Bridging Organizational Silos and Creating a Constancy of Purpose

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Abstract

Silos are the unintended product of a firm's organizational structure. Department managers strive to optimize the processes within their scope of responsibility with modest attention to the impact of their outputs upon downstream departments. Organizational leaders must challenge this paradigm and hold department heads to a higher standard, seeing the big picture and striving to optimize the entire firm. A structured methodology utilizing process flow diagrams, cause and effect analysis, experimentation, and standardization helps leaders and managers bridge silos and optimize the entire value chain.

Silos

Silos are the consequence of organizational structures defining the subject expertise perimeters. They become subcultures with their own internal priorities and influencers, ensuring their objectives are achieved. Too often, each department develops their own performance metrics and strives to make significant improvements. The reports flowing to the upper management report progress and provide supporting evidence; however, the performance indicator for the overall organization fails to move and actual cost savings seldom appear in the financial statements.

The structure inhibits the recognition of common organizational goals and external information flow, limiting the overall efficiency of the end-to-end process. In order for a company to work efficiently, leaders must facilitate communication and establish common goals across all divisions.

For example, a nanolithography manufacturing process is illustrated in Figure 1. Although each department was operating efficiently, orders often ran late. A production control team of expeditors was required to routinely expedite "hot" orders through the process ensuring the "on time" metric was sustained at an acceptable level. To improve the team's efficiency, management decided to dedicate several molding machines for expedited orders. Unfortunately, this reduced overall capacity and did little to resolve the problem. An investigation into the process revealed 18% of the parts arriving into the molding department were routinely "knocked off" because they failed to produce acceptable finished parts within the specification limits. Rejected parts scrapped and rescheduled in the Mastering department were usually available the next day. Some parts though, were able to be salvaged by tweaking the molding machines, but only by the most competent technicians. A log of the changes to the molding settings was not required and eventually the machines drifted out of standard operating conditions. This created a continuous cycle of re-tweaking by expert molding technicians increasing downtime and reducing productivity.

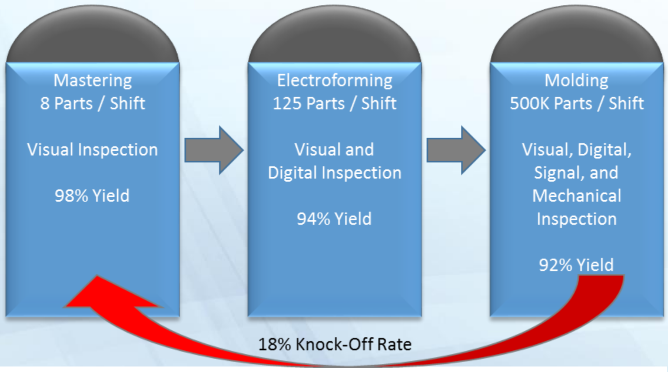


Figure 1: Manufacturing Silos

This problem is prevalent throughout many industries. Work orders improperly entered by telephone operators are rewritten by service and delivery; sales order bills of materials do not make sense to the factory foreman in assembly; or spare parts procured by purchasing are discovered to be incompatible with the existing machinery.

Dr. Deming instructed managers to break down barriers between departments. He observed complex processes, checkpoints and handoffs forming barriers between departments hindering quality. Instead, he argued, a "constancy of purpose" is needed to drive true change.[i] It requires executive dedication to a vision, a focus on where we are going, a profound understanding of the process, an explanation of why we're going there and how we will reach the destination.[ii]

Leadership

It is the responsibility of the top leadership to recognize problems and bring cross functional teams together to deal with business challenges. Upper management must unify the company's departments, gain a fundamental understanding of the problems at the boundaries and inspire managers to address the issues. Unifying the leadership team encourages trust, empowerment, and transforms the "my department" mindset and into the "our organization" view.[iii]

How teams work together to solve problems requires leaders to carefully navigate the treacherous waters of team dynamics. It behooves leaders to invest the time to clearly articulate the problem, state the goal, identify the team lead, clarify each members' responsibilities, ensure the time allocations, outline decision making methods, and communicate significant milestones.[iv]

Resolving a problem requires profound understanding of the processes involved. A balanced approach to implementing short-term successes as well as long-term sustainability to the bottom line must be taken through continual improvement.

