NPI

GUIDELINES FOR A NEW PRODUCT DEVELOPMENT AND INTRODUCTION PROCESS

Practical Implementation of a classic Stage-Gate model

Authored by Al Cioffi

4GM Group

Introduction

This document provides a detailed description of a systematic approach to organizing and managing the process of developing products and launching them into a marketplace, generically referred to as an NPI Process. It consists of five distinct phases of development based on a classic Stage-Gate model, and is organized around a project team approach. It can be adopted by, and adapted to many types of products and many business models. It applies to basic technology development, base product platform development, as well as derivative product development, with expectations for effort and timeframes adjusted accordingly. It addresses the activity, expectations, and linked efforts of every functional organization.

This process is tactical in nature. It does not specifically address issues of the strategic fit of products or opportunities with the overall corporate strategy or mission. Certainly strategic considerations may enter into the decision making process, especially if discovery of opportunities lead to corporate strategic shifts. This NPI process assumes strategic considerations to be parallel activities.

There are several important benefits of implementing a Stage-Gate NPI model;

- Apply discipline to the seemingly chaotic product development process
- Create visibility and understanding of the NPI process, guidelines, and criteria
- Establish decision Gates that consciously drive unemotional economic decisions
- Establish a complete process with no gaps or missing elements
- Create a working environment of collaboration and shared accountability among cross functional team members
- Engage senior management support and empowerment of NPI project teams

Although detailed and comprehensive, this procedure is intended to provide a simple to understand and implement process that can be easily executed and yield positive results. It is also expected that as an organization adopts and adapts these concepts, continuous improvement of the procedure, its organization, and contents will naturally occur.

1. Definitions

New product development encompasses a wide variety of activity and specialized skills, and not all persons involved in the process may be familiar with the various technical, commercial, operational, financial, etc., aspects involved, and even if they are, the diversity of skills and experiences that each individual possesses will lead to differences in communication and understanding among project team members. For this reason it is not only useful, but critical to establish clear meaning of terms used to describe the NPI process. This encourages common understanding throughout the organization and fosters clear and crisp communication among team members. It also helps to focus efforts quickly and effectively. The following sections list areas for standard definition of terms and suggested terminology for adoption.

A. Product Related Documents

DCD – Design Concept Document (Theory of Operation)
ERD – Engineering Requirements Document
ATO – Assemble to Order Model
DWG – Any type of Design Drawing
OLD – Outline Drawing
BOM – Bill of Material
WD – Wiring Diagram
SD – Schematic Drawing
PWB – Printed Wiring Board Drawing
PFC – Programming Flow Chart
ERF – Embedded Reference File (set points, data file, etc.)
EEF – Embedded Executable File (programming)
ASD – Assembly Drawing
LBL – Label Drawing
PKG – Packaging Diagram
WI – Work Instruction
MTR – Manufacturing Test Requirements
PCR/PCO/PCN – Product Change Request/Order/Notice

B. General Terms

DVT – Design Verification Testing
SIT Systems Integration Testing
FMA – Failure Mode Analysis
RCA – Root Cause Analysis
EAU – Estimated Annual Usage
COGS – Cost of Goods Sold
SIOP – Sales, Inventory and Operations Planning
API – Application programming Interface
DCF – Discounted Cash Flow

C. Product Platform

A new class of product that forms the basis for a family of similar items that are derived from the base platform in a straightforward manner. A platform can usually be characterized by 4 to 6 major attributes that capture the essence of the platform – these attributes will vary from product type to product type. Examples of platform defining attributes are listed in Table 1.1 for a component type product and for system type hardware products. Table 1.2 lists attributes for software based products.

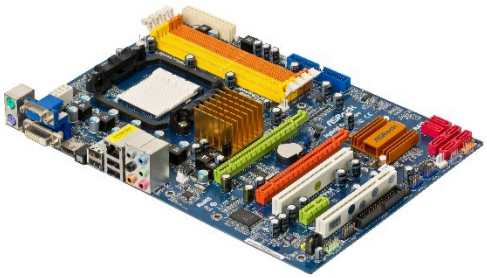
For component type products a useful rule of thumb is that that when two or more attributes change a new platform is generally defined. System platforms can be defined by one or more new attributes, depending on how extensible the platform is designed. For example, referring to the table 1.1, the UPS will contain a computer motherboard. There can be a change in computer motherboard platform that serves the UPS system platform that also facilitates a change in control and communications functions and enables an additional battery technology. These new attributes in turn may define a new UPS platform or may be viewed as an extension of the existing platform.

Hardware "Example"	Component "Computer Mother Board"	System "Uninterruptible Power Supply"
Platform Attributes	Printed Wiring Board Layout	Delivered Power Rating
	Component Set	Power Quality Type
	Circuit Topology	Battery/Energy Reserve
	Packaging and Thermal Management	Packaging and Thermal Management
	External I/O Connections	Control and Communication Functions
	Embedded Software	Power Conversion Modules

Table 1.1

Software "Example"	Component "Variable Speed Drive"	System "Plant Controller"
Platform Attributes	Real Time Switching Control	Plant Control and Configuration
	Communication Protocol	Communication Protocol
	User Interface	Local and Remote User Interface
	Fault Protection and Alarms	Fault Protection and Alarms
	New Hardware Support	New Component/Plant Element Support

Table 1.2



D. Project Types

Defining project types is a useful way of characterizing required scope of effort and setting project deliverable expectations. This is very helpful especially at Stage 1 when potential customer commitments are under discussion. Table 1.2 defines five suggested Project Types, application to Component and System type products, and suggested expectations for timing and resources.

		Description and Attributes		
Project Type	**General Description**	**Component type Products**	**System type Products**	**Resource and Timing Expectations**
1	New Configuration	Generally does not apply	A new combination of existing components or subsystems that has not been combined before. Requires product release documentation changes only.	Should be handled on sales order as much as possible. May require BOM, MTR, WI changes. 1-3 days to release.
2	New Item - not agency affecting	Modified standard. Minor component, programming, cosmetic mechanical, test changes. Changes do not affect any agency certification. Results in a new derivative SKU within a product platform.	New configuration option sub-assembly, component, S/W feature, bus bar, harness, etc. - that does not affect any agency certification. Results in a new standard option within the system platform.	New BOM, MTR, WI, ASD. Minimal DVT and SIT. 4 weeks to release.
3	New Item - agency affecting	Modified standard. Moderate component, programming, mechanical, test, etc. changes that must be agency re-certified. A subset of full blown DVT is required. Results in a new derivative SKU within a product platform.	New configuration option that must be agency re-certified. A subset of DVT and SIT is required, both H/W and S/W. Results in a new standard option within the system platform.	New BOM, MTR, WI, ASD, DVT and SIT report. 4-12 weeks to release.
4	New Platform or "Custom"	A new product that differs in enough attributes from other products to be considered a new "standard" from which many modifications are derived. Full blown DVT and agency certifications are required.	A new system product based on new H/W or S/W products and technologies such that a different customer value proposition is created or a new application space is addressed. Many configuration options and derivations are anticipated. Full blown DVT and SIT and agency certifications are required.	Complete new design and product release package. 8-18 months to release.
5	New Technology	Classic pre-development research. Development required to test and validate new components, circuits, structures, materials, etc. and validate their general applicability to enhance product lines and business results.		Classic pre-development research. 4-60 months.

