembly.	Modularity, interface design
Configuration Design	Finalization of shape and profile, production process selection.	Selection of material.
Parametric Design	Design calculation, tolerance design, CAD model.	Industrial design, Rapid prototyping
Detail Design	Bill of Material, Engineering drawing, Cost Sheet, release of drawing	PDS finalization, Design project report.
DFX	Design for manufacturing.	Design of assembly, Design for environment

Success of business is based on successful product having longer product life cycle with customer satisfaction. Steps in Product development processes ensure the quality of product for their performance, reliability, aesthetic and other requirement of customer. Different level of customer needs like expecters, spokens, unspokens and exciters must be taken in consideration during new product development stages.

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