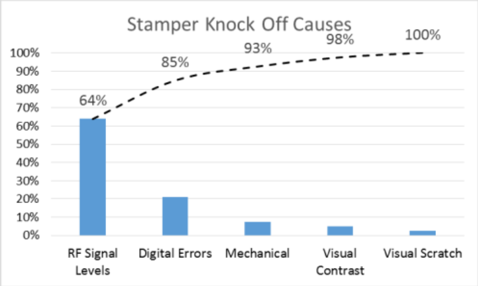


Figure 2: Pareto Chart

The team's first objective in the example was to gain an understanding of the problematic process. Samples of knocked-off parts were examined by the team and subject matter experts (SMEs). A Pareto diagram constructed of the defects indicated 64% were attributed to radio frequency signal level defects. The signal level was known to be a function of the geometry formed by the exposure process in mastering, later filled with plastic during injection molding. To keep the team focused on the most prevalent issues, the scope of the project was limited to RF signal levels.

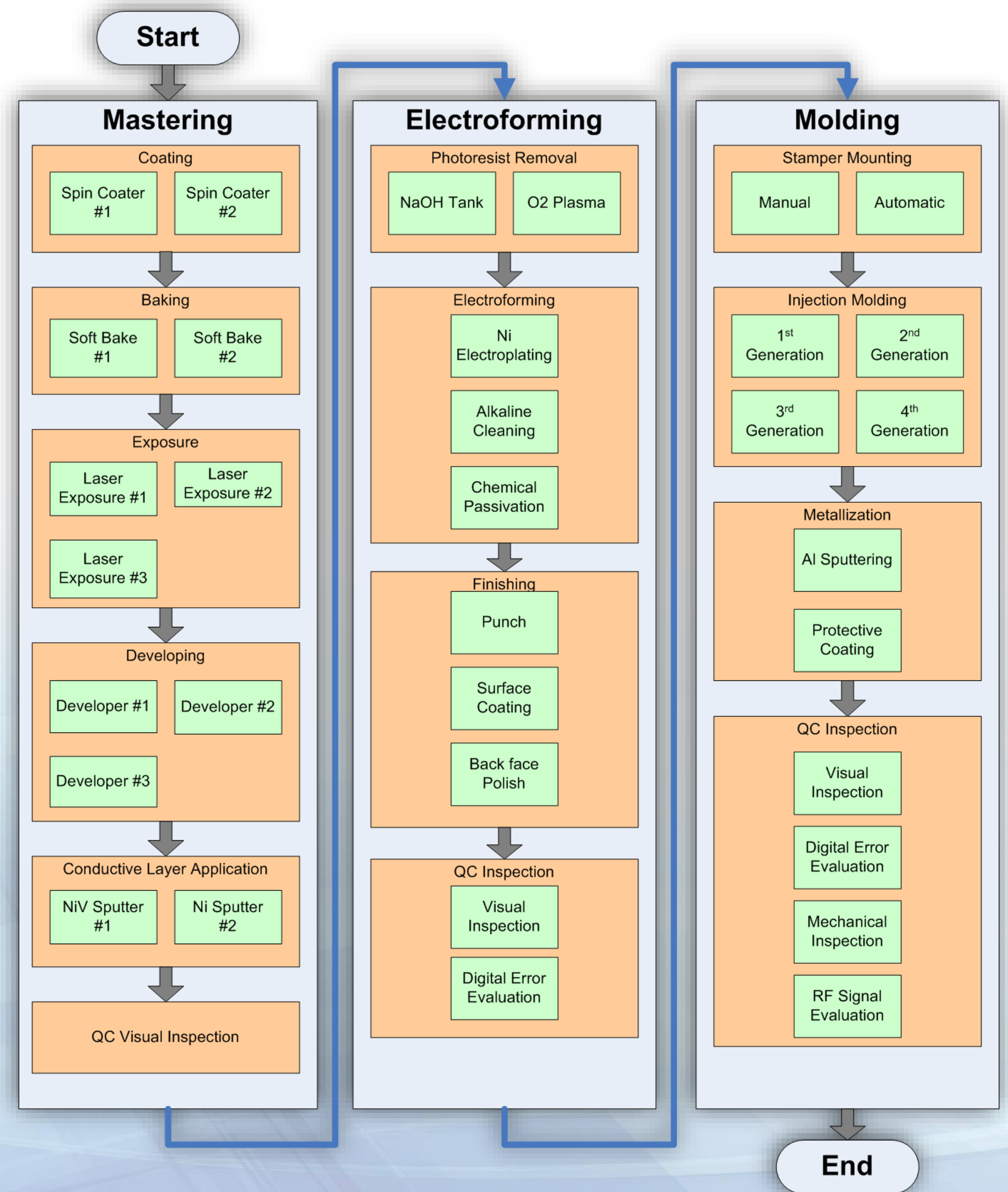
PF/CE/CNX/SOP

The four-step PF/CE/CNX/SOP methodology, defined by Air Academy Associates, is used to identify, quantify and reduce the sources of variation within the entire process.[v] It applies process flow (PF) maps, cause and effect (CE) diagrams, control, noise and experimentation (CNX), and standardization control methods (SOP) to the process.

Process Flow (PF)

A Process Flow map was constructed by the team. Construction of the map served as a topic to break the ice and encourage team conversation, as they discovered the factors which may have influenced the challenge they were facing. The document helped the team visualize how the entire process was performed to develop a hypothesis of contributing factors (Figure 3).

Figure 3: Comprehensive Process Flow Diagram



Cause and Effect (CE)

After the managers documented the process flow map, they began the collaborative process of identifying which factors which may have the most influence on the outcome of RF signal level knock-offs. Profound process knowledge from each department head was shared with adjacent department managers during the process, expanding the teams' scope of knowledge and strengthening the information bridge across the silos. An analysis performed of the measurement systems concluded bias, linearity, stability, repeatability and reproducibility were within acceptable levels. The interaction of factors was discussed in theory as the dependencies upon each department's process became vividly apparent to the team.

