# LEAN ENGINEERING

A GUIDE TO HELP YOU UNDERSTAND THE CONCEPT AND PROCESS THE POTENTIAL IMPACT OF INTRODUCING IT TO YOUR WORLD.

## Is Lean Engineering Right for YOU?

- Does your Engineering output level directly affect the Production output level of your company?
- Does your company's "Engineering Intelligence" walk out the door every day at 5 or 6 o'clock?
- Is the adoption of new design technology prevented by reasons outside of Engineering's control?
- Is the quality of Engineering output hampered by workload and deadlines?

## LEAN ENGINEERING

Lean Engineering is a concept developed to increase the efficiency of engineering departments within manufacturing companies. It is the continual process to increase the amount of valid engineering data (Engineering Intelligence) produced per dollar invested.

The process involves an honest review of the current situation, followed by a series of adjustments to address inefficiencies one at a time.
Each incremental step is planned out and justified before changes are made. This "success and repeat" method works to gain the confidence of all the team members from top management on down to the base worker.

## LEAN MANUFACTURING

Lean Manufacturing is a proven process used to increase the production efficiency of a manufacturing shop. Attempts to use Lean Manufacturing principles in an Engineering department are met with only minimal success. This is largely due to the fact that Lean Manufacturing increases efficiency through inventory control and production process improvements and Engineering doesn't have inventory and in most cases is not a "production" environment.

It is important to note that, while both Lean Engineering and Lean Manufacturing focus on improving efficiency and share some of the same concepts, all the concepts are not the same. The intention is to use Lean Manufacturing concepts where they make sense and adjust or add new concepts that make sense within Engineering.

# STEP 1 - ENGINEERING REVIEW

The first step in the Lean Engineering process is to have an honest review of the current situation within Engineering. This involves defining Engineering's role within the larger organization as well as identifying the Resources and Processes that make up Engineering.

## DEFINING ENGINEERING'S ROLE

*To define Engineering's role within the larger organization a few major questions need to be answered.*

### Who Is Engineering's Customer?

One of the concepts borrowed from Lean Manufacturing is to define Value based on the customer's perspective. In Lean Engineering we need to determine who Engineering's customer is in order to determine the Value of tasks performed and deliverables created. Most Engineering departments have a number of customers ranging from the shop floor to purchasing to the end customer.

### What Does Engineering Produce?

Once we've determined who Engineering's customer is we need to take a closer look at exactly what Engineering produces. Engineering deliverables usually include drawings, specification documents, Bills of Material and so on. As a whole we will refer to this type of information as Engineering Intelligence. It is the physical or digital record of the organization's Intellectual Property.

### How Do You Measure Your Engineering Intelligence Production?

Before any improvements can be made, it is first important to understand what is being improved. In order to improve engineering through-put we first have to measure that through-put. Determining a unit of measure should be done at a business level rather than a department level. This is a difficult task, as all measurable items, such as the number of drawings, jobs, estimates, etc. do not all have the same Value. As mentioned earlier it is very important in a Lean process to determine Value from the customer's perspective. Keep in mind, often these customers are internal customers.

## THE FORMULA FOR GENERATING ENGINEERING INTELLIGENCE

Philosophically speaking, in order to generate any output, Resources must be used in a Process over a certain amount of Time.

**RESOURCES + PROCESSES + TIME = OUTPUT**

In Lean Engineering we've determined that our Output is some form of Engineering Intelligence and that our goal is to increase the Output. Time can be ignored in the equation as we can have little effect on Time other than working overtime, which is generally only used to temporarily increase Output. Also, Time is the one factor we share with our competitors; we both have the same amount of time to work with. This leaves us with 2 areas of improvement: Resources and Processes.

***Resources*** // Engineering resources can be broken into three major categories.

**PEOPLE** // People are often referred to as a company's greatest asset. This is very true within an engineering department. The creativity of a good engineer or designer cannot be replaced. With this in mind, this resource can still be improved to increase overall output. Two common areas of inefficiency found with this resource are Tribal Knowledge and On-The-Job training. If an individual or group of individuals is constantly used as a walking reference, steps should be taken to capture that Tribal Knowledge and turn it into Engineering Intelligence that can easily be accessed by all without affecting the production of the person with the knowledge.

**TOOLS/TECHNOLOGY** // Everything an engineer/designer uses from software to hardware to network infrastructure is part of their Tools/Technology resource. With the high rate of technological change this is a very common area for improvement. Every day new tools are released to the market with the intention of helping improve engineering efficiency. Often large efficiencies can be gained from simply configuring and training the users on the tools they already have.

**EXISTING ENGINEERING INTELLIGENCE** // All the previous output of engineering, if stored correctly, can be referenced and re-used in later designs. Nearly every manufacturing company, at some point or another, produces a design very similar to an existing design. This is often known as a "same as except" design. Even if "same as except" designs are not created there are usually a number of standard components that are shared between designs. When this happens, existing Engineering Intelligence is a huge resource in the efficient creation of the new design. The key to using this resource efficiently is the storage and retrieval methods put in place.

