Six Sigma and College Applications Alike

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Is college about the knowledge or is the knowledge of how to find answers? What about work? Do we need to know all or is it just important we know where to go? My experiences in finding answers and what knowledge is used and applied based on current job in lean manufacturing has opened up a wide variety of tools that are in my arsenal for everyday life as well as for college, and work.

Before we are told about college we are taught that knowledge is key, that knowledge drives the world. Is it knowledge, knowing facts, or is it knowing where and how to find the answers? I feel this question comes up very frequently when discussing college. Over the course of 3 and a half years I have been told that “you will forget all that anyhow” or its not about what you know its about how we “find the answers”.

On one side of the fence I can understand that knowledge drives the world. Knowing small portions of the facts of 100 different topics is pretty great and might make you a universal resource for random facts. My goal is to become a connoisseur of sorts in my profession and let’s be honest are we 100 percent established while in school? Absolutely not. That is why we chose to go into debt to choose a lasting career. Learning about 100 different things can serve me a great thing when being quizzed on random facts but does it make me as useful as per say I would like to be? Am I okay with just knowing a bunch of facts I more than likely won’t ever need to use? Am I okay with not being a resource to people for a specific area of my expertise?

These are the things I am going to be discussing in this paper, my experiences in school, my trial and tribulations at work that have molded me into the engineer I am at this very moment in time and how Six Sigma can be applied in school and work and even in home situations as well. I believe in hard work, I believe in dedication, but I don't believe it is all about retention. It is not all about how many pages we memorized or if you know the definitions by heart. As fast as one person may be able to tell me what the coefficient of linear expansion is based on text book definition? Unless we use the information often we tend to forget what those definitions are and how they are used.

I want to speak on something I find myself to be a connoisseur in which is six sigma yellow belt certification. The 7 areas I will be speaking of will be about is SIPOC diagrams and what is associated with SIPOC (Supplier Input Process Output Control), Value Stream Mapping, Ishikawa Diagram, Data Collection, PDCA. These areas I find very important for lean manufacturing and I have used most often in my current place of employment. It is not that I know this stuff like the back of my hand, but I can utilize resources, people, old documents, and FIND the information that I need to make appropriate changes to meet a goal within our plant.

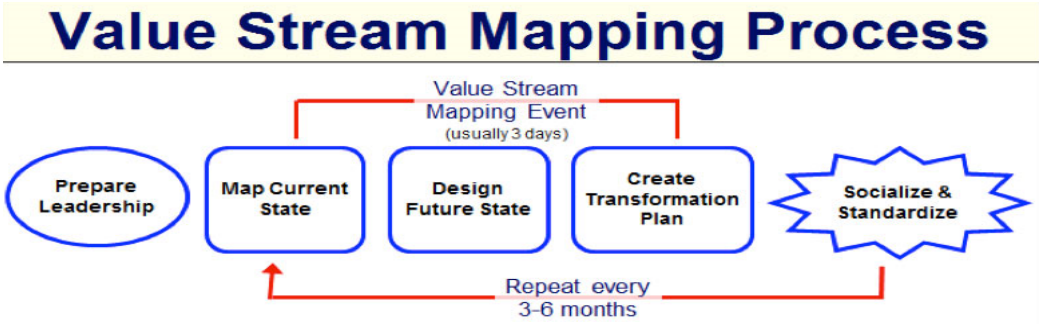
First topic to discuss is the basis of any project which is called value stream mapping. Value stream mapping is created to identify all processes involved when manufacturing a product from start to finish. This value stream includes suppliers, production operations and the end customer. Product development uses this because it involves the design flow. Mainly used for improvement opportunities. Value stream mapping identifies all the important steps we may over think. For example, ordering materials, flow of product from location to location, hold times etc. those can all effect a product in the end, so it is far better to identify all areas of the process

rather than to forget a key process in the lineup. This will lead into current state mapping, and it is the same as the name describes. It is a map that describes the current state of the process.