Table 1.2

E. Product Phases

As product development moves along the project timeline several iterations of the product will become realized that offer varying levels of functionality and suitability for certain purposes. Customers will want samples to evaluate, third party test and compliance agencies will need to perform tests on working product, manufacturing will want to ramp up production, etc., etc., etc. Terminology abounds referring to these iterations: Samples, Models, Prototypes, Production, Released, Pre-release, First Articles, Alpha, Beta, and so on. These terms have distinct and clear meaning and all too often those meanings are not shared by the various constituencies that converse using these terms – even within the same organization. To drive improved communication and productivity it is useful to define and adopt a common set of terms to define the phase of a product as it moves through development and institutionalize this language throughout the organization. Table 1.3 lists three suggested terms for defining three product phases.

Phase	Description	Intended Purpose	Level of Compliance
Prototype	Engineering built product. Multiple iterations of Prototypes may be created depending on product complexity.	Consumables used to develop, characterize, and qualify the product design. Not yet under change control. May be provided to customers for product acquaintance.	None. Partial compliance or anticipated compliance at best.
First Article	First production built units. Utilizes all factory and supplier automation, tooling, processes, etc. First Article builds should be highly visible events and attract much attention.	Validate design transfer and production processes. Under strict change control. Pending successful First Article build, resulting units may be put in inventory and sold as Production products with full agency compliance and warranty. Second, third, etc. article builds may be necessary but are undesirable.	Full with every agency complete.
Production	Fully released product. Normal production and business processes are functioning without extraordinary effort.	Business as usual sales - fully backed by warranty.	Full with every agency complete.

Table 1.3

F. Project Team Members, Roles and Responsibilities

New product development is most often viewed exclusively as an engineering or design function activity. The reality is that product development is a multidisciplinary team sport and requires meaningful participation of many job functions on a single project team. It is useful to list the various job functions, their role in product development, and their responsibility to the project and other team members. Table 1.4 provides a generic listing that can be applied to many organizations engaged in product development.

The Project Team is the basic working group that will carry out all product development, introduction, and launch steps.

Job Function	Role	Responsibility
Product Manager	General stewardship of product line	Liaison between customer/sales and engineering/operations. Manage product expectations, margins, and competitiveness.
Program Manager	Manage cross-functional team activities of end-to-end Stage/Gate process	Delivery of new product through the stage/gate process. Lead and manage end-to-end team activities and interactions. Foster co-operation among team members. Attainment of all program deliverables; on time and budget.
Project Manager	Manage product design & qualification activities	Lead and Manage overall design integrity, performance, and qualification activities. Attainment of all project deliverables - quality, cost, and schedule. Co-ordination of activities among various design team members.
Marketing Manager	Determination of product need and promotion of products into market	Overall market assessment of product need/application/fit, and total economic potential
Design Engineer	Perform all product design and development activities	Design integrity, performance, and qualification. Attainment of all project deliverables - quality, cost, and schedule.
Supply Chain Engineer	Evaluate and recommend purchased components, materials, and suppliers	Purchased component/material integrity, performance, and qualification. Attainment of all project deliverables
Safety Engineer	Manage agency test and evaluation	Liaison between design team and certification agencies. Attainment of agency certification on time and on budget.
Scheduler	Creates and manages first article and production build schedules	Accuracy and timeliness of all shop floor schedules according to material availability, capacity, and capability analysis. Attainment of all project deliverables.
Manufacturing Engineer	Develop manufacturing capability and process	Integrity, performance, and qualification of all assembly aids, fixtures, processes, instructions, etc. Attainment of all project deliverables.

Job Function	Role	Responsibility
Materials Manager	Assure cost effective material availability and scheduled production build for Stage 3, 4, and initial Stage 5 activities.	Supply and cost effectiveness of purchase materials. Attainment of all purchased material deliverables - quality, cost, and schedule. Schedule all Stage 4 production builds. Transfer to GA (SIOP and standard production)
Quality Engineer	Manage quality data collection, analysis, and action	Integrity, timeliness, and effectiveness of 1) process data collection and analysis and 2) corrective actions. Attainment of all project deliverables - quality, cost, and schedule.
Shop Floor Supervisor	Manage daily product assembly and delivery	Quality and timeliness of all First Article and Production build schedules. Attainment of all project deliverables - quality, cost, and schedule.
Sales/Account Manager	Manage all customer facing activity	Quality and timeliness of all customer and/or market requirements and insights. Maintain good customer relationships. Attainment of all project price and margin targets.
Customer Service	Manage customer transactional activity	Quality and timeliness of all customer transactions and communication of project status.
Finance	Provide accounting and financial analysis	Quality and timeliness of all financial data and business case analyses. Attainment of all project deliverables - quality, cost, and schedule.

Table 1.4

G. NPI Review Team

The NPI review team is comprised of senior managers responsible for the overall stewardship of the business. These individuals are typically executive level managers with specific functional responsibilities in Engineering, Sales, Marketing, Finance, Operations, etc. In their executive capacity the NPI Review Team should set NPI process policy, determine guidelines for evaluation of projects, and set criteria for gate decisions. These policies, guidelines, and criteria should be expressly stated and communicated as part of the overall Stage-Gate process.

The NPI Review Team also has transactional responsibility and should hold a regularly scheduled review meeting that has two purposes. First, they should regularly meet with Project Teams to stay current with project progress, and lend whatever support to the project teams as is necessary to keep projects on track. This keeps the senior management team informed and engaged with NPI activity and empowers the Project Teams. Second, they should perform a formal Gate Review at the end of each project stage and decide whether to proceed to the next stage, cancel the project, or take some other action.

2. Process Overview

A. Daily work activity and business as usual - Discovery

Before exploring the NPI process it is important to provide context for how this fits into the day-to-day activities of any vibrant business. Every day, employees come into contact with customers, suppliers, competitors, analysts, and many other people who define the targeted industry and market. These efforts invariably stimulate the creative thought process of how to improve and grow the business. Out of these activities will come ideas for new and improved products; directly through customer request, via opportunistic circumstances, or via more deliberative and contemplative research and planning. This 'Discovery' activity is both prelude and prologue to the NPI process and must necessarily remain separate and distinct. The NPI process begins when an idea or opportunity requires evaluation for potential investment of R&D and Inventory. It ends when a project is either cancelled, or after such period of time that commercial success can be measured, usually by revenue and profit.

B. Stage Gates

The overall NPI process is divided into five distinct Stages, with major approval Gates at the end of each Stage. The Stages and Gates are defined in Table 2.1 and illustrated in Figure 2.1 below.

STAGE		GATE Decision
1	Opportunity Scoping	Proceed to plan the project Customer Quote
2	Project Planning	Publish plan and schedule Invest R&D
3	Product Development	Product release to manufacturing Purchase initial inventory
4	Product Implementation	Buildup Inventory Invest in Market Promotional Activities
5	Commercial Launch	Release to SIOP

Table 2.1

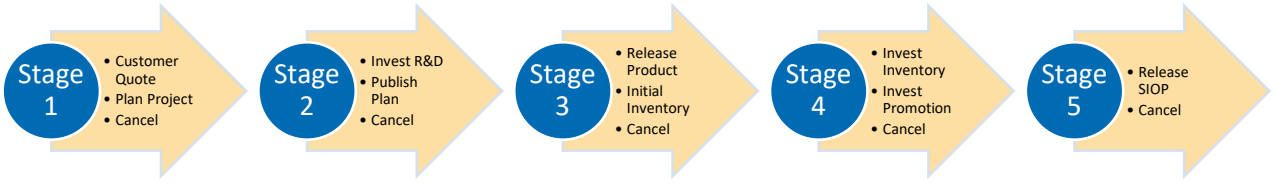


Figure 2.1

Stage 1 evaluates a new products' feasibility and the commercial opportunity presented by the new product. Gate 1 review decides whether to invest effort into creating a detailed project plan and/or whether to provide a customer quote on a specific opportunity.