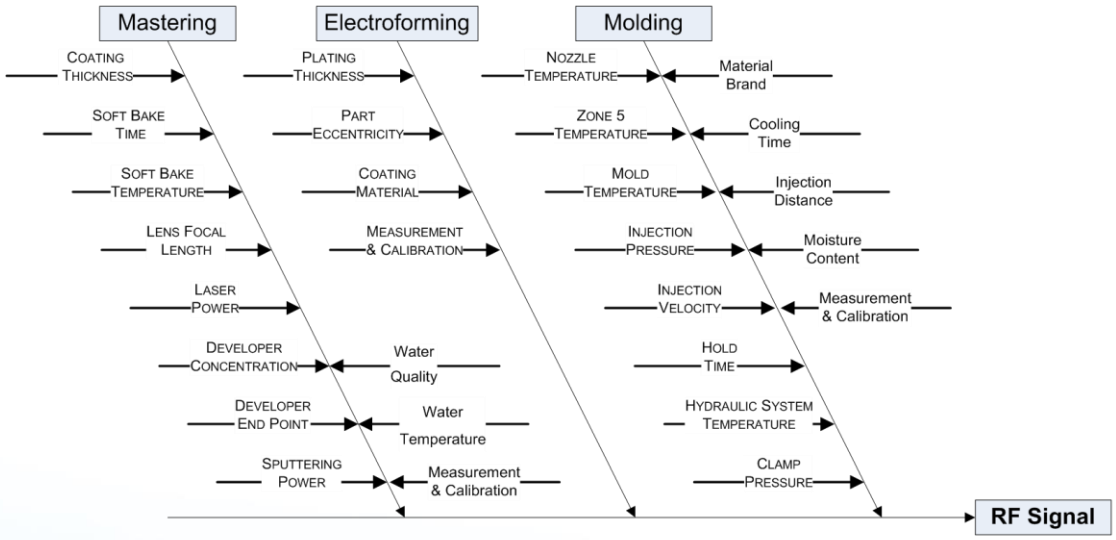


Figure 4: Cause and Effect Diagram

Control, Noise or Experiment (CNX)

The probable causes were tagged as controllable (C), noise (N) or experimental factors (X). To keep the optimization process less complex, the team agreed to standardize the electroforming and molding conditions. Molding machines were set to optimize the mechanical and visual characteristics. Standard operating procedures and controls were updated and reviewed with stakeholders to establish robust methods for holding the "C" factors constant. The team elected to label factors too expensive or too difficult to control as "N" noise and revisit them later if necessary. Technicians and engineers were eager to discuss theories of the factors which may have the greatest effect on the RF signal. Those factors were labeled as "X" for experimentation and optimization in Figure 5.

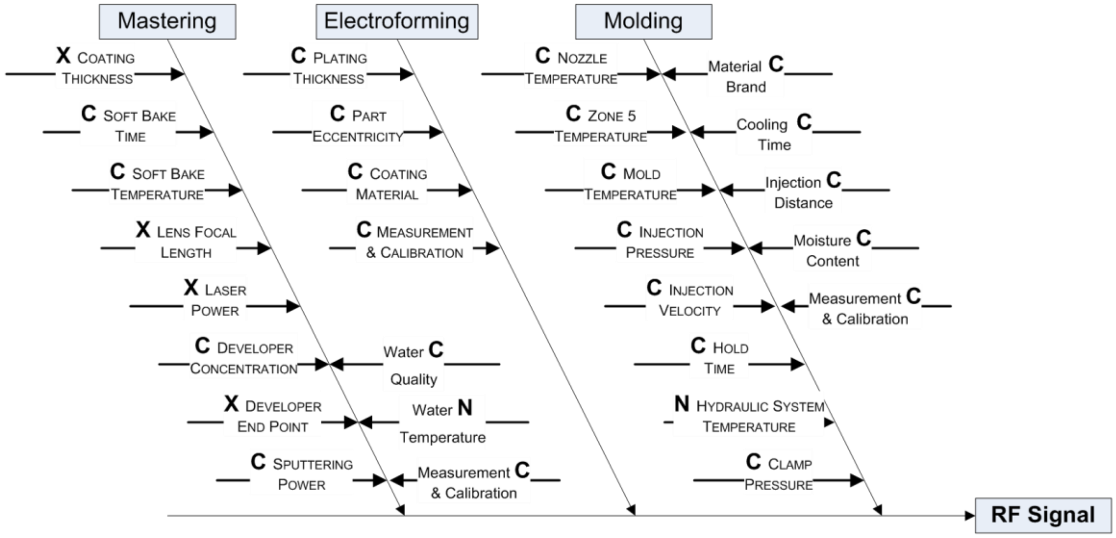


Figure 5: CNX Diagram

Experimental Design

Design of Experiments (DOE) is a valuable tool for gaining a profound understanding of the process variables. The approach alters multiple input factors between high and low settings simultaneously in a controlled and monitored procedure, to quantify the effect of each input variable and the interactions upon the process outputs. The factors for experimentation identified by the team were Coating Depth, Lens Focal Length, Laser Power and Developer End Point. All were adjusted to high and low levels, and repeated four times each to determine the mean and variation of each combination. In trial 1, each factor was set to the lowest value while trial 16 required each factor to be adjusted to the highest level. All other process parameters and measurement methods were held constant to minimize sources of external variation. Signal A and B levels were measured and recorded on the table below (Figure 6).