Some benefits involved with Value Stream Mapping:

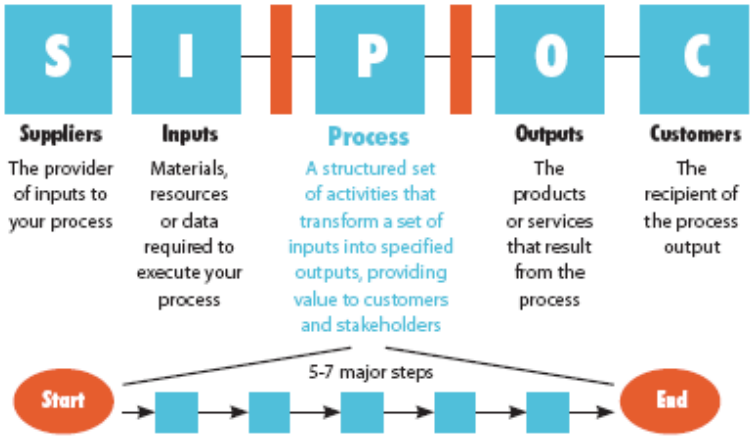
- Seeing complete flow
- Identifying sources and locations of waste
- Providing common terminology for process discussions
- Helping to make decisions about the flow
- Tying multiple lean concepts and techniques together
- Providing a blueprint for lean ideas
- Showing the links between the information and material flows
- Describing how process can change
- Determining effects on various metrics.

(Example below of a Value Stream Map)



Second topic to talk about is what Lean Six Sigma calls a SIPOC diagram. This is a visual that represents major elements that constitute the core processes within a system. These diagrams give us a very divided and accurate representation of what each one of these categories contains. The below image is a very basic descriptive SIPOC diagram more so explaining what each section is but what this ultimately helps us to is to identify KPI (key process inputs) of a system. The critical if you will that allow us to pin point all parts involved. The reason Value stream mapping and SIPOC are so closely related is due to the “birds eye view” of a process but

SIPOC gets into more detailed information. The idea of Six Sigma is to start large and begin to "trim the fat" if you will and zone in on low hanging fruit while identifying critical inputs that could return the most improvement.

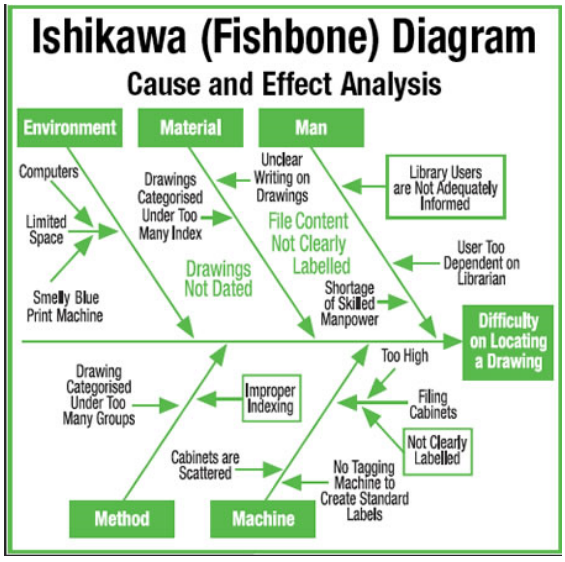


Many facilities use this in the beginning process of an improvement project. Within this step of a project we are revealing all variables at large so nothing is missed when improvements are declared to become a project. Six Sigma quality relies on this diagram to create, monitor and improve closed-loop business systems for process improvements alongside other improvements. Allows the process to be seen at a bird's eye perspective. This will then lead into the resolution of the low hanging fruit referenced before. Low hanging fruit can at times provide a vast improvement without much capitol, resources, and materials. That is why companies will start by resolving the issues that take small improvements.

Improvements may include 5S initiatives, part replacement, PM's, speeds and feeds, single minute exchange of dies, as well as getting rid of all waste within a system, also known as "Muda". Transportation of product is usually the first to be resolved since this can be better dealt with by simply moving things around etc. takes no money, limited results, with large impact on the flow of product and cycle times generally.

These diagrams do not always have to be introduced into lean manufacturing but generally the largest impact is done in lean manufacturing. Mass production of a product is reliant on cycles and if every cycle is not quick concise etc. with great quality, sometimes companies will scrap a lot of material simply due to lack of observing the weak spots within a process. That is what Six Sigma is for.

Within a process due to the possibility of having multiple KPI (key process inputs) at this point there has to be some form of voting and a lot of the ways voting happens within the facility I work in is what is called an Ishikawa Diagram (fishbone diagram).