Stage 2 creates project and product development plans to support the opportunity. Gate 2 review decides whether to fully invest R&D funds to develop the product and whether the project plan meets commercial needs and can be published.

Stage 3 executes the detailed design, development, and qualification of the product, and readies for introduction to regular manufacturing. Gate 3 review decides product readiness for release to manufacture approves initial inventory investment.

Stage 4 is the initial production batch and validates that the product can be manufactured with acceptable quality and cost. Gate 4 decides product readiness for commercial launch, invests in inventory buildup, and invests in preparation for market promotion.

Stage 5 prepares to launch the product into the marketplace and ramps production to meet commercial demand. Gate 5 decides whether to proceed into the marketplace and release the product to standard Sales, Inventory, and Operations Planning

Figure 2.2 illustrates the important relationship between investment and time as a project progresses through the NPI process. During discovery and Stage 1, there is relatively little investment of company resources and assets (namely cash) required to effectively carry out those activities. As the project progresses through Stage 2 greater efforts are required but still modest compared to what comes next. Stage 3 is where engineering resources are invested and Stage 4 is where product inventory is purchased. These investments are expected to yield returns in the form of future revenue and profits. As the project progresses through these stages the significance of Gate decisions stand out. Even though relatively little more of hard assets are invested in Stage 5 there is significant reputational capital expended as this is the opportunity for the company to gain or lose marketplace stature and respect

Each of the Stages and Gates will be discussed in detail later in this document. It is important to note that each gate review is an opportunity to either move forward or to declare a project non-viable (for a variety of reasons) and cancel the project. For obvious reasons these decisions need to be made with full senior management participation and engagement.

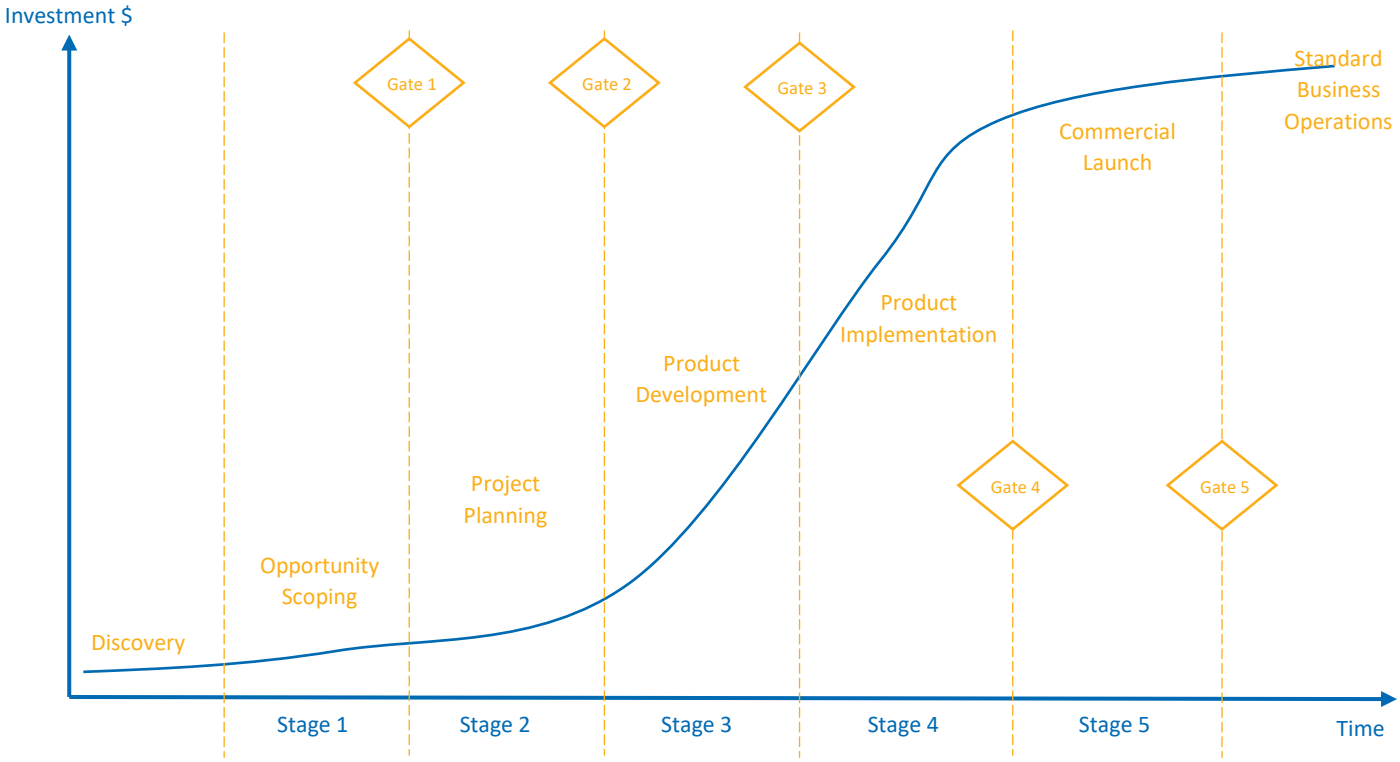


Figure 2.2

C. Project Teams and NPI Review

Product development projects are carried out by some form of project team. Although technical activity makes up the bulk of core product development, successful companies realize that NPI touches every functional organization, engage a cross-functional approach, and engage senior management in the stewardship of those cross-functional teams. In this respect it is useful to define the structure and mission of both the Project Team and an NPI Review team. Project Teams execute activity within the project stages. The team should consist of all functional skills and resources required to execute the various activities required for successful product introduction into a marketplace.

The NPI Review Team consists of senior management functional heads and is responsible for Gate decisions after a Stage review.

3. General Process Description

A useful way to think about how this process works is that at each Gate, answers to a set of questions are sought by the NPI Review Team, and those answers are provided by the Project Team through their efforts during the preceding Stage. The detail sections on each stage will follow this format by posing the questions to be answered and outlining the activities taken to determine answers.

The Stage-Gate NPI process is typically led and driven by the Product Manager who in almost all cases will also serve as the overall Program Manager. Anyone can initiate an NPI project by engaging in collaborative discovery activity described in section 2A but all activity begins with contacting the Product Manager for action and attention.

The Stage-Gate templates (Appendix 1-5) provides a structured approach for the Project Team to manage and track activities, gather and analyze the information generated, and concisely present the project at Gate junctures to the NPI Review Team for consideration and disposition. These templates are color coded to indicate which functions have responsibility for generating the required content.

Content Responsibility
Commercial Team
Engineering and Operations Team
Finance Team

Remember that as the project progresses each stage attracts increasingly more investment and raises the stakes on execution and delivery.

Stage 1 – Opportunity Scoping

All product development projects begin with scoping the opportunity and answering three central questions.

- Is the product feasible?
- Is there a viable commercial opportunity?
- Can we deliver the product at an acceptable profit?

Answering these three questions is accomplished via the five following activities;

- Develop a product description
- Perform competitive and market research
- Quantify potential commercial value

- Develop a rough product development schedule and cost model
- Perform a financial analysis

Anyone can initiate an NPI project, but usual practice is for the initiator to be part of the customer or market facing team. The initiator works with the Product Management, Engineering, Operations, and Finance to quantify as much information as possible as demanded by the template.