	Coating	Focal	Laser	Dev	Signal A (Vpp)				Signal B (Vpp)			
Trial	Depth	Length	Power	End Pt	Run 1	Run 2	Run 3	Run 4	Run 1	Run 2	Run 3	Run 4
1	1400 Å	140 mm	2.1 mj	7.8 V								
2	1400 Å	140 mm	2.1 mj	8.5 V								
3	1400 Å	140 mm	2.5 mj	7.8 V								
4	1400 Å	140 mm	2.5 mj	8.5 V								
5	1400 Å	160 mm	2.1 mj	7.8 V								
6	1400 Å	160 mm	2.1 mj	8.5 V								
7	1400 Å	160 mm	2.5 mj	7.8 V								
8	1400 Å	160 mm	2.5 mj	8.5 V								
9	1440 Å	140 mm	2.1 mj	7.8 V								
10	1440 Å	140 mm	2.1 mj	8.5 V								
11	1440 Å	140 mm	2.5 mj	7.8 V								
12	1440 Å	140 mm	2.5 mj	8.5 V								
13	1440 Å	160 mm	2.1 mj	7.8 V								
14	1440 Å	160 mm	2.1 mj	8.5 V								
15	1440 Å	160 mm	2.5 mj	7.8 V								
16	1440 Å	160 mm	2.5 mj	8.5 V								

Figure 6: Four Factor Experimental Design

Computer aided analysis of variance and multiple response regression of the data set enabled the team to identify the most significant factors and plot models of the influence on the variance and mean. The parameters were set to minimize the variation and optimize both signal levels, achieving the greatest process capability index (Cpk).

Standard Operating Procedures (SOP)

Existing control methods were improved and new practices were formed to prevent the standard operating conditions from drifting from the required settings. An approved and controlled standard molding program was saved in each molding machine and loaded into the active memory at the start of each new run. Parameters were set limiting deviation from the standard operating conditions and a log was kept of the adjustments. Engineers and supervisors reviewed the logs during their gemba walks ensuring cognizance of the activity

The first part produced in mastering each day was carefully monitored by the team as it progressed through the value chain. Anomalies were immediately addressed through thorough analysis, corrective and preventative action plans as part of the organizations continual improvement plan.

The Quality Assurance team assisted by scheduling random audits of the control methods ensuring adherence and sustainability.

Results

The leadership's transformation to an aligned and disciplined culture was initiated. Communication bridges and common goals were being established across departments. A profound understanding of the effects of the process variables became shared knowledge throughout management as the organization optimized its end-to-end process. Two weeks after the team was formed, knockoffs were reduced from 18% to 10%, molding yield increased 4% along with equipment uptime and part output, generating $2.1M annually in additional capacity and cost avoidance. The plant's "on time" metric improved which led to higher customer satisfaction, and fewer expeditors were required. The seeds for optimizing the entire value stream across silos was planted as the leadership focused on other failure points.

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[i] W. Edwards Deming, Out of the Crisis, Massachusetts Institute of Technology, Cambridge, MA, ©1986

[ii] Ibid

[iii] Brent Gleeson and Megan Rozo, The Silo Mentality: How To Break Down The Barriers, Forbes, October 2, 2013, http://www.forbes.com/sites/brentgleeson/2013/10/02/the-silo-mentality-how-to-break-down-the-barriers/#2c5ae3125f3e

[iv] George Eckes, Six Sigma Team Dynamics, John Wiley & Sons, Hoboken, New Jersey ©2003

[v] Air Academy Associates, 1650 Telstar Drive, Suite 110, Colorado Springs, CO 80920, http://www.airacad.com