Ishikawa diagrams/Fishbone/Cause and effect diagram are used to identify all inputs to a process under these 5 categories (machine, method, environment, material, and man (operator)) this is zoning in on a single process. The idea is that the issue has been identified that is causing quality issues, but root cause has not been identified so with this voting method we are attempting to zone in on top 5 potential root causes and thoroughly working through each one. Under environment for instance, if making cabinets, environmental conditions such as ambient temperature, materials, expansion of material, all can affect the product differently. We would

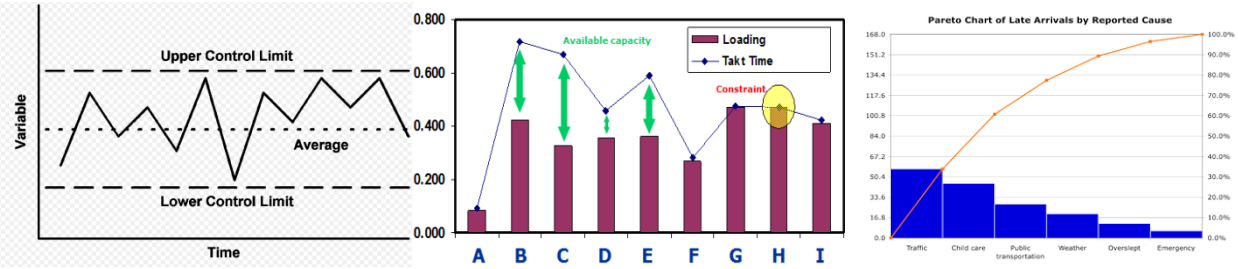
list all these under that category and move through all of them. Once done, the voting of top 5 or 10 etc. what is determined to be the best number based on total number of inputs, vote on top 5 relative to the issue trying to be resolved and from there, thorough data collection begins to rule out each one and find a root cause.

Data can come in all forms. And can be evaluated in different forms as well and knowing which is suitable for your data is very important. In order to represent data in a way that can be easily digested. If you are taking a survey for customer satisfaction you are not going to use a scatter plot to display the information, but maybe a bar chart or another control chart.

Some data analysis tools used in Six Sigma is listed below:

- Statistical tests: showing changes in customer satisfaction or to show shifts
- Line graphs: these are used to graphically show changes over time
- Control charts: can be used to display customer feedback
- Pareto analysis: can show rejects or defects in product. What percent of a whole is "x"?
- Other comparative analyses: histograms, matrix diagrams etc. to provide insight into the customers needs.

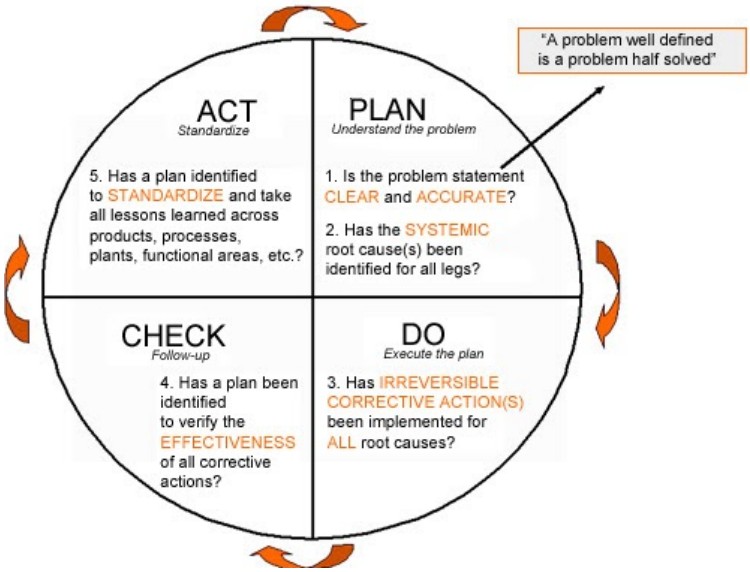
Please notice some examples of charts used to display data



Data collection if not taken properly can skew data and show false information which won't benefit you or your place of work. The importance of understanding the proper data collection, how many data point is necessary, which falls into power and sample size analysis which can be done in the computer software Minitab, but I won't be talking about that. All these

aspects are important and how we need to present the data. Looking at a bunch of numbers becomes a bit cumbersome but if we can digest and see the data presented easily to understand, some of the simplest add-ins of color that signified good and bad can be a great visual as well.

If root cause has not been found there is a system PDCA (Plan, Do, Check, Act) this process goes around and around and around and represents the revisiting of breaking down data, using the DMAIC SIX SIGMA steps. Define, Measure, Analyze, Improve, Control. SPCA is a dwindled down version of DMAIC.



The above diagram shows the idea of starting in the "plan stage". Problem statements are found here, you want to be clear and concise in what the problem statement is. Once problem statements are too vague then from there the entire resolution of the "project" is very subjective and can go many of ways one of which may not be the way you want it to go and will have to repeat the cycle again instead of accomplishing the first round. There is a lot of data collection done in this step and data will point you in the right direction all in all if collected properly.