The remainder of this section refers to the Stage 1 template found in the Appendix 1.

1. Customer/Market Information

Identify the target customer, if any, and their contact information, or if the proposed NPI project is part of the product roadmap or other internally driven initiative.

Identifying a project name on behalf of a customer is useful as a means of gauging commercial viability. Usually a named project is funded and therefore more likely to come to fruition. Conversely an un-named project may indicate a supply chain due diligence exercise only.

Identify the Product Family as defined by the Product Roadmap.

Identify the Industry Segment as defined the Go-to-Market Plan.

2. Product Description

This can be done in narrative form, but it is best accomplished by either creating a preliminary product datasheet using a standard template, or by simply marking up a competitor's datasheet.

3. Project Rationale

This is typically a narrative, best written in resume or bullet point style that describes why it may makes sense to take on the project. The reasons may be to support or gain a strategic customer, filling out the product roadmap, addressing a competitive gap, an opportunistic profitable venture, etc.

4. Competitive Situation

Identify any and all relevant competitors - replace "A", "B", and "C" with competitors' names.

Indicate competitive sell price or price ranges.

Briefly list competitors' strengths in the marketplace, real or perceived.

Briefly list competitors' weaknesses in the marketplace, real or perceived.

Briefly describe your differentiation achieved with this proposed new product.

Provide any additional information that would add to understanding the competition.

5. Timing or Interval

Indicate with either a future date or an interval the requested timing for delivery of each of Prototypes, First Articles, and Production units.

Indicate with either a future date or an interval the expected timing for delivery of each of Prototypes, First Articles, and Production units.

6. Commercial Targets

Indicate the EAU and sell price for each of the next few years, up to a maximum of five years, if appropriate.

Indicate the corresponding COGS, and product margins.

7. Development Expense Plan

Indicate the Project Type according to the definition in section 3D. This is an important determination in that it will help to bridge any gaps in expectations versus effort among the entire team.

Indicate the number of headcount required to dedicate to this project.

Indicate the external costs for design and qualification.

Indicate any capital expenditures required.

Indicate the costs for materials to be consumed for development.

Indicate the EAU dependent material, labor, and overhead costs at volume breakpoints.

8. Payback Analysis

Perform an economic payback analysis using any number of standard finance analysis techniques. For convenience a DCF template is included in Appendix 6.

9. Gate 1 Review

Once this template is completed the project is ready to move to a Gate 1 review by the NPI Review Team. As posed at the beginning of this section, the NPI Review team must determine if;

- The product is feasible
- There is a viable commercial opportunity
- The product can be delivered at an acceptable profit

If accepted the project moves to Stage 2.

Stage 2 – Project Planning

This stage of the project is where the detailed planning for project execution occurs. For Type 1 projects this phase is not necessary and projects can proceed directly to Stage 3. Type 2 projects need some project planning - the effort required is low due to the nature of type 2 projects and can be accomplished much more quickly but it should not be skipped. Project types 3, 4, and 5 will required a good deal of planning so expect to spend some time in this stage.

The four central questions to be answered in this stage are;

- Are there available and capable resources to develop the product?
- Can the product be developed in a reasonable time frame?
- Can cost targets be met at expected annual volumes?
- Is there a reasonable plan to achieve the goals?

Answering these four questions can be accomplished via the following activities;

- Develop a product design concept
- Develop detailed engineering requirements
- Assemble a team roster
- Develop a major milestone schedule
- Quantify/update potential commercial value
- Perform/update a financial analysis

The remainder of this section refers to the Stage 2 template found in the Appendix.

1. Engineering Requirements Document

This is a formal document to be written and released under revision control that describes the detailed technical requirements of the product. A formalized template that is part of ISO9001 registration should be utilized.

Indicate the primary author of the document.

Indicate the date the document was initially released.

Indicate the assigned document control number.

2. Design Concept Document

This revision controlled document is a technical narrative that describes the design approach and intended functions of the various design elements. The goal is to create a reference document that informs the technical community (both current and future) about how the product is supposed to operate. Liberal use of block diagrams, equations, simulation results, state space diagrams, etc., and detailed technical prose is encouraged. Think of this as the text book reference document for future troubleshooters. The document should be brief yet informative and avoid overly complex language and detail.

Indicate the primary author of the document.

Indicate the date the document was initially released.

Indicate the document control number assigned.

3. Team Roster

The team roster serves to identify the specific individuals responsible for carrying out the tasks required to develop and deliver the product. The roster should be completely populated as each and every function will necessarily contribute at various points throughout the process timeline. Each position is not necessarily a separate job function requiring a distinct individual to satisfy the role - the same person may fulfill multiple positions. For example, the Product Manager may also (likely?) fulfill the role of Program Manager, and one of the Engineers may also fulfill the role of Project Manager. The number of individual team members fulfilling multiple roles will flex with project type with types 4 and 5 requiring more individual resources than types 1 and 2.

Indicate each member of the team by position.
Multiple team members per position may be required.

Indicate team roster changes as the project progresses.

4. Schedule/Major Milestones

An important aspect of a successful development plan is a realistic schedule of major milestones. The selected milestones should represent key indicators of project progress or slippage and serve as a guide for making commitment to external constituents. For example, publishing Design Concept and Requirements documents is a key indicator that further investment in engineering resources is ready to begin. Similarly final DVT/SIT reports demonstrating achievement of product performance goals is a key indicator that cash investments in both raw material and finished goods inventory can proceed. Each major milestone, selected to indicate such key points, serves as an effective way to focus team efforts and management review on the most impactful aspects of NPI.

For each major milestone indicate the planned timeframe (future month or week) for completion.

As the project progresses, indicate the actual timeframe that the planned task was completed.

5. Commercial Targets & Development Expense Plan

The commercial targets and development expense plan determined in Stage 1 should be revalidated after the detailed Stage 2 work has been completed. Changes will undoubtedly occur and major changes may impact project viability.

Indicate the EAU and sell price for each of the next few years, up to a maximum of five years, if appropriate.

Indicate the corresponding COGS and product margins

Indicate the Project Type according to the definition in section 3D. This is an important determination in that it will help to bridge any gaps in expectations versus effort among the entire team.

Indicate the number of headcount required to dedicate to this project.

Indicate the external costs for design and qualification.

Indicate any capital expenditures required.

Indicate the costs for materials to be consumed for development.

Indicate the EAU dependent material, labor, and overhead costs at volume breakpoints.

6. Payback Analysis

Revalidate the economic payback analysis performed during Stage 1 with updated data created during Stage 2 and compare the two. For convenience a DCF template is included in the Appendix.

7. Gate 2 Review

Once this template is completed the project is ready to move to a Gate 2 review by the NPI Review Team. As posed at the beginning of this section, the NPI Review team must determine if;

- There are available and capable resources to develop the product
- The product can be developed in a reasonable time frame
- Cost targets can be met at expected annual volumes
- There is a reasonable plan to achieve the goals

If accepted the project moves to Stage 3.

Stage 3 - Product Development

This stage of the process is where classic product development and qualification take place. The plans developed in stage 2 are put into motion and executed during Stage 3. Depending on the project Type at least one, and often times several prototypes are developed and tested before finalizing a design that can be released to manufacturing. This document does not, and really cannot, incorporate design and

Illustration by Chris Gash

documentation practices that are to be utilized – indeed these are very specific to each individual industry and organization.

The five central questions to be answered in this stage are;

- Does the product perform according to specification or a reasonable modification to the specification?
- Does the product meet cost targets or is reasonably close?
- Will the product perform reliably in the field?
- Can the product achieve 3rd party agency certification?
- Can the product be reasonably transferred to volume manufacturing?

