Continuous improvement to stay competitive!

Do you have any of the following challenges?

If you do please continue reading to find out ways to create significant savings!

- ☐ Are your energy and raw material costs too high?
- ☐ Are you utilizing your materials well and ensuring low shrinkage?
- ☐ Are there bottlenecks in your production, which slows down productivity?
- ☐ Is your product quality the same every time? Are you aware of variations?
- ☐ Are your emissions under control? Do you know the root cause for occasionally high emissions?
- ☐ Do you have the necessary facts in order to make good decisions?
- ☐ Can you trust your numbers and measurements?
- ☐ Do you work preventively or are you firefighting?
- ☐ Have you set the right objectives and targets?
- ☐ Are you performing experiments in an efficient manner?
- ☐ Do you know which suggestions and ideas are the most profitable?

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1. Reduce energy and raw material usage

Start by mapping today's consumption; how much energy is used for different purposes in production? Energy per product? Energy for different process steps? For different machines and equipment? The more you know about your energy consumption, the easier you can improve. If you do not have the necessary measurements, you can calculate the theoretical consumption, and start by improving your most energy intensive processes. If there are great deviation between theoretical and practical consumption it means the potential for improvement is significant!

It can be profitable to invest in flow meters for steam or electricity meters in order to differentiate the consumption, and identify the most energy intensive processes. Lean Tech has helped a company reduce the energy costs with 200 000 $ annual, and the raw material cost with 470 000 $ annual. Raw material consumption and waste/shrinkage is related, see next chapter. For companies who recover raw material by use of distillation processes, there can be a lot to gain through optimization.

2. Reduce emission and shrinkage

Shrinkage of raw materials often ends up as emission, through the companies' wastewater, air emission, waste to landfill or waste for recovery. If you want to reduce the waste, you need to control your emissions. By reducing the waste, you can achieve cost reduction at the same time as you save the environment!

Start by mapping todays' situation; what is the size of your emissions to water, air, landfill and recovery? This can be detected by sampling. Many companies measure their emissions to water through the analysis of COD (chemical oxygen demand) or BOD (Biological Oxygen Demand), and possibly nitrogen and phosphorus. It can be challenging to connect BOF or COD to wastage of raw materials, but if you know what goes down the drain and how much the relevant components contribute to BOD / COD, you can get good estimates of wastage to drain.

Lean Tech has identified wastage of 1.4 million $ / year for a company by mapping emissions. By gaining control of your emission, you can achieve significant savings.

3. Optimization and bottle neck analysis to achieve production target

For some manufacturing companies, multiple independent machines cooperate to produce the finished product. Some machines produces more scrap, have more down time or run at lower speeds. This might result in long waiting time for the next machine. Obviously, capacity can be increased by

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increasing the efficiency of the slowest machine, but also increasing the buffer between machines can improve productivity. The machine with the lowest efficiency should have enough buffer to ensure that it never waits for the machine up-stream. If stop causes and stop duration are logged, analysis can reveal the increased capacity gained by investing in buffer capacity.

Some companies have manual logging of stops causes. In this case it is important to have clearly defined stop causes so that operating personnel selects the same cause regardless of who is at work. It is also important that the stop causes are defined in order to identify the root cause. I have for example experienced that the main stop cause was "Waiting for tank capacity". What was the root cause? Which tank was full? Why? It is not possible to improve without dividing this stop cause into several possible root causes.

4. Improve product quality

Quality is something you achieve when you have control of the important details. In order to improve product quality it is important to consider all factors that can be significant. Start by identifying everything that can affect your product. Even if you do not think it matters, include it! It is reflecting about everything that may affect product quality, which is important. What do you control and what is noise?

All processes are subject to variation, which may be classified as random or chance variation / noise (common cause) or assignable cause variation (special cause). Noise is found in all processes and exhibits random yet stable variation that is predictable within calculated process control limits. Noise is synonymous with natural variation, expected variation, or random variation. Special cause variation, on the other hand, is unpredictable, sporadic, or unstable variation. It is the result of a specific assignable cause, for example Machine (Equipment), Man (Operator), Material, Method, Milieu (environment). Humidity is an example of specific assignable cause (mileu) that can be controlled.

The challenge of quality improvement is to identify the critical factors and then control the variation of these factors. Six Sigma involves statistical tool to understand variation and identify critical factors. I have experienced that companies have used resources to control a factor that was not decisive for the quality. I have also experienced that businesses had to cancel the launch of a new product because they failed to identify the critical factor that gave variable product quality. What factors do you think are critical for your production? And how do you control the variation?

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5. Quality assurance of data and data collection

Today there is access to infinite amounts of data; but what data is interesting? What data is important to follow up in order to reach your targets? Is data quality adequate? Is data consistent with the data source? An important point when it comes to data acquisition is to use resources to ensure the quality of the data.

If you do not know that you can you trust your data; what do you do when the data do not agree with your assumptions? Some stop using the data, or they use the data only when they agree with their assumptions. You can gain a lot of knowledge by investigating the numbers that does not match your predictions. There is a cause somewhere.

