HydraMaster Engineering
Product Development Roadmap

The eNPI I-CORE Model

Identify * Create * Optimize * Release * Evolve

Goal: To move as quickly as possible along the product development cycle with a reliable, quality product that meets customer needs and expectations and is manufacturable in a production environment.

HydraMaster Engineering to have product through at least trough Phase Three of the eNPI the month following the annual Sales Meeting.

eNPI Process Initial Activities

- **3X3 Matrix**: Measure of ease of implementation versus payback for a product. Allows selection of best project to pursue when faced with multiple choices.
- **Project Kick-Off**: Formal initiation of the selected project. Team is identified.
- **Director's Sign Off**: Phase gate signoffs communicate project progress and status.

Phase One – IDENTIFY

[This is THE most important phase of the process; it cannot be ignored or shortcut.]

- **1-Page Scope Statement**: Textual account of the mission, justification, constraints, and deliverables of the project. Requires sign-offs at management level.
- **Business Justification**: Economic, Market, and STRAP analysis of the project.
- **Gemba**: Go to the source for information (shop, vendor, customer, etc.). Customer interviews.
- **QFD/Kano: Quality Function Deployment** – Clear VoC (voice of the customer); customer wants and customer want prioritizations for a product. Kano analysis differentiates products.
- **Risk Mitigation**: Provides up-front understanding of project risks (cost, features, schedules, etc.) and allows brainstormed mitigation early.
- **ISR – Input Specification Requirements**: Detailed specifications on the output of the product, including quality (technical), cost, delivery, safety, morale issues.
- **BAR – Business Assessment Review:** Meeting where Director's answer the question, "Does this project address the customer needs and does it make business sense for HydraMaster."

Phase Two – CREATE

- **Detailed Schedule**: Thorough listing of time-sequenced tasks required to complete the project. Updated weekly (sometimes daily).
- **Concept Selection**: Review of candidate designs, often CAD models, to show appearance, technical features, layout efficiency. Used before cutting metal. Can occur multiple times in this phase.
- **Preliminary Cost Model**: High-level review of major components and their contribution to project cost requirements. A rough-order-of-magnitude (ROM) estimate.
- **Rapid Prototyping**: Used in response to Risk Mitigation and/or Concept Review to answer unknowns. Can include empirical data gathering through testbeds, platforms, etc.
- **Breadboard**: Used to gather data to confirm adherence to ISR when paper calculations are insufficient or inconclusive.
- **Scorecard, Part 1**: A collective measurement of the capability of the parts, processes, and performance ("X's") relative to the ISR, equated to a sigma level. Typical initial sigma level is ~2.
- **PDR – Preliminary Design Review**: Meeting where Director's answer the question, "Is our technology (via testbeds and/or calculations) able to meet the ISR? Are there any showstoppers?"

Phase Three – OPTIMIZE

- **Brassboard**: A prototype of the product that demonstrates that it meets the ISR.
- **Verification (HALT)**: Subjection of the brassboard to time-accelerated cyclic loading.
- **Y=f(X)**: The physics of the product. "Y" is the desired output and "X" is the variable(s) affecting the output. "f( )" is the function, or how the variables affect the output.
- **Robust Optimization**: When the equation for Y=f(X) is understood, it is mathematically optimized to provide robustness to the variables, i.e. the output is insensitive to the variation in the inputs.
- **Refined BOM**: The assembling of a Bill of Materials that is 90% complete. Used to further bracket the cost of the product.
- **Betaboard**: An exact replica of the production unit.
- **Scorecard Part 2**: Update of the scorecard once optimization has occurred. The higher the sigma level, the fewer defects will be produced in manufacturing which will result in higher quality to the customer. A Six-Sigma product has 3.4 defects per million opportunities.
- **CDR – Critical Design Review**: Meeting where the Director's answer the question, "Does this design demonstrably meet the ISR; do our manufacturing processes support a production design."

Phase Four – RELEASE

- **Final BOM**: Detailed description of the materials used to assemble the production unit.
- **LRIP – Low Run Initial Production**: The first saleable units made with both engineering and production. Redlines allowed without ECR. Establishing the production line.
- **Validation**: Engineering keeps in touch with LRIP field users and survey's their experiences.
- **Quality Plan**: Establishing metrics (e.g. SPC, etc.) to maintain quality levels when higher volume production begin.
- **Lean Manufacturing Plan**: Setting up the production line to support Lean. Includes workstations, Kanbans, etc.
- **Documentation Package**: Includes field manuals, work instructions, wiring diagrams, full shop drawing and assembly drawing package.
- **PRR – Production Readiness Review**: Meeting where the Director's answer the question, "Can we produce this in a cost-effective, quality manner? Can this design be turned over to Production?"

Phase Five – EVOLVE

- The ongoing, conscious pursuit of continuous improvement of released product, including materials, methods, quality controls, etc. Engineering sustaining with the goal of improvement ever present.

Other Tools Used as Needed

- **FMEA – Failure Modes and Effects Analysis**: Identifying possible failure modes and mitigating their risk.
- **DOE – Design of Experiments**: A systematic way of understanding the key drivers in a process or design.
- **SPC – Statistical Process Control**: A graphical method of evaluating variation in a process, usually over time.
- **MSE – Measurement System Evaluation**: A process whereby measurement error versus normal variation is separated and quantified.
- **I/O – Input Output Function**: A mathematical relationship between the input variables and their effect on the specified output.
- **Fishbone (Ishakawa) Diagram**: A fishbone skeleton-shaped diagram where the head is the output and the "ribs" are divided into five variable categories that themselves are further broken down into potential variables. The five main categories are Manpower (labor), Machinery (equipment), Mother Nature (environment), Methods (processes), and Material.
- **DPM – Detailed Process Map**: A systematic, serial arrangement of steps in a process, including the overall desired outputs and major variables, with minor outputs and minor variables included in the subsets of the process steps. Captures noise, critical, SOP, and normal variables.