HCL

New Product Introduction

WHITE PAPER

1. Introduction

Product Design and development is an activity jointly performed by both the engineering as well as manufacturing teams. When the time to market pressure was not there product development happen to be a sequential activity and manufacturing team takes over the prototype design that was delivered to them by the design team and converts it into a manufacturable product. However with that luxury gone and with reduced time to market and product life cycle, a product has to be developed concurrently to reach the market at the fastest time. While designers take care of the cost aspect early in their design, cost is not the only element that affects the product performance in the market. When a product is either outsourced to an EMS vendor or their own manufacturing team for manufacturing – both of them subject the design to a process called New Product Introduction (NPI) which is an engineering process which converts the design into a product. In this write up we will see what are the elements of NPI and how the designers can reduce the NPI time working concurrently with manufacturing team to develop a robust product with reduce time to market.

2. What is NPI?

New Product Introduction is basically a set of processes which are unique individual Contract Manufacturers as well as the OEM based on their capability. Typically NPI addresses four broad areas which then have subsections. These are :

- BoM (Bill of Material) Cost of the product and Supply Chain Integration
- Manufacturing Issues
- Testing issues
- Product Qualification and Certification issues

3. Bill of Material issues

Bill of material might look straight forward but has a huge impact on the cost of the product if there is no synergy between the EMS vendors Supply Chain and AVL (Approved Vendor List). BoM can have a big impact as each vendor's supply chains and costing

mechanism depends on

- Geography where the manufacturing facility is located – How the components that are not available locale will be shipped to the factory
- Local Vendor base – How large and heavy sheet metal and plastic parts will be procured
- Product Mix of that location – Composition of the existing AVL and the impact of new product's BoM
- Logistics and warehousing capability – How the finished goods will shipped to the end client location as well as how the inward material will be handled

These issues become very critical at the early stage of the design. If these are not addressed product cost will be impacted.

4. Manufacturing issues

Manufacturing issues also impact the time to market as well as cost & quality of the product. Some of the issues that don't get addresses when the design team does the initial designs are

- Board assemble related issues
- Product assembly related issues
- Assembly process related issues
- Product packing and handling issues

One of the critical factors for the success of a product is how easy and convenient to manufacture a product and especially across the globe without much dependency on the geographic location

5. Product Testing Issues

Other key aspect of success of the new product is how easy and efficient to test and qualify a product. Some of the key aspects of this are

- Board testing
- System testing
- System calibration
- Prost production quality and reliability testing

These issues are very crucial for the success of the product in the market and product's reliability. Poorly tested product can mar the entire reputation of the product and its maker.

6. Product Qualification and Certification

Product certification is a must for a product to be sold globally. With different countries and different regions have different standards based on the domestic needs one size fit all approach will not work. Key issues which need to be addressed are

- Safety standards that need to be met
- Environmental laws (e.g. RoHS for EU)
- Homologation to country specific standards

These issues are crucial for the product to reach global users. In most cases it mandatory for the companies to meet these standards.

Having seen all the 4 major aspect one common thread that runs across these issues is the fact that most of these issues are directly liked to the design of the product and if the designers take care of these issues early in the stage of design product becomes more robust and reaches the market on time.

In the next section we shall slightly in detail about the various aspects of these 4 major issues and what they really mean.

7. Elements of New Product Introduction Process

NPI process is basically a structured way of introducing a new product into the assembly line with in a short span of time within the cost target set. While NPI has been thought to be so far a process carried out by the EMS vendors, integration of the design cycle into the NPI concurrently can reduce the time to market. With active collaboration of Design Service Vendors and EMS vendors this can be successfully achieved. Purpose of this section of the write up targeted towards the NPI teams of design and manufacturing team explaining the advantages of concurrent NPI. To make the reading easy individual elements of a NPI process and it its impact along with the owner has been given in the table.

