

# LEAN SIX SIGMA THE STATSTUFF WAY

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A Practical Reference Guide  
for Lean Six Sigma

**MATT HANSEN**

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**Lean Six Sigma the StatStuff Way: A Practical Reference Guide for Lean Six Sigma**

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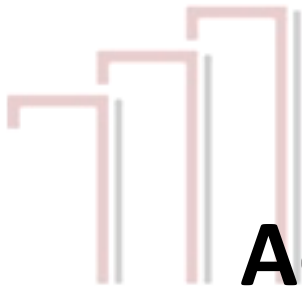
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# Acknowledgements

*To my wife and kids,  
for enduring my many late nights  
and loving me anyway.*

~M@ & D+





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# Endorsements

The training videos from StatStuff have helped so many people. Below are a few examples of the comments some people were kind enough to share.

"StatStuff provides a wealth of information that is extremely helpful. I will definitely share it with my colleagues."

*R.W., Infrastructure Operations Analyst, PepsiCo*

"I was extremely impressed that this resource is available. I plan to share this within the BPI organization at our company. Thanks for putting this together!"

*D.M., Master Black Belt, The Nielsen Company*

"I truly enjoyed the videos. I love the way you explain some of these concepts."

*W.D., Operational Excellence Director, eBay*

"I am really impressed. The content is very clear to understand, there's a logical flow through the different tools and techniques, the examples are easy to relate to and you try to interact with the audience."

*J.F., Process Design Specialist, BP*

"Absolutely great videos. I have been teaching Six Sigma and Lean for 5 years and feel that your approach is very easy to follow and right on with the content. Your real world examples make the lessons clear, contributing to understanding at a deeper, more practical way. Thank you for making this available to the world. Many will benefit."

*R.A., Dir of Continuous Improvement, Staples Inc.*

"I viewed your videos. Really good stuff."

*M.C., Global Program Leader, DuPont*

"Thanks so much for sharing with us these training videos."

*T.L., Order Management, Apple Inc.*

"Excellent content that's easy to understand with practical applications to make each concept real and relevant. I wish I had this content when I was preparing for my certifications but it's great info to refer back to for reinforcement and reference."

*J.G., SVP, Bank of America*

"I've been checking out some of the videos and am impressed with the quality and thoroughness!"

*J.S., Sr. Business Development Rep, Minitab Inc.*

"First I am overwhelmed with the generosity of Matt's offering so much free. Rather than using a few of them as free teasers to entice us to purchase more of what he has available, when the previews are so good. They are all so good. Second, I know a lot of what Matt is teaching in his videos, I just can't say it as clearly he can. So I'm watching them to get the same amazing clarity of communication. Third I simply feel gifted by all that Matt offers, and want to be able to as clearly gift to others what I know. Thank You Matt!"

*B.B., Senior Systems Engineer – Control Systems, UOP, A Honeywell Company*

"I am sharing your website with my peers at my company. Love your videos on the site."

*K.W., VP HR Business Partner, SunTrust Banks, Inc.*

"Your videos are bang on. StatStuff.com is a commendable initiative and after watching your videos I feel mastered in Lean and Six Sigma concepts. StatStuff.com makes me feel rich in knowledge today and saved me at least \$5000 I would have otherwise spent at a school to understand Six Sigma. The quality of information and the way each video is organized and concepts illustrated are the best I have ever seen for a training video."

*S.K., Project Manager, Wells Fargo*

"StatStuff is Great Stuff!"

*V.M., Head - Business Development & Migration,  
Six Sigma Process Solutions (SSPS)*

"I'm such a fan of your work and your StatStuff site. I follow your video lessons and appreciate your clear no nonsense approach to Six Sigma."

*J.J., SVP Ops Managed Care, AEMERUS Consulting*

"A great way to present & teach Lean Six Sigma. All should find time to go through the videos."

*A.C., CEO, Bissoft Technologies*

"The videos are great, easy to understand and watch. They have been extremely helpful."