Answering these five questions can be accomplished via the following activities;

- Build and characterize product prototypes
- Perform Design Verification, System Integration, and Certification testing
- Audit the design for reliability and failure mode effects
- Hold peer level design reviews and close all identified actions/issues
- Audit the design for manufacturability
- Assemble a complete design documentation package and release formally
- Quantify/update potential commercial value
- Perform/update a financial analysis

The remainder of this section refers to the Stage 3 template found in the Appendix.

1. Development Checklists

Product development checklists can be extremely useful to both document required activity and also to ensure completeness of development effort. The type of checklist and the content of those checklists needs to be tailored to the individual organization, as well as the specified manner that those activities are carried out. The stage 3 template includes a section to record that every development checklist is complete. The sample checklist covers major items that comprise best practices for product development.

Indicate the date that technical requirements have been written and accepted by the development team.

Indicate that design for reliability analysis has been completed. Typical design for reliability analysis include MTBF calculations, application of derating guidelines, and consideration of operational and environmental conditions.

Indicate that an analysis of failure mode effects are completed, either experimentally, by simulation, or otherwise.

Indicate that design for manufacturability considerations are completed.

Indicate that design verification testing of individual components, building blocks, and/or subsystems has been completed.

Indicate that systems integration testing on the complete assemblage of components and subsystems has been completed.

Indicate that sample prototypes are available for submission to agency or 3rd party certification testing.

2. Design Reviews

Peer level design reviews at various points along the development process are an excellent way of incorporating the collective

intelligence of the entire product development community. Individual team members and non-team members alike benefit from the experience of sharing design details and constructive critique. Design reviews can and should be of several types, focused on specific topics such as software, safety, structural, etc. However design reviews are constructed, it is important to record the action items arising from these reviews and ensuring that those items are acted upon and resolved, even if resolution turns out to be conscious non-action.

Record the item number of the design review item.

Record the type of design review that originated the item.

Record a brief description of the item.

Record who is responsible for action and expected completion date.

Record the action taken.

Record the status of the item, usually open, closed, or cancelled.

3. Release Package

The release package is the package of design information that is formally released to manufacturing for action. All design information that is released should be done so under strict revision control following company policy and utilizing adopted recordation system (i.e. Product Data Manager, ERP, paper based Document Center, etc.)

Indicate the status and completion date of the BOM/Stock lists.

Indicate the status and completion of all Design Drawings.

Indicate the status and completion of all Annotated Code files.

Indicate the status and completion of all Package Drawings.

Indicate the status and completion of all Supplier Drawings.

Indicate the status and completion of all Assembly Drawings.

Indicate the status and completion of all Manufacturing Test Files.

4. Commercial Targets And Development Expense Plan Review

The commercial targets and development expense plan determined in Stages 1 and 2 should be revalidated after the detailed Stage 3 work has been completed. Changes will undoubtedly occur and major changes may impact project viability.

Revalidate the EAU and sell price for each of the next few years, up to a maximum of five years, if appropriate.

Revalidate the corresponding COGS, and product margins.

Revalidate the Project Type according to the definition in section 3D. This is an important determination in that it will help to bridge any gaps in expectations versus effort among the entire team.

Revalidate the number of headcount required to dedicate to this project.

Revalidate the external costs for design and qualification.

Revalidate any capital expenditures required.

Revalidate the costs for materials to be consumed for development.

Revalidate the EAU dependent material, labor, and overhead costs at volume breakpoints.

5. Payback Analysis

Revalidate the economic payback analysis performed during Stages 1 and 2 with updated data created during Stage 3 and compare to previous results. For convenience a DCF template is included in the Appendix6.

6. Initial Finished Goods Planning Model

A key element of transitioning a new product from development to production is initial planning of the material supply chain in anticipation of expected volume production. Using the business case values for estimated annual usage and COGS, and considering supply chain and marketplace delivery expectations, an inventory plan can be created that details cash required to fund on-going finished goods inventory balance and expected marketplace delivery lead times. This activity can be very useful in setting expectations amid the realities of operational and financial constraints.

For outsourced finished goods manufacture, indicate the delivery interval of finished goods, ex works, to your staging or warehouse facility.

For outsourced finished goods manufacture, indicate the minimum buy quantity established for the product.

Indicate the fulfillment planning model to your marketplace. Typical choices are built to order, ship from stock, assemble to order, etc.

Based on all assumed and planned parameters, and using whatever method desired, calculate the indicated values of inventory investment and fulfillment lead times.

- Planned Kanban quantity
- Number of period Kanban deliveries
- Planned maximum finished goods material at any given time
- Average market lead time
- Maximum market lead time

7. Gate 3 Review

Once this template is completed the project is ready to move to a Gate 3 review by the NPI Review Team. As posed at the beginning of this section, the NPI Review team must determine if;

- The product performs according to specification or reasonable modification
- The product meet cost targets or is reasonably close
- The product will perform reliably in the field
- The product will achieve 3rd party agency certification
- The product can be reasonably transferred to volume manufacturing

If accepted the project moves to Stage 4.

Stage 4 - Product Implementation

This stage of the NPI process is the initial manufacturing ramp up of the designed and qualified product. One or more 'First Article' production batches are planned and executed via standard operating procedures

using the information generated in Stage 3. These initial builds are in turn supported by the project team to ensure successful completion and transition.

The planning and execution of these builds is critically important and should be given plenty of visibility and management support. The desired result of a First Article build is sellable inventory and institutionalization of the new product into the daily operational processes used to run the business.

The five central questions to be answered in this stage are;

- Can the product be produced reliably with reasonable effort?
- Can the product be produced at cost targets or is reasonably close?
- Can the product be introduced into the Standard Business Operations Systems?
- Has the product achieved 3rd party agency certification?
- Is the product ready to be transferred to volume manufacturing?

Answering these five questions can be accomplished via the following activities;

- Ready the manufacturing environment with tools, instructions, test capability, quality plans, and materials
- Ready the supply chain, especially new suppliers and materials
- Ready the ERP by populating all new item master information
- Audit the build readiness, record and address any issues
- Execute the First Article build and record all test yields
- Record and resolve all action items that arise out of the build
- Plan follow-on builds if necessary until all items are resolved
- Quantify/update potential commercial value
- Perform/update a financial analysis

The remainder of this section refers to the Stage 4 template found in the Appendix 4.

1. First Article Readiness Checklist

Similar to the product development checklists utilized in Stage 3, First Article Readiness Checklists can be extremely useful to document required activity and drive completeness of initial production build.

Indicate the status and completion date of the total design package release.

Indicate the status and completion date of item master population.

Indicate the status and completion date for availability of all raw material.

Indicate the status and completion date of required production tooling and aids.

Indicate the status and completion date of required test equipment and aids.

Indicate the status and completion date of a governing quality plan.

Indicate the status and completion date of all agency and/or 3rd party certification testing (depending on agency procedure this may not be completed until after the first article build).

2. Readiness Review Notes

Good practice is to hold one or a series of First Article Readiness Reviews in preparation for the build. While most of the activity of these readiness reviews will center on the readiness checklists, this section should be used to record any significant issues uncovered, actions taken, compromises, etc., that will add color and understanding of the team efforts. There is no set structure to this section and the team is free to use this at their discretion.

3. First Article Build Test Yields

This sections is used to record the test results from the first article, and any subsequent article, build at various stages of tests applied. This is the primary dataset utilized by the project team to drive successful production transfer.