A challenge during quality assurance of data is to reveal problems that occur occasionally. An example is a manufacturing line where tremendous number of data was logged. This caused unstable data acquisition and missing data. Quality assurance was done by monitoring manufacturing during a given time, logging all events manually before verifying that the data collection was correct.

When implementing new production lines with data acquisition, do not practice "nice to have". Spend resources to collect only the data you need. Are you unsure of what data is important, it is better to use resources to decide this. Here are some questions that might be of help; what targets apply in production? What data is necessary to monitor these targets? What other targets will be relevant in the future? Why? I have witnessed the implementation of a comprehensive data acquisition process that resulted in production downtime due to failure with the data collection. The rule "Make it simple" applies here as well.

6. Measurement system analysis (MSA) / evaluation (MSE)

All measurements involves uncertainty. Suppliers of measuring equipment usually specify the measurement uncertainty as a symmetrical interval around the measurement result. Example: The length of a special measuring rod is 2000 mm ± 1 mm. With a 95 % confidence interval, which is normal to use, there is a 95% probability that the rod is between 1999 mm and 2001 mm.

Within Six Sigma, measurement system analysis (MSA), also referred to as measurement system evaluation (MSE), is used to determine the real uncertainty of measures. This can be done by measuring the same item repeatedly and note what the measuring equipment shows. Based on the repeated measurements, the real uncertainty of the measurement can be determined. Measurements

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are done in many different ways and with many different technologies within manufacturing companies.

Lean Tech has done measurement system evaluations of subjective measurements such as appearance, taste and smell. Surprisingly, the measurement uncertainty of a visual test was greatest for the quality manager, who made the decision when there was doubt about the quality. The quality manager did not perform the test frequently, only occasionally when the quality was questioned. Ironically, this person evaluation involved more uncertainty than for operators that performed the test more frequently.

Many companies use cameras / automatic optical inspection (AOI) to control product quality. The measurement can be performed based on reference points that the camera identifies. Measures of distance can be made between reference points in order to control product quality. Measurement System Evaluations that Lean Tech has performed for camera controls show that they are both accurate and precise if they find the right reference point. Unfortunately, there were cases where they were unstable because they failed to find the correct reference point and thus rendered incorrect measurement.

It is highly recommended to evaluate your measurements, specially measurements used for important decisions regarding quality.

7. Preventive maintenance rather than firefighting

Statistical process control (SPC) is a tool for distinguishing between normal and special variation. It has many applications, one of them is preventive maintenance. Equipment wear will gradually increase variation. By identifying the normal variation of a process, you can react to special variation caused by need for maintenance, and thereby working more preventive rather than firefighting. Alarms related to the variation of your measurement (Range or stdev) can alert you when parts need to be replaced. An example is replacement of an O-ring used to test capillaries at a company. When an O-ring starts to get worn this will provide greater variation in the measurements being performed. This can be used to determine the time for maintenance.

8. Design of experiments (DOE) in order to perform efficient testing

With Design of experiments, you can design your experiments in such a way that you get the information you need with minimal effort. Significant resources can be saved by doing smarter design of experiments. Save time and effort by doing less experimentation while still gaining the same or

better information. Some companies perform far more experiments than necessary because they believe it is the safest thing to do. As an example, Lean Tech was asked to analyse 1100 trials within an experiment. The same information could have been achieved by running only 150 trials. If you start with a few trials based on your assumptions, you can always increase the number of tests based on your experience as you go. But there is no need to start with too many tests.

9. Defining the right goals and objectives

One of the most important things when doing improvements is to define good metrics. To motivate individuals, teams and departments, their operational goals and Process Indicators must be something they can influence, and something they believe is important for the strategic objectives (KPIs). Otherwise, they lose motivation.

Here is one example: An operator's performance is evaluated based on OEE (Overall Equipment Effectiveness). The downtime of the machine is mostly affected by access to maintenance personnel and technicians. OEE is not a metric reflecting the operator's effort. If the operator is evaluated based on stop causes he/she affects, it's more motivating.

Goals are not motivating if they are not reflecting your effort.

Balanced goals and KPIs are important as well. By focusing entirely on productivity, quality costs and waste might increase. There may be situations where you have to choose between waste and efficiency. It's important that operators know what to prioritize and when.

10. Cost – benefit calculations

To choose between alternative solutions, cost-benefit analysis can help you make the right decision. It can be challenging to quantify the effect. It requires the ability to see the complete picture and how the change affect the overall business.

Lean Six Sigma focus on gathering neutral information and make fact-based decisions. Improvements should create bottom line results and true root causes are to be solved by choosing the best option among several alternatives. To make the right decision it is important to evaluate pros and cons and calculate the cost-benefit effect of the various alternatives. It does not need to be 100% correct, 90% is usually more than enough to make the right choice. Time, effect on problem and cost of implementing are important to consider when deciding.

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Good luck improving your business!

Did you know…… that Six Sigma has given Motorola and GE savings between 1.2 and 4.5% of their turnover? For a business with 