*T.S., Reg. Dir. of Process Improvement, Cox Ent.*

"StatStuff offers high quality video lectures with user friendly interface. It is a great compilation of free videos that simplifies the industry specific benchmarking tools and concepts to the global audience. StatStuff videos enable us to judge the usefulness of these tools and ensures we keep on creating value."

*A.R., Process Coordinator, M&R Consultants Corp.*

"The videos are great! Excellent content and very well done. I have enjoyed watching the videos and will continue doing so."

*C.C., Lean Six Sigma Black Belt, Genesis Energy*

"Thanks a lot Matt. You made such a great effort on those videos. They are just amazing. You are really serving humanity."

*R.G., Six Sigma Instructor, ITI*

"I've seen StatStuff.com and think it's great. I'd like to start suggesting to my clients that they view your website too."

*D.H., Director, Orbital Training and Consulting*

"Your videos are technically solid, understandable, and high quality. You are a gifted communicator."

*J.J., Sr. Manager of Operations, NP Photonics*

"StatStuff is full of rich info that will add value to anyone's learning - new or experienced. I've been using it for weeks now. Matt is a great teacher and excellent presenter. He should be charging for those videos. Matt, thanks for putting this out there. I will recommend your site to anyone."

*E.E., President & CEO, Eliason Consulting Group,*

"The Lean Six Sigma stuff in StatStuff is simply awesome & the best thing is it's FREE, which makes it a winner hands down any time!"

*V.M., Senior Consultant, enRICH*

"I use your videos all the time to help explain the concepts of Lean Six Sigma to Green belts. Your explanations are easy to understand with great visual support on each topic. Outstanding job!!!"

*M.W., Lean Six Sigma Black Belt, Molex Inc.*

"StatStuff is a fantastic resource."

*L.R., Ops Foreman at Wisconsin Water Utility*

"I used your videos to prepare for both my Lean and Six Sigma Black Belt certifications. The lessons and structure were easy to follow, clear and broken into digestible sections. They were a great help and I continue to reference them and refer them to others. I really appreciate the level of effort and time spent on putting this material together for use. Many thanks."

*E.H., Dir of Op. Excellence, Cross Match Tech.*

"StatStuff has to be one of, if not the best free resource of its kind on the internet."

*A.S., Logistics Manager,  
Premier InfoAssists Pvt Ltd for Gemini Corp.*

"StatStuff is my new favorite site! Everything that I have learned, should have learned and will review all in one place! Love it."

*C.C., Director of Change Management,  
Chambers Business Consultant*

"Great website and content! I'm really impressed with the quality and volume of your material. Thanks for making this available."

*R.F., Information Systems Support Engineer,  
University of Illinois at Chicago*



# Preface

## **What is Lean Six Sigma?**

It seems rather ironic how something like Lean Six Sigma, which is built on a premise of reducing waste and variation, can cause so much wasted time among many experts who have a high variation in how they define it. I don't pretend to have the only definitive answer, but here's how I would simplify the definitions:

- **Lean** - A philosophy (i.e., not a methodology, but more of a belief or way of thinking) focused on improving efficiency (e.g., cost, flow, timeliness) in a process. For more details, see page 49.
- **Six Sigma** - There are actually two separate ways to define this:
  - As a measurement, Six Sigma refers to the number of standard deviations between the mean and an observation (e.g., a customer's lower or upper specification limit). By squeezing six standard deviations between these data points generally means the process is so precise (little variation) that it yields only about 3.4 defects per one million opportunities. For more details, see page 87.
  - As a methodology, Six Sigma is most commonly executed using the DMAIC methodology which is an acronym representing 5 different phases typically focused on improving the effectiveness (e.g., quality, accuracy) of an output from a process. For more details, see page 81.
- **Lean Six Sigma** - The term reflects the blending of the tools and concepts of both the Lean philosophy and Six Sigma methodology in order to yield a more holistic approach to process improvement.

