White Paper – Product Design for Hardware Startups

Godwin Sonnoe S, Sudesh M. Naik

***Abstract*—**the approach to design a product is significantly different from that of prototyping and involves extensive planning and collaboration between various stake holders. A lot of hardware product startups have wonderful ideas, make a great prototype, but find it hard to get it Ready to Manufactured. This white paper is aimed to help Hardware startups get a step closer to designing a product that can be productized and volume manufactured

***Keywords*—**Startups, Product Design, Volume Manufactured

I. INTRODUCTION

HARDWARE startups create proof-of-concept and prototype quite easily. These prototypes serve the purpose of winning the confidence of the investors and customers on the product. This will followed by certification, cost optimization and volume manufacturing. This will call for a strong engineering process to meet the global demand. This is the stage where everything is put to test. Will it be possible to deliver to the product with all the market expectations? How long will the market have to wait? When will the RoI be? Dive a little deeper and questions like, how many products can be made in a day? Can the price be reduced any further to make additional profit? What is the MoQ? Can it be manufactures out of any different plant which has bandwidth available?

Most of the questions may be too late to ask if the product is already in the volume manufacturing phase. Any change/revision will be time consuming and a cost overhead, but yet forced upon the startup to move further, to meet the business needs, and sometimes probably the one that stands between the success of a startup.

The preparation for NPI starts from the time product is conceptualized. This whitepaper is intended to help you a step closer for a successful product design.

II. COLLABORATION BETWEEN TEAMS

Collaboration between the industrial design, mechanical electrical, firmware and software teams is one of the key for a good product design. The aesthetics of the product plays an important role in the success of a product, particularly if the product is in the consumer domain. While the look, feel, form factor, material choice, strength, assembling procedure are deciding factors for the mechanical and industrial design team, the feasibility to implement electrical design, radiation pattern, antenna location, thermal dissipation, power distribution are deciding factors for the electrical and mechanical team. If the product is battery powered equipment, power conservation, boot time, dynamic power levels are deciding factors for electrical and firmware teams. It will involve tradeoffs between these disciplines and cost to achieve a product. This collaboration has to encouraged, however timelines have to be enforced to ensure that the project plan is not jeopardized. It is a good practice to allocate time in the project plan to account for this

Godwin Sonnoe S. Sr. Lead, ASM Technologies Limited Bangalore

Sudesh M. Naik, Sr. Technical Manager, ASM Technologies Limited, Bangalore

III. COSTING

Cost is one of the critical factors in any business. While bill of material is first in scrutiny to reduce cost, there are other areas where cost target can be worked out. For example the time the product needs in the assembly line will impact resource utilization in the manufacturing house, and cost of a product. Choosing PCB material, PCB layer count, via structure, component placement, assembly line testing and packaging, can alter the cost of the product. These will have to be thought through in the initial design stage. This is also a where; experts in the field can lead startups to reach the optimum cost.

IV. YIELD

Yield can simply be termed as the ratio between the no of working units leaving a process to the total number of units entering a process

Yield = (# units leaving the process as good parts) / (# units put into the process

A yield of above 96 -97 % should be the target from the start of the PCB manufacturing to end of packaged products. Low yield will result in lower margin/profit, and probable redesign of the product to improve yield. Violation of design rules and manufacturing rules will affect yield. Apart from the electrical/mechanical design guidelines/rules, there are industry practices like DFA, DFM, DFT, DFx followed to get high yield.

V.DFA, DFM, DFX

Design for Assembly (DFA), Design for Manufacturing (DFM), Design for Testing (DFT), are design methodologies needed to get the best yield from each of these process in volume manufacturing. These rules are manufacturing plant specific. The PCB fabrication and assembly houses have their own capabilities. The rules vary with the manufacturing plant capability. The simpler the manufacturing process, the more are the options of EMS and a hence price advantage and lesser dependence on specific plants. Ideally the design should fall into the standard DFx requirements. Standard practices many not be feasible for products in wearable/miniaturized designs. This will be another area to seek help from experts.

VI. Design Process

Hardware startups hardly get a second iteration to prove a product. Hardware development process is time consuming and expensive compared to a software development process. This calls for "right the first time" designs. This needs a proven process while developing a hardware product. The process followed should be an optimum which achieves quality and does not affect the timeline much.

VII. Project and product management

Project and product managements are often misunderstood to be the same. They have similarities but have different goals. The product management is for the entire life of the product, from concept to end of life. The product can have multiple projects below it, each with a specific time bound requirement. Though it is possible for one person to take the responsibilities of both the roles, it is best that they are handled by different people.

VIII.External vendor dependence

Hardware Engineering needs many specialized machines/equipment, design / development environments and processes to achieve the desired quality. These equipment/tools are expensive to be owned and maintained by startups. There are many fabrication/assembly houses which does the manufacturing as a service. While a product is designed the external vendors will have to be carefully identified, depending on their capabilities and expertise, and the needs of the product. These engagements with the vendors are those that the startup will have least control during product development cycle, and is best to plan the risks in the project plan. Startup should have a defined ecosystem of vendors to get the product design/tested/certified and manufactured.

IX. NPI

The engineering process creates a product; the manufacturing house volume manufactures the product. New product Introduction transitions the ownership of product from the engineering to the manufacturing team. The decisions taken by the engineering team while designing the product should help the manufacturing team while volume production. For example the choice of components and components vendors may have a huge impact during volume manufacturing. This calls for interaction between the both the teams from the early stage of design. The interactions between the teams will peak between the proto build to the first few sets of volume manufacturing.

X.Review plan

Reviews at each stage with a defined quality process is away to spot costly mistakes early on the in design phase. Particularly in hardware, the later the issue is found; it is more expensive to get it corrected. Never miss the review process in while designing hardware product.

XI. Conclusion

With a design to market time shrinking every day, it is best to work with an ecosystem to meet the time to market requirement, while protecting Intellectual property rights.

Godwin Sonnoe S. has over 14 years of experience in product design.

Sudesh M. Naik has over 18 years of experience in product design,

Both the authors have worked for leading OEM/EMS Company across geographies and associated with product, in consumer, network and enterprises storage, medical and automation domains which are volume manufactured