D of the PDCA cycle is the “executing the plan” stage. This stage is very important as this is where magic happens, where the problem is resolved, or there are implementations that assist in solving the issue at large. Execution of a plan can fail or cause other issue if not strategically done so this will take some planning in the prior step.

C of the cycle is the CHECK stage; this stage is actually gauging the success of the improvements or changes made. collecting data etc., then checking all variables and data collected and act out the improvement or standardization being implemented. This cycle is more times what companies use but the only issue with this is even though it follows the same concept of six sigma DMAIC process steps, DMAIC runs through each step in its entirety and leaves no detail unfound. There is a lot of planning, a lot of doing, checking, and acting that may not result in the proper improvement or standardization desired.

A of the cycle is the ACT of standardization. Standardizing is to conform to a standard. The changes implemented should realistically be the new “standard” to be met. Every improvement made past that will then become a new standard. It is sometimes hard to keep these new standards as you have more variables in other processes. One I have found that gets in the way is the people. The idea that “this is the way we have always done it” mentality but that is more so along the lines of communication effectiveness. We can control machines, but we can not control people. Becomes the most uncontrollable factor.

Sometimes PDCA system is used for continuous improvements within a plant or other manufacturing facility. For instance, if there is a major outlier or issue that can be resolved fairly quickly, naturally we have already worked through the first 2 steps on what needs done then completing the other 2 is just the physical completion of whatever the improvement was. There

is a lot to gain from both systems but sometimes it pays more to be more thorough and getting away from broad topics or broad information.

All of the areas of interest I have spoken about, I have actually applied at work. I have used each step in the DMAIC process to make cycle time reductions, quality improvements, establishing bottlenecks within a process. Six Sigma is one way that allows me to Plan accordingly and execute efficiently. With my most recent cycle time reduction I was capable of earning back 100,000 dollars a year on one doorline. Decreasing cycle time allowed us to produce more while not sacrificing quality of the product which is part of the project scope. I am fortunate enough to have used all the above process steps and more to make vast improvements within my career.

Over the course of this paper we have touched on a couple of different steps in the Six Sigma DMAIC process including SIPOC diagram, Value Stream Mapping, Fishbone diagram (Data Collection), PDCA system. Over the course of this paper there has been a lot of information presented but more importantly what I see in all these steps is that a lot of this is used throughout the time I have been with IVY TECH.

Almost all labs that have been performed consist on data collection and the organization of the lab. 1 class that sticks out in particular is Circuit Analysis. The final was called “The 7 questions” through this process which was ultimately very tough! 7 questions that needed to be throughouly evaluated, circuits to be built, drawn, and calculation performed, there was a lot of steps and those steps for each were crucial. One of the biggest projects I believe I have had but ultimately was worth it and allows me to excel in my line of work currently.

Without the organization and step by step system we follow, labs would not actually produce any results that would be worth anything as we would have to piece it all together. If we break things down and think about the beginning steps of a lab, we look at the overall picture, what the procedure is, or we can think about that procedure as value stream mapping, looking from start to finish of what is in front of us. Once that is done we do not necessarily vote and use fishbone but what is done is the data collection.

9 times out of 10 someone is manually writing down data and making a chart of some kind that presents data in a way that can be digested and transferred into some computer program to produce a fancy chart with colors etc. that let you evaluate your results and plot whatever is needed. A lot of what we do in college reflects on generalized problem solving and it is not about retaining information and memorizing information. The information memorized is what applies to you daily. If we do not use something repetitiously then the issue that arises is, we naturally forget it. we must be able to find answers we are looking for by using tools presented to us. In school resources may be a description, a text book, you tube you name it. Work is the same way.

Work takes knowledge of the processes at hand, but the steps involved in improving them is the same system we use in school. Retain what you need but know how to find the rest is very important. When working with or as an engineer, there are resources at your disposal it's a matter of knowing where to go to find what is needed and I find that to be the largest take away. Problem solving, I believe falls under the same phrase of "Give a man a fish, he will eat for a day, teach a man to fish, he will eat for a lifetime" if, understanding that we can accomplish anything by using the tools and resources we can accomplish an end goal. Whether it be Calculus, Physics, Electrical, AutoCAD, process improvements, scrap reduction initiatives there are multiple areas this can apply to but its important to know what you need to do to accomplish

a result and what better way to do so than utilizing the tools we have at hand and being the problem solvers, we are.

Works Cited

2014. CSSYB2014. “CCSSYB PRIMER” pg. II18-21,V7-V18,II-4,II-36,II-37,VII-4,V-16