## **The ultimate purpose of Lean Six Sigma is NOT to reduce waste or variation**

Many people (including experts) will state that the purpose of Lean is to reduce waste and the purpose of Six Sigma is to reduce variation. But I think that's like saying the purpose of a hammer is to hit a nail. While that is technically true, the real purpose of the hammer is to accomplish the purpose of the carpenter, which could be to build a house. I think this confuses the "what" with the "why" where the "what" is hitting the nail, which in and of itself is meaningless without the "why", i.e., building the house.

In the same way, reducing waste for Lean and variation for Six Sigma are merely the "what". They define the technical purpose without correlating them to the ideal purpose of the one using them. They are merely tools which, like a hammer to a skilled carpenter, are only as effective as the one using those tools. Until we make that clear distinction, we'll never fully succeed in accomplishing the "why".

## **What is the "why" for Lean Six Sigma?**

The ultimate purpose for Lean Six Sigma is to make the business successful primarily by improving its financial performance. Yes, it primarily comes down to *money*. Every organization, including non-profit organizations, must have money to survive. It doesn't matter how altruistic an organization's products, services or goals are, how satisfied their customers are, nor how beloved they are in the marketplace (all other Level 1 CTQs in the CTQ Drilldown as reviewed on page 10) - without a positive financial value (e.g., cash, assets, etc.) the organization will not be able to survive very long.

So how does the "what" of Lean Six Sigma fit into this? By reducing waste in a process, Lean can help a business be more efficient which is typically measured by improved flow and productivity (for people, machines, or equipment). This kind of improvement can often be realized through reduced payroll which helps to improve the financial performance of the business.

Likewise, by reducing variation in the output from a process, Six Sigma can help a business be more effective which is typically measured by improved quality and accuracy to meet a customer's requirements and less product scrap or waste. These kinds of improvements can be realized through more revenue, less returns, and reduced cost from scrapped materials which help to improve the financial performance of the business.

### **Lean Six Sigma will fail if we don't focus on the "why"**

I believe every Lean Six Sigma effort must be focused on improving the Level 1 CTQs of the business, especially financial performance. If you cannot tie a Lean Six Sigma project to a financial improvement in the business (as defined on page 16), then I believe that project is a failure.

That's right. It's a failure. Otherwise why would we spend our own time and resources to work a project that doesn't yield any measurable improvement back to the organization? Was it just for fun? Was it just for trying to grow the personal or political control for ourselves or our business leaders? If so, then please do the rest of us a favor and don't apply the "Lean Six Sigma" label to it; it's counter-productive to its true intent and only gives a bad name to it and those who practice it as such.

### **What about Lean Six Sigma certifications?**

Those who know me well know I have strong opinions about certifications. I address some details about certifications on page 25, but there are a few comments I'd like to add here.

What many folks don't realize is that there is no central governing organization that grants certifications for Lean, Six Sigma, Lean Six Sigma, or any of the variety of similar types of certifications promoted in the marketplace. Because of this, any organization can define its own requirements for certifying people. Despite the flexibility this offers, it unfortunately means there are many organizations who dilute the requirements by certifying people who can't truly demonstrate any form of Lean Six Sigma expertise.

### **Certifications can get you the interview, but proven experience will get you the job**

With such a disparity in certification requirements, is it worth getting one? Yes! A certification can certainly open doors for career opportunities and in many cases can help someone command a higher salary. However, a certification is meaningless if the person being certified doesn't have the skills to back it up.

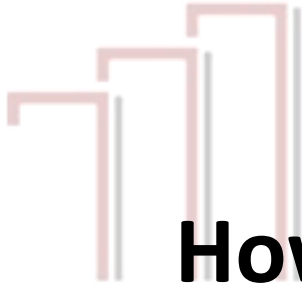
Instead, focus on learning to successfully apply the Lean Six Sigma tools and concepts in order to build your expertise. Then the certification will simply validate what skills and expertise you can demonstrate. And it's in the demonstration of those skills you can accelerate in your career.