Record the date(s) and quantity of the first article build.

Record the test yield for any pre-test or conditioning test such as ICT.

Record the test yields for any parametric testing such as a powered first test.

Record the test yields for an infant mortality screening such as burn-in.

Record the test yields for any safety testing such as Hi-Potential.

Record the test yields for any other testing as appropriate.

Determine the composite test yield through the manufacturing process.

4. First Article Build Action Register

Invariably there will be items that arise during the first article build that require project team attention and action. These items and resulting actions should be recorded and tracked to completion

Record the item number of the first article build item.

Record a brief description of the item.

Record who is responsible for action and expected completion date.

Record the action taken.

Record the status of the item, usually open, closed, or cancelled.

5. Additional Builds

Depending on the nature of the learning during the First Build, it may be necessary to perform subsequent Second Article and perhaps even a Third Article build to successfully transfer the product to standard production. Any additional required build should follow the same steps as the First Article and be treated in the same manner.

6. Commercial Targets and Development Expense Plan Review

The commercial targets and development expense plan determined in Stages 1, 2, and 3 should be revalidated after the Stage 4 activity has been completed. Changes will undoubtedly occur and major changes may impact project viability.

Revalidate the EAU and sell price for each of the next few years, up to a maximum of five years, if appropriate.

Revalidate the corresponding COGS, and product margins.

Revalidate the Project Type according to the definition in section 3D. This is an important determination in that it will help to bridge any gaps in expectations versus effort among the entire team.

Revalidate the number of headcount required to dedicate to this project.

Revalidate the external costs for design and qualification.

Revalidate any capital expenditures required.

Revalidate the costs for materials to be consumed for development.

Revalidate the EAU dependent material, labor, and overhead costs at volume breakpoints.

7. Payback Analysis

Revalidate the economic payback analysis performed during Stages 1 and 2 with updated data created during Stage 3 and compare to previous results. For convenience at DCF template is included in the Appendix 6.

8. Initial Finished Goods Planning Model

A key element of transitioning a new product from development to production is initial planning of the material supply chain in anticipation of expected volume production. Using the business case values for estimated annual usage and COGS, and considering supply chain and marketplace delivery expectations, an inventory plan can be created that details cash required to fund on-going finished goods inventory balance and expected marketplace delivery lead times. This activity can be very useful in setting expectations amid the realities of operational and financial constraints.

For outsourced finished goods manufacture, indicate the delivery interval of finished goods, ex works, to your staging or warehouse facility

For outsourced finished goods manufacture, indicate the minimum buy quantity established for the product.

Indicate the fulfillment planning model to your marketplace. Typical choices are built to order, ship from stock, assemble to order, etc.

Based on all assumed and planned parameters, and using whatever method desired, calculate the indicated values of inventory investment and fulfillment lead times.

- Planned Kanban quantity
- Number of period Kanban deliveries
- Planned maximum finished goods material at any given time
- Average market lead time

- Maximum market lead time

9. Gate 4 Review

Once this template is completed the project is ready to move to a Gate 4 review by the NPI Review Team. As posed at the beginning of this section, the NPI Review team must determine if;

- The product will be produced reliably with reasonable effort
- The product will be produced at cost targets or is reasonably close
- The product can be introduced into the Standard Business Operations Systems
- The product will achieved 3rd party agency certification
- The product is ready to be transferred to volume manufacturing

If accepted the project moves to Stage 5.

Stage 5 – Commercial Launch

This stage of the NPI process is the preparation for commercial launch of the product into the marketplace to start generating revenue and profit. At this point the technical and initial operations planning efforts are completed and promotional activities begin in earnest.

The six central questions to be answered in this stage are;

- Is there still a market demand for this product?
- Do we have all the promotional materials in place?
- Do we know how to sell/position the product?
- Can we take orders and deliver the product?

- Can we support the product in the field?
- Can we still make a profit?

Answering these six questions can be accomplished via the following activities;

- Ready the marketing and promotional materials such as datasheets, cyber media, communication packages, presentations, configurators, etc.
- Audit the ERP for pricing, part numbers, etc.
- Ready the product support materials such as manuals, drawings, API, and training
- Audit the build readiness, record and address any issues
- Plan for formal communications and internal and external events
- Quantify/update potential commercial value
- Perform/update a financial analysis

The remainder of this section refers to the Stage 5 template found in the Appendix 6.

1. Market Launch Checklist

This checklist provides a convenient way to assure that all necessary marketing and fulfillment collateral are completed.

Indicate the status and completion date of product datasheets.

Indicate the status and completion date of established pricing.

Indicate the status and completion date for product configurators (if any).

Indicate the status and completion date of sales and product presentations.

Indicate the status and completion date of non-proprietary product drawing packages.

Indicate the status and completion date of product manuals.

Indicate the status and completion date of application programming interfaces (if any).

Indicate the status and completion date of product training materials.

Indicate the status and completion of incorporating the new product into standard Sales, Inventory, and Operations Planning.

Indicate the status and completion date of any other launch materials.

2. Commercial Targets and Development Expense Plan Review

The commercial targets and development expense plan determined in Stages 1, 2, and 3 should be revalidated after the Stage 4 activity has been completed. Changes will undoubtedly occur and major changes may impact project viability.

Revalidate the EAU and sell price for each of the next few years, up to a maximum of five years, if appropriate.

Revalidate the corresponding COGS and product margins.

Revalidate the Project Type according to the definition in section 3D. This is an important determination in that it will help to bridge any gaps in expectations versus effort among the entire team.

Indicate the number of headcount that were dedicated to this project.

Indicate the external costs incurred for design and qualification.

Indicate any incurred capital expenditures.

Indicate the incurred costs for materials consumed in development.

Revalidate the EAU dependent material, labor, and overhead costs at volume breakpoints.

3. Payback Analysis

Revalidate the economic payback analysis performed during Stages 1, 2, 3, and 4 with updated data created during Stage 5 and compare to previous results. For convenience at DCF template is included in the Appendix 6.

4. Initial Finished Goods Planning Model

A key element of transitioning a new product from development to production is initial planning of the material supply chain in anticipation of expected volume production. Using the business case values for estimated annual usage and COGS, and considering supply chain and marketplace delivery expectations, an inventory plan can be created that details cash required to fund on-going finished goods inventory balance and expected marketplace delivery lead times. This activity can be very useful in setting expectations amid the realities of operational and financial constraints.

For outsourced finished goods manufacture, indicate the delivery interval of finished goods, ex works, to your staging or warehouse facility.

For outsourced finished goods manufacture, indicate the minimum buy quantity established for the product.

Indicate the fulfillment planning model to your marketplace. Typical choices are built to order, ship from stock, assemble to order, etc.

Based on all assumed and planned parameters, and using whatever method desired, calculate the indicated values of inventory investment and fulfillment lead times.

- Planned Kanban quantity
- Number of period Kanban deliveries
- Planned maximum finished goods material at any given time
- Average market lead time
- Maximum market lead time

5. Gate 5 Review

Once this template is completed the project is ready to move to a Gate 5 review by the NPI Review Team. As posed at the beginning of this section, the NPI Review team must determine if;

- There is still a market demand for this product
- All the promotional materials are in place
- We know how to sell/position the product
- We can take orders and deliver the product
- We can support the product in the field

If accepted the project is completed and Three Year Lifecycle Tracking begins.

6. Three Year Lifecycle Tracking

A key element of success is attaining actual sales volume used to justify the new product development project. This section allows for quarterly reviews over the initial three year period of actual sales as a way of validating the assumed commercial viability of a product.