***Processes*** // Every engineering department has its own unique set of processes. Often these processes are the result of years of adjustments, which each makes sense at the time, but in the end create an inefficient process filled with NVATs.

**NON VALUE ADDED TASKS (NVATS)** // As with Lean Manufacturing, in Lean Engineering we determine the Value of an output from the customer's perspective. When evaluating and optimizing Engineering processes it is important to look for tasks within the process that do not add Value. For instance, if the process is to type a part description in a title block, then re-type it in a BOM, then print the drawings as a deliverable to the internal customer Purchasing, there are a number of NVATs. The Value to Purchasing is the description, not how many times it is typed.

# STEP 2 - LEAN ENGINEERING SOLUTIONS

After completing the Engineering Review, the next step is to create a plan for attacking individual inefficiencies one at a time. It is important to limit the scope of each individual solution in order to create a "success and repeat" mentality. As mentioned above these incremental successes build confidence and buy-in in the process from all team members, which in turn builds momentum making each subsequent solution easier to implement.

There are a number of different solution sets within the Lean Engineering umbrella. More often than not, a phase or step in the Lean Engineering process involves a number of the areas described below. However, for the purpose of this document they will be broken into logical categories.

## PROCESS OPTIMIZATION

To improve the efficiency of a process it must first be defined. The same questions used to define Engineering's role can also be used to help define each individual process and sub-process.

- Who is the customer of this process?
- What is produced in this process?
- How do you measure the Value of what is produced?

Some additional questions for optimizing engineering processes:

- How is the process done today?
- Why do we do it this way?
- Are there any Non Value Added Tasks?
- Can we add Value to what we produce in this process?

## TECHNOLOGY IMPLEMENTATION

Engineering technology is a huge industry that has made great strides in providing efficiency tools over the past 25 years. Tools exist today that can greatly help Engineering create more Engineering Intelligence faster and with more Value. That said, actually putting these tools in to production use is sometimes a challenge.

Technology changes the way work is done and change within an organization can be a risk. The whole Lean Engineering approach of "success and repeat" is one way to mitigate this risk. Small incremental steps build confidence in Technology as well as create a Culture of Change Acceptance. Once this culture is in place adapting to the ever changing world of Technology becomes second nature.

## TRAINING

One of the major inefficiencies surrounding the People resource is them simply not understanding the Tool they are using or the Process they are doing. Both of these areas can be easily improved through training. Training also plays a big role in Technology Implementation. People will not accept what they don't understand and the people using the technology are ultimately the ones that determine its success or failure.

## ORGANIZATION OF ENGINEERING INTELLIGENCE

As discussed above, an organization's Engineering Intelligence is a huge resource. To make this resource even more valuable it needs to be organized in a manner that allows for quick referencing and reusing of the data. Data should be categorized in a manner that makes sense to the person or persons who will be searching for it later. It is also important for the data to be controlled so that only valid data is reused. Organizing the data can simply be a Process change; however Technology does exist to help with this task as well.

## AUTOMATION

Many of the Non Value Added Tasks discovered in a Lean Engineering evaluation can be automated. Any repetitive task such as releasing BOM information into a purchasing database or publishing electronic CNC files is a prime candidate. Targeted automation solutions are often the easiest to justify.

# STEP 3 - SOLUTION JUSTIFICATION

Every solution implemented in the Lean Engineering process must first be justified from a business standpoint. This can be done a number of ways. Keep in mind that the justification for each step is a minimal calculation to ensure that it makes sense to take that step. In nearly every case, uncalculated Value is discovered after the change has been made, often eclipsing the original calculation.

## INTERNAL JUSTIFICATION

If the value of the output is not going to change, but the quantity is, then the project will need to be justified internally to Engineering. Using the Engineering Burden Rate and/or Opportunity Cost along with the amount of time saved in a particular process a Return on Investment (ROI) can be calculated.

The Engineering Burden Rate is the cost to the whole organization to employ an engineer/designer per hour. This rate not only includes the individual's salary but also all benefits, taxes, insurance and associated company overhead. This rate is usually averaged across the Engineering department.

The Opportunity Cost is the calculated loss of profit when an individual is unable to perform a Value added task. For example, if an individual has to redo an entire job because the data was lost, then the company has a loss of profit in that that individual could have been working on another paying job.

## EXTERNAL JUSTIFICATION

Projects that add Value can be justified by the amount of Value added to the customer. For instance, if a change in the process allows Engineering to cut the lead time of estimates in half, which in turn allows their customer Sales to close 25% more business then the Value of the gained business is used to justify the process change.

# CONCLUSION

Lean Engineering is a low risk process that can be used to not only improve an Engineering department but also increase the overall profitability and competitiveness of the larger organization as a whole.

While it is low risk, it is not necessarily easy. In order to be successful it requires management buy-in, an openness to change within the company culture and an experienced external party who can give unbiased insight into possible solutions.