### **Where should you pursue certification?**

An airline pilot may have obtained his flight training from an unknown flight school, but if he has a lot of experience where he can demonstrate his command and control of the plane, then that's all that matters. In the same way, there are many great choices for where you can get certified, but in my experience, where you get certified isn't as critical as how you can demonstrate the skills for which you're certified.

Generally, I recommend avoiding any training organization that has low certification requirements making it too easy to get certified. I most strongly recommend finding someone who can mentor you through it. But regardless of where you go, you can always supplement your training using the resources from StatStuff.

~M@



# How To Use This Guide

## **What does this guide contain?**

StatStuff has produced many videos that simplify the Lean Six Sigma tools and concepts. Since each video contains a lot of information, this guide compiles the written text and illustrations (not the commentary) used in those videos in order to help the viewer save time from taking notes and referencing the content.

Just as in each training video, each lesson in this guide identifies if there is a pre-requisite lesson that may be helpful to review prior to reviewing the content for that current lesson. In addition, each lesson ends with a "Practical Application" section instructing the user on effective ways to apply the respective tool or concept.

## **What does this guide not contain?**

This guide isn't intended to be an exhaustive resource on either Lean Six Sigma or on statistics. For example, many tools don't include a comprehensive review to explain every nuance of how each tool works or how it can be applied. There may even be some Statisticians who disagree with some unconventional ways the statistics are interpreted or applied. From a classical approach to applying statistics, they may be justified. But an expert in Lean Six Sigma doesn't necessarily have to be an expert statistician; what's more important is that they know how to expertly adapt their statistical analysis in a practical way that benefits the business.

The training video resources from StatStuff are designed to address the most critical tools and concepts that help the user quickly learn and apply those tools and concepts most effectively. To that end, there may be some statistical shortcuts used in this guide. Therefore this guide should not be used as a defense against any contradictions to the classical approach to statistics. Despite that, it's always best to consult with an expert (like a Master Black Belt) who can advise how to apply the tools to your unique situation.

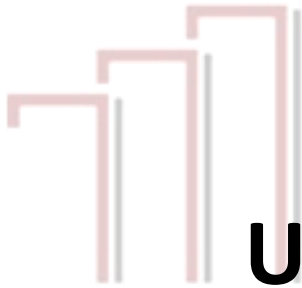
## **How can I make the most of learning Lean Six Sigma using this guide?**

The StatStuff lessons are ordered in such a way that the information builds on itself. Generally, if you're new to Lean Six Sigma, then it may be best to start with the Introduction set of videos and continue in order through all the remaining videos. But if you're more seasoned in Lean Six Sigma, then you may prefer to deviate from the order of the lessons and go directly to a particular tool or concept that interests you.

The best way to learn the Lean Six Sigma tools and concepts is to apply them in a real-world circumstance. To be most effective you should follow the instructions in each lesson's "Practical Application" section and try to apply them using current or historical data or experiences. If possible, it's recommended that you find a Lean Six Sigma Black Belt or Master Black Belt who can mentor you through the tools and concepts and review the results of each practical application you follow.

**If you're a Lean Six Sigma trainer, this guide can make you more efficient**

If you do any form of training on Lean Six Sigma as a trainer, mentor or consultant, then the StatStuff resources can help you be more efficient. For example, if you're leading a training class where you may spend 90 minutes covering a particular Lean Six Sigma tool, then you can assign your students in advance to watch the free StatStuff video about the tool so that by the time you start the training class, they should already have a solid understanding about it. Then you can either reduce your training time (since you don't need to review the tool yourself) or you can enhance the training time by spending more time on practical examples that can help reinforce the application of the tool.