For each reporting quarter record sales for the quarter and cumulative sales for 12 reporting quarters

Compare to the original business case and determine the true value and success of the individual NPI program.

4. Best Practices

The preceding three sections describe the organization, deployment, and mechanics of the NPI Stage-Gate procedures. While these steps are necessary and useful, they are really incomplete without some sense of how to effectively navigate through projects. What follows is a discussion on best practices that can and should be employed alongside the NPI procedures that will enable better execution and help prevent getting bogged down for too long.

A. Concurrent Design

This Stage-Gate NPI procedure is written as if everything follows a linear serial path; unfortunately this is not real life. While true that some things need to follow in sequence, like not ramping production until the first article is evaluated and accepted, there are many areas where doing things in parallel can speed up the overall process and make for much improved productivity. A hallmark of a mature organization is one where team members and their respective functional managers not only understand parallel workflow but also seek them out and build them into the plan. The actual parallel paths will vary from business to business but they do exist, should be sought out, and exploited. This is very much analogous to forecasting sales and making risk buys on inventory prior to booking actual customer orders – savvy organizations utilize this technique but within discretionary limits.

Within the context of this NPI procedure, here are a few concurrent activity examples that can be applied generally.

1. During stages 1 & 2 for projects that indicate economic viability and/or strategic importance;
    a. CAD work on a design in support of a Design Concept Document
    b. Begin or actually complete the Engineering Requirements Document during stage 1
    c. Name team members and start working during stage 2 and sometimes during stage 1
    d. Explore supply chain options and solicit quotes, but never place any orders at these stages
    e. Plan factory floor and equipment changes, but again, don't buy anything yet
2. During stage 3 for projects that indicate successful attainment of the product plan;
    a. Start the 3rd party certification testing
    b. Partial release of BOM to order long lead time material in support of First Article build
    c. Begin to write shop instructions based on evolving prototypes and design files
    d. Plan assembly and test processes and perhaps order equipment, tools, fixtures, etc.
    e. Populate the Item Master
3. During stage 4 for products that indicate strong market or customer demand;
    a. Prepare sales and marketing collateral
    b. Establish pricing
    c. Take an order and deliver a First Article unit (trusted customers only)
    d. Ready communication, training, and product documentation

You get the idea. There are sometimes very good reasons to delay action and sometimes very good reasons to jump ahead. Sometimes it's a calculated cost risk, such as ordering relatively inexpensive assembly jigs knowing that if the design changes before the end of stage 3 there is a risk of scrapping the jig. Use judgement and encourage this way of thinking.

B. Front End Activities

Most often product development, and many times product conception, is viewed as an engineering only activity. While the technical community needs to be absolutely engaged in the definition of new products it is equally important to meaningfully engage the market facing team to define and validate new product specifications and plans. It is also important to provide enough time to get a generally accepted, complete, product definition. In the quest for speed to market this phase is often short changed. Doubtless speed is important, but paradoxically, quality time spent in this stage will avoid delaying scope changes later on and result in faster time to market. If short cuts are taken on the front end inevitable spec changes and scope creep occur during design and development that both add development cost and delay time to market. This also tends to frustrate the development team and a frustrated team is an unproductive team.

C. Engaged Management, Visibility, and Transparency

General Dwight Eisenhower famously remarked, "Plans are nothing, planning is everything." This is true of wartime battle plans and also true of NPI. No plan considers all future and/or unforeseen circumstances so the best course of action is to be prepared to adjust course. To effectively manage NPI top management must be visibly engaged in the process and treat it with the same importance as sales, financial, operational, or any other type of review. Conversely, project teams must be willing to openly share project status and details to all constituents. Sadly, management may only get involved in a product development project when things start going badly, and the tone of that involvement can become somewhat like an investigation. Project teams can also be very protective and unwilling to air issues, preferring to work things out themselves, which can in turn be viewed as somewhat secretive.

A better approach is to utilize an NPI centric periodic review, such as the NPI board meeting described herein, and use that time to understand and shepherd projects along. To be effective, the NPI board meeting needs to have the following characteristics;

1. Recurring day and time slot
2. Published agenda ahead of the meeting
3. Forum for open sharing of information and frank dialogue
4. Chaired by the members of the management team
5. Faithfully attended – if someone can't make it send a proxy
6. Non-threatening – this is the place to talk about everything

Generally there are two types of reviews that occur at NPI Board meetings – a Gate Review and a Project Update. Gate Reviews occur at naturally occurring times during project progression. For longer duration projects, Project Updates should be periodically held to provide that forum for open sharing of project status, issues, and general dialogue. If well executed the NPI Board results in wide visibility and understanding of product development progress and prognosis for the future of the project, as well as an informed management that cares enough to provide meaningful support to the project teams.

D. Guiding Principles and Criteria

During the analysis and evaluation phases of any project there are assumptions and decision points to be made that will affect the viability and attractiveness of a project. Many times there is disagreement, sometimes impassioned, over those assumptions and the criteria used for making decisions. It is good practice to define as many relevant guiding principles and criteria as necessary and ensure that they are consistent with overall corporate strategy. A few examples are,

1. Cost of capital rate
2. Minimum desired project rate of return
3. Minimum desired product projected revenue
4. Market share targets
5. Overhead and burden rates
6. Minimum desired margin percentages
7. Are there different criteria for a roadmap product versus a custom development?

Armed with this information the project teams can concentrate on the tasks at hand rather than get distracted with, for example, how much overhead is allocated in a particular cost center. This also lends context to NPI board decisions on projects.

Much of this information should already exist but may not be generally understood or known. What's important is that the criteria and principles are pre-determined in the context of overall business strategy and part of the NPI process. There are always exceptions, but only worthy exceptions need special handling; everything else is more readily evaluated.

E. Unemotional Analysis

People work hard and often times become emotionally invested in their work. Passion and dedication of the business leaders can be such a rare and prized commodity, especially in businesses that thrive on innovation. Sometimes however people become so invested in their work and in reaching their goals that it can be difficult to apply objective analysis. There is also a tendency to want to see things through to the end and not 'give up' on a project, especially given all the investment that has already happened.

Well managed companies are able to apply a degree of unemotional analysis in their decision making. They tend to see things for what they are and what they are going to be, rather than what they want them to be. A particular NPI may have started out as market shifting but has since turned out to be somewhat 'me too' for any number of reasons. These companies would quickly either recast the project, or perhaps cancel the project all together and start anew. Undoubtedly the participants will feel the gamut of emotions (fear, shame, doubt, anger, etc.) but they resist letting those emotions get in the way of making the right decision.

F. First Article Event Status

Many companies make a big deal out of product launches, new corporate initiatives, process changes, etc. and rightly so. It can be a challenge to manage acceptance of change and good organizations expend bandwidth on change management activities. The transition of a product from design to manufacturing is typically not thought of as something that requires change management, but it most

definitely qualifies. Most often it is not celebrated and usually ignored. This sends a message that positive results are taken for granted and the activity is perhaps routine and not so important. In reality the First Article build can be an arduous task requiring detailed planning, considerable forethought, and patient execution. It also represents the first opportunity for the company to ring the cash register with a shiny new widget.

Just like opening day of a new sports season the First Article build needs to be a visible and celebrated event – employees should have the dates circled on their calendars. The actual building, testing, data recording, and analysis should be a big deal to the whole company. The forms of visibility and celebration can certainly be varied and tailored to match company practice and culture as long as there the recognition is there.