S.No.	NPI ELEMENT	OWNER		DECRIPTION	IMPACT
		Designer	EMS		
1.	BoM Cost of the product	☑		Since the designer starts the product design ownership of cost of the product remains with the Designer. EMS vendor can influence from his AVL and lead time perspective only	Bill of Material is the single most contributors for the cost of the product. If this is not arrived at in consultation with the EMS vendors cost of product can never be controlled. Also this exercise has to be done early in the game not after the design is frozen
2.	Component Selection	☑	☑	This particular activity is not only applicable for the electronics components as well as custom parts like sheet metal and plastic parts which are specific to products which needs vendor development as well as local procurement which is crucial aspect for success	Impact of this activity is very substantial
3.	Custom Part Design	☑		In the over all context of product development Custom Part Design is the responsibility of the Designer. However unless the designers understand the geography and the capability of the vendor who is ultimately going to manufacture, custom part in the design can create problems for the overall development	This essentially means that the designers have to work with the EMS partner early in the design phase to address this issue and ensure correct vendor is selected.
4.	Electronic packaging	☑	☑	This also an issue which is very similar to Custom part as most of the times electronic packaging are custom built and needs close interaction with the vendor.	Most of the times electronic packing is based on metal and big. This means unless the packaging vendor is not in the close vicinity of the EMS vendor cost of the transport will increase. So electronic packaging has a direct impact on cost based on the location of the vendor.
5.	Cable harness Design	☑	☑	Systems which have multiple PCBA need dedicated cabling which could be for the signals as well as for power distribution. Cable harness design also has very serious impact on the product assembly, ease of supporting the product in the field and compliance certification of the product. Unless the harness is designed properly compliance to emission and safety standards can a major nightmare.	Cable harness design has impact on the • Compliance Design • Thermal Design • System Assembly and checking • Field support • Safety of the product (like UL etc.) Location of the cable harness vendor and his/her capability is a very key aspect for the trouble free operation of the product
6.	PCB layout (Dfx)	☑		This is one of most important aspect in a product design which decides the success of the product and its cost. Design for X typically consists of • Design for Assembly • Design for Manufacturing • Design for Testing • Design for Compliance • Design for Reliability • Design for Cost • Design for Support While these DFx activities are the responsibility of the Designers the inputs have to come from the EMS partner for most of these aspects. Primary reason being these aspects are closely linked to the manufacturing infrastructure of the EMS vendor.	• DFx activities are one of the key contributors to the cost of the product. • DFx aspects are very key as these are dependent of the capability of the manufacturing location, the processes followed and the manpower capability to produce. • When the products are meant for regulated industries are manufactured aspects related to Hygiene as well as safety of the equipment when being manufactured
7.	Assembled PCB Testing		☑	Once the PCB is assembled it has to be tested before this can be used to build the system. Easiest of the lot is a system with a single PCB. However product volume decides what kind of testing that will be used. Some of the key aspects of PCBA testing are: • Volume of the Product (larger the volume testing should be automated) • If the product is low volume dedicated tester for testing the PCB has to be designed. Especially in the case of Avionics Products testers have to be co designed and validated • When the product has multiple cards most of the system integration needs special hardware as well as software for integrating the tested PCBAs	In a typical product one of the key contributors costing the manufacturing is the testing which takes about 5-7% of the product cost. Apart from just testing product's reliability, yield in the manufacturing line time of testing a product impact the efficiency of the product to a large extent both before and after manufacturing. Unless proper planning is done during the design phase of the project testing can be a nightmare once the product design is frozen.
8.	System testing and Checkout	☑	☑	System check is basically final check where the product as a whole is tested inclusive of the packaging and all other intended peripherals. System checkout becomes more critical when multi PCBA systems are assembled. This is true in computing and telecom systems and in Medical & Avionics to some extent. Designers have to plan and device hardware and software for carrying out the system integration and checkout.	Apart from using the dedicated procedure one of the key element which impacts this process is the ability of the assembly and test line engineers/technicians to adapt to the procedure quickly. Primary reason for this is completely tested individual PCBA don't guarantee a successful integrated product due to involvement of Back planes, cable and harnesses etc. Both the designers and Manufacturing contractors have to be conscious of this fact.
9.	System Calibration	☑	☑	This process is the one most of the time designers tend to ignore. This could be fatal to the product when the product has analog circuitry which needs calibration for correct measurements. One of the common mistake designers do is the non provision of self calibration mechanism so the system detects the long drift in the component and hence in the circuit and correct any anomaly.	While calibration per say look very simple most of the designs/systems need a complex setup to do the calibration of the system. Invariably these will not be available off the shelf and the designers or the test engineering team of the EMS vendor has to assemble them or design team. Unless this is sorted out at the earliest this can be a major issue

10.	OEM Part Selection & Qualification	☑	☑	OEM parts are typically Power Supplies, Motor Control packs, Standard cabinets etc. While designers should offer at least minimum of two alternatives, most of the time designers end up converting an OEM to a custom part. This tendency should be curbed. Second important aspect ensuring the OEM vendor consistently supplies the materials to the required standard. This is more important in the case of Medical/Avionics products where the OEM supplier also has to maintain the history of the parts supplied in case there is a recall of the part. Challenge for the designers is that they have to ensure they evaluate the parts and select them correctly to meet the product specification.	For the EMS vendor challenge become even more as ensuring the product quality throughout the life of the product and the same time cost has to be under control. One way of doing this to ensure multiple vendors are available but this may not be possible in case of specially tooled parts. Second bigger problem is due to their size and cyclic nature of the business the OEM vendors may go out of business or the parts they supply may go out of production which leads to business risk and EMS vendors have to protect themselves against this.
11.	Certification and homologation	☑	☑	Certification of a product for standards as well as country specific standard requirements (homologation) has to be addressed during the product concept phase itself. Even better will be it should be addressed in the stage of Market Requirements and Market Research phase. With each country driving their own standards especially to meet their region specific environmental requirement it is imperative that unless certification is addressed early in the design getting the product certified after the design is complete is a Herculean task fraught with the risk of delay and cost escalation.	From the EMS vendors this becomes a challenge to ensure the product consistently meet the required standards as well as ever evolving new standards. This particular certification process puts the load on the EMS vendor to technically be equipped with professionally qualified team. Sometime the OEM may not even have the team which originally designed product so this can result in even difficult situation of no knowledge available. So one of the key aspects that EMS vendor has to ensure is that product knowledge is captured and documented.
12.	Burn in test Plan		☑	This stage of the manufacturing is to ensure that the product in the infant mortality stage are weeded out of the production line to ensure that the product reliability is ensured	This phase of the product is typically decided by the EMS partner with the data colleted over period of time from their experience and also the sensitivity of the components used in the design. This typically varies from 24 Hrs to 72 Hrs depending on the requirement as well as the infrastructure
13.	DMR/DHF/MDD Records		☑	DMR/DHF/MDD these are very specific to the Medical industry while DHF & MDD pertain to Design history of the Medical Devices for US and European Union respectively. While DMR (Device Master Record) is the record which needs to be maintained by the EMS vendors for the individual devices that they manufacture.	• Challenge for the EMS partner is the IT infrastructure and the Application to support this as part of their MRP/ERP systems. • Facility has to comply FDA's GMP (Good Manufacturing Practices) as well as CFR Part 11 along with surprise audit by FDA and inspection of the facilities any time.