# Unit 1: Introduction

*A general overview of Lean and Six Sigma concepts including some generic tools that can be used for finding, prioritizing, and managing Lean and Six Sigma projects and initiatives.*





## Introduction – Lesson 1: StatStuff Orientation

*An opening orientation to the resources available on the StatStuff.com website.*

Pre-Requisite Lessons:

- None

### **Orientation Video Transcript**

Hi, I'm Matt Hansen, and thanks for checking out StatStuff.com. We have a bunch of videos that teach the fundamentals of Lean and Six Sigma and how to apply them to our work. There are a lot of other great resources available that teach Lean and Six Sigma, so what makes StatStuff so different? Well our videos are all free, they're available online 24/7, and rather than bundling several tools and concepts into each session like a typical classroom environment, each of our videos cover just one topic at a time so you can quickly and easily jump to the tool or concept you want to learn.

If you're not sure where to start, just follow the full list of videos in order from the top all the way to the bottom. We start with some introductory tools and concepts, then touch on a variety of Lean tools and concepts, then we spend the rest of the time of time swimming in the deep waters of Six Sigma through the DMAIC methodology.

Before you begin, you may be wondering why do we even need Lean and Six Sigma. Well honestly, we don't! There are many people throughout history who have been extremely successful in business long before the Lean and Six Sigma methods were developed. So does that mean they don't add value? Of course not! I think of Lean and Six Sigma like putting a scope on a rifle - sure, a skilled marksman can hit the target without a scope, but for the rest of us who aren't skilled in marksmanship, a scope can help us more confidently aim at and hit our target.

In the same way, the Lean and Six Sigma methods use statistical analysis on data to help us be more confident that we're aiming at and hitting the right target, or solution to the problem we're trying to solve. Now, don't let the term "statistical analysis" scare you off. I don't consider myself to be a mathematician or statistician by any means, but I know and can teach you enough of the fundamentals to help you apply these analytical concepts in practical and relevant ways to help make you successful.

And finally, some people believe that Lean and Six Sigma can only be applied to manufacturing environments. But I strongly disagree. It's true that these methods were primarily born out of and are generally easier to apply to a manufacturing environment. But I've been very successful at applying these same tools and concepts across several non-manufacturing industries too. Every company is built on a variety of processes; as long as we're willing to believe that those processes aren't necessarily "perfect", there should always be opportunities to improve those processes that could help improve the company's bottom-line. Lean and Six Sigma can be very effective methods for finding and improving those opportunities.

So please feel free to check out all our free resources here at StatStuff.com. I'm Matt Hansen. Thanks for watching.



## Introduction – Lesson 2: Introduction to Lean and Six Sigma

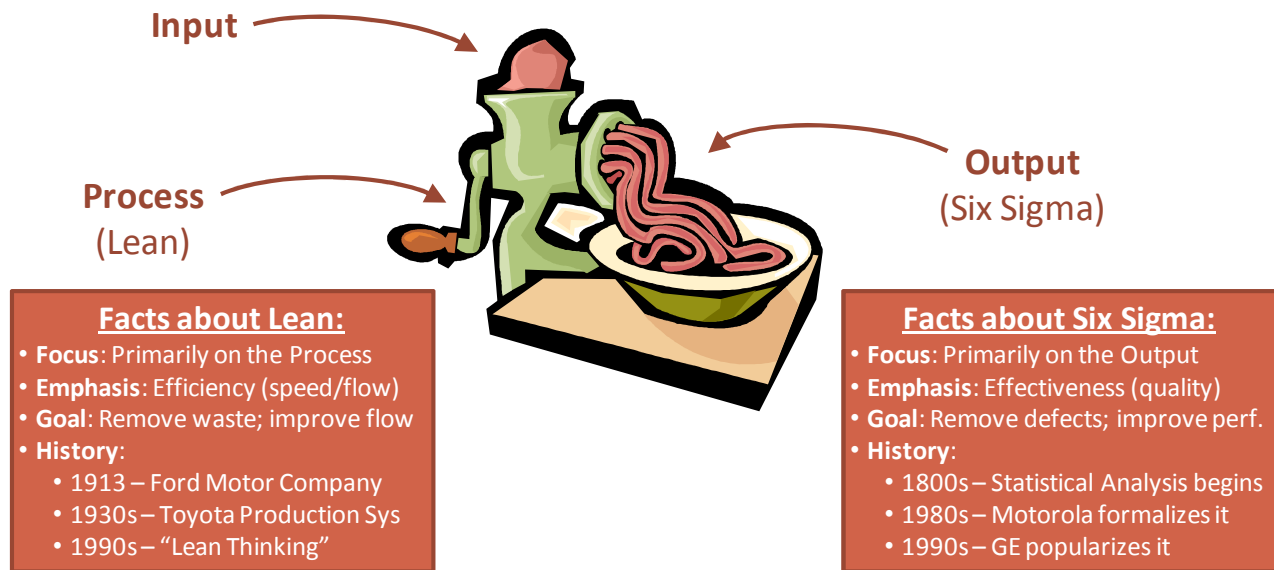
An introduction to the fundamental concepts of the Lean and Six Sigma methodologies using the IPO model.