This is a great way to actually practice management engagement and build trust among the workforce. Successes should be touted and failures should be opportunities to re-group and collectively overcome.

G. Metrics

Some of the metrics associated with NPI are fairly straightforward and obvious. The three most common are,

1. Product cost target attained, actual versus planned
2. Product schedule attainment, actual interval vs planned interval
3. Product performance specifications achieved, actual vs planned

These metrics are tactical in nature, that is, they measure what was accomplished by each team and can be tracked during project execution to provide an idea on project status. The metrics can be expressed as percentages, actual amounts, differences, etc. As long as they are measured consistently, just define the method most applicable to your business and apply consistently. Any number of other tactical measures can be defined and adopted.

You should also strive to adopt some strategic metrics that provide an idea of overall process capability and perhaps provide insight into the capability of the business. Some suggested strategic metrics are,

1. Overall time to market, broken down by product type
2. Interval spent in each Stage
3. Percentage of projects rejected at each stage
4. Percentage of revenue/margin generated by products released in the last 3/4/5 years

These kinds of metrics are more geared towards understanding the health and vitality of a business and can be very insightful. These kinds of metrics should definitely be defined and utilized by management.

APPENDIX 1
STAGE 1 TEMPLATE

Initiator:	Date Initiated:
Customer/Market Information	
Target Customer(s):	
Contact Information:	
Customer Project Name:	
Product Family:	
Industry:	
Application	
Product Description (attach preliminary datasheet or competitors datasheet)	
Project Rationale (Why do we want to do this? Strategic, Opportunistic, in Roadmap, etc?)	

Competitive Situation			
Competitor	A	B	C
Price			
Strengths			
Weaknesses			
Our Differentiation			
Additional Information			

Timing or Interval		
Deliverable	Requested	Estimated
Prototypes		
First Article		
Production		

Commercial Targets				
Year	EAU	Price	COGS	Margin

Development Expense Plan				
Project Type	Headcount	External Costs	Capital Costs	Consumables
EAU	Material Cost	Labor Cost	Overhead Cost	Total Cost

APPENDIX 2
STAGE 2 TEMPLATE

Engineering Requirements Document		
Author	**Date Released**	**Document Number**
Design Concept Document		
Author	**Date Released**	**Document Number**
Industry:		

Team Roster			
Position	**Team Member**		
Product Manager			
Program Manager			
Project Manager			
Marketing Manager			
Design Engineer			
Supply Chain Engineer			
Safety Engineer			
Scheduler			
Manufacturing Engineer			
Materials Manager			
Quality Engineer			
Shop Floor Supervisor			
Sales/Account Manager			
Customer Service			
Finance			

Schedule/Major Milestones		
Major Milestone	**Planned**	**Actual**
Design Concept Review		
First Pass Design		
First Pass Design Review		
Second Pass Design		
Order Long Lead Time Material		
Second Pass Design Review		
Final DVT/SIT		
Design Package Release		
First Article Readiness Review		
First Article Build		
Agency Certification Complete		
Production Readiness Review		
Production Launch		
Market Readiness Review		
Market Launch		

APPENDIX 2
STAGE 2 TEMPLATE

Commercial Targets (changes if any)				
Year	**EAU**	**Price**	**COGS**	**Margin**
Development Expense Plan (changes if any)				
Project Type	**Headcount**	**External Costs**	**Capital Costs**	**Consumables**
EAU	**Material Cost**	**Labor Cost**	**Overhead Cost**	**Total Cost**

APPENDIX 3
STAGE 3 TEMPLATE

Development Checklists	
Item	**Date Completed**
Technical requirements	
Design For Reliability	
Failure Mode Effects Analysis	
Design For Manufacture	
Design Verification Test	
System Integration Test	
Ready for Agency/Certification	

Release Package		
Item	**Status**	**Date Completed**
BOM/Stocklist		
Design Drawings		
Annotated Code Files		
Assembly Drawings		
Package Drawings		
Supplier Drawings		
Manufacturing Test Files		

Design Review Notes and Actions

Item #	Review	Description	Who	Date Due	Action taken	Status

APPENDIX 3
STAGE 3 TEMPLATE

Commercial Targets (changes if any)				
Year	**EAU**	**Price**	**COGS**	**Margin**

Development Expense Plan (changes if any)				
Project Type	**Headcount**	**External Costs**	**Capital Costs**	**Consumables**
EAU	**Material Cost**	**Labor Cost**	**Overhead Cost**	**Total Cost**

Initial Finished Goods Planning Model		
Ex Works Delivery Interval		**Entered values by Supply Chain**
Minimum Buy Quantity		
Planning Model		
Planned Kanban Quantity		**Calculated values of inventory investment and achievable lead times**
# Kanban Deliveries		
Planned Max FG Inventory		
Average Market Lead time		
Maximum Market Lead time		

APPENDIX 4
STAGE 4 TEMPLATE

First Article Readiness Checklists	
Item	**Date Completed**
Design Package Released	
Item Master Populated	
Material Available	
Production Tools and Aids	
Test Capability and Aids	
Quality Plan	
Agency/Certification Achieved	

First Article Readiness Review Notes

First Article Build Test Results								
			Test Yields					
	Date	**Quantity**	**Pre/Conditioning**	**Functional**	**Infant Mortality**	**Safety**	**Other**	**Composite**
First Build								
Second Build								
Third Build								

First Article Build Action Register					
Item #	**Description**	**Who**	**Date Due**	**Action taken**	**Status**

APPENDIX 4
STAGE 4 TEMPLATE

Commercial Targets (changes if any)				
Year	**EAU**	**Price**	**COGS**	**Margin**

Development Expense Plan (changes if any)				
Project Type	**Headcount**	**External Costs**	**Capital Costs**	**Consumables**
EAU	**Material Cost**	**Labor Cost**	**Overhead Cost**	**Total Cost**

Initial Finished Goods Planning Model (changes if any)		
Ex Works Delivery Interval		**Entered values by Supply Chain**
Minimum Buy Quantity		
Planning Model		
Planned Kanban Quantity		**Calculated values of inventory investment and achievable lead times**
# Kanban Deliveries		
Planned Max FG Inventory		
Average Market Lead time		
Maximum Market Lead time		

APPENDIX 5
STAGE 5 TEMPLATE

Market Launch Checklist	
Item	**Date Completed**
Datasheets	
ERP (Pricing, P/N, etc.)	
Configurator	
Sales/Product Presentations	
Cyber Media	
Communications Package	
Drawing Packages	
Manuals	
API	
Training	
SIOP Visibility	
Other	

Commercial Targets (changes if any)				
Year	**EAU**	**Price**	**COGS**	**Margin**

Initial Finished Goods Planning Model (changes if any)		
Ex Works Delivery Interval		**Entered values by Supply Chain**
Minimum Buy Quantity		
Planning Model		
Planned Kanban Quantity		**Calculated values of inventory investment and achievable lead times**
# Kanban Deliveries		
Planned Max FG Inventory		
Average Market Lead time		
Maximum Market Lead time		

Three Year Lifecycle Tracking			
Quarter	**Date Checked**	**Quarter Sales**	**Cumulative Sales**
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

APPENDIX 6
DISCOUNTED CASH FLOW TEMPLATE

FIVE YEAR DISCOUNTED CASH FLOW									
				Development Expenses					
Year	Revenue	COGS	Gross Margin	Internal	External	Consumables	Capital	Paid in NRE	Contribution
									Discount Rate
									NPV

Content Responsibility
Commercial Team
Engineering and Operations Team
Finance Team