Pre-Requisite Lessons:

- None

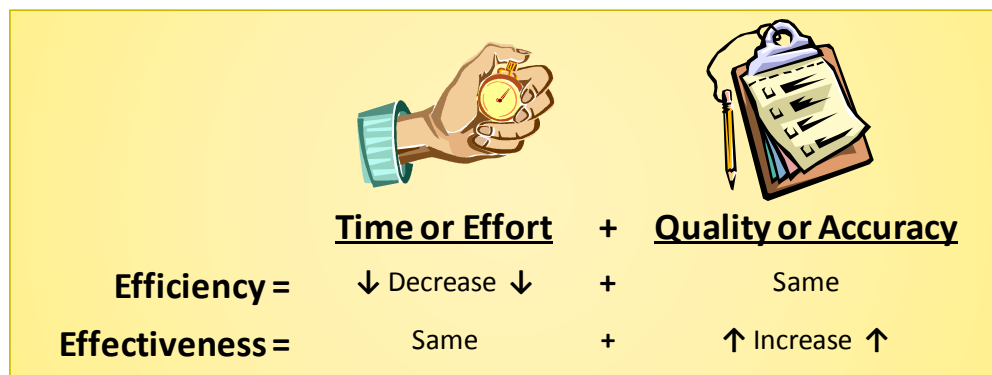
### What are Lean and Six Sigma?

- Lean and Six Sigma are methods that help improve business processes & performance.
  - Despite many similarities, they have different tools that focus on different areas of the IPO flow.
- Input > Process > Output (IPO) flow model.
  - Below is a brief example of IPO and how Lean and Six Sigma are applied:



### Efficiency vs. Effectiveness

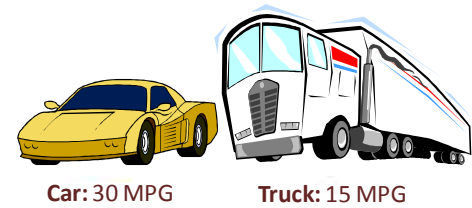
- Improvement projects primarily focus on improving Efficiency and/or Effectiveness.



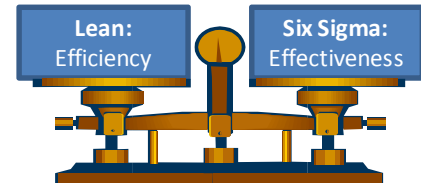
- What is Efficiency?
  - Achieve same level of effectiveness (quality/accuracy) in less time or with less effort.
- What is Effectiveness?
  - Achieve same level of efficiency (time/effort) with less error or higher quality/accuracy.
- Despite this difference, they are not mutually exclusive.
  - Though a project may target efficiency or effectiveness, they generally end up improving both.

## Balancing Efficiency and Effectiveness

- Which is more important between efficiency & effectiveness?
  - Neither! It depends on your goal.
  - For example, suppose you had a car and a truck. Which vehicle is “better”? It depends on your purpose for each.
    - Purpose A: Transport a couple people across town.
      - Both vehicles are equally effective, but the car is more efficient (consumes less fuel to achieve same purpose).
    - Purpose B: Haul a large quantity of furniture and appliances across town.
      - Only the truck would be effective.



- How does this compare to Lean and Six Sigma?
  - Effectiveness (i.e., quality or accuracy) should always be considered first.
    - For example, who cares how efficient the car is if it's incapable of achieving Purpose B? Most of the Six Sigma tools are designed to improve effectiveness.
  - Efficiency can improve time/cost, but shouldn't compromise effectiveness.
    - When targeting efficiency, the output should always be measured to ensure quality isn't compromised. Lean tools are designed to improve process efficiency.
- Can Lean and Six Sigma apply to non-manufacturing environments?
  - Absolutely! Intangibles (like transactions) can be more challenging to measure and improve.
  - Regardless, the Lean and Six Sigma tools can apply to any process fitting the IPO model.



## Practical Application

- Identify at least 3 different functions in your work that fit the IPO model.
  - What are the inputs going into each?
  - What are some of the general processes being performed in each?
  - What are the outputs coming out from each?
- Identify the efficiency and effectiveness metrics for each function.
  - How is effectiveness (e.g., quality or accuracy) being measured in each?
  - How is efficiency (e.g., timeliness) being measured in each?

## Introduction – Lesson 3: Lean and Six Sigma Project Methodologies

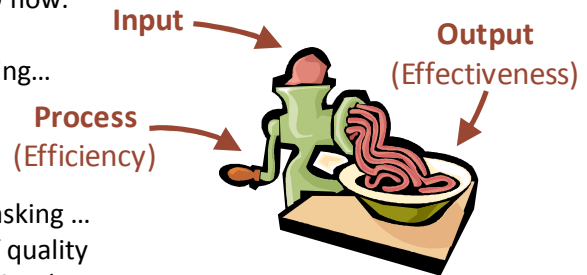
An introduction to five project methodologies (Lean, DMAIC, DMADV, DFSS & PMI) and when to use each.

Pre-Requisite Lessons:

- Intro #02 – Introduction to Lean and Six Sigma

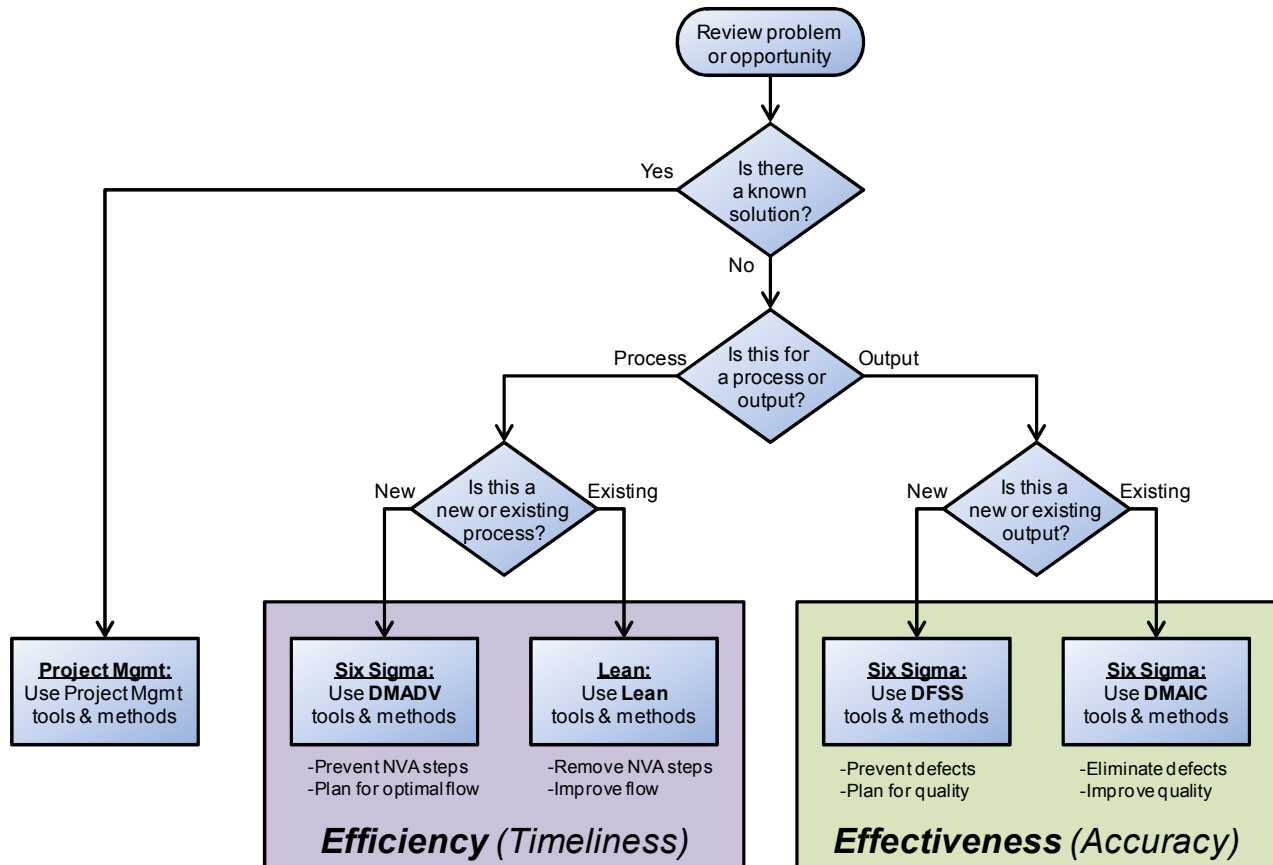
### IPO Flow and Efficiency vs. Effectiveness

- Remember, nearly all we do can be modeled in the IPO flow.
- Comparing Efficiency vs. Effectiveness.
  - Efficiency focuses on improving the process by asking...
    - Can we produce the output in faster time or with less effort/cost at the same level of quality or accuracy?
  - Effectiveness focuses on improving the output by asking ...
    - Can we produce the output at a higher level of quality or accuracy within the same time or level of effort/cost?
- These distinctions will help us understand the different project methodologies.



### Project Methodologies Decision Tree

- Use the following decision tree to help determine which project methodology to use:



### Which project method do I use?

- There are 5 general types of project methods:
  - Project Management (PMI)
  - Six Sigma – DMADV (create new process)
  - Lean (fix existing process)
  - Six Sigma – DFSS (create new output)
  - Six Sigma – DMAIC (fix existing output)

- Not every project requires Lean or Six Sigma.
  - Many of the same PMI, Lean & Six Sigma tools overlap the different project methodologies.
  - It's not uncommon to start with one project method and change midstream to another.
- The ideal project method to use depends on 2 critical factors:
  - Root Cause: Is the root cause (and solution) already known?
    - Yes? Use project management (PMI) tools & methods.
    - No? Use Lean or Six Sigma tools & methods.
  - Process vs. Output: Is the problem efficiency in the process or effectiveness of the output?
    - Process? Use Lean or Six Sigma tools & methods that identify & fix the root cause in the process.
    - Output? Use Six Sigma tools & methods that identify & fix the root cause of the output.
- Most projects target opportunities for existing processes or outputs.
  - Therefore, most projects where the root cause is unknown will use Lean and/or DMAIC.

### **Practical Application**

- Identify at least 3 prior projects that were worked in your area.
  - Of the 5 methodologies listed, which one was applied for each?
  - Based on the decision tree, was the correct methodology applied to each?
    - If not, then which method was used and why?
    - Was the outcome of the project affected by the methodology that was applied?
- Identify one or more potential future project opportunities.
  - For each opportunity, which of the 5 methodologies should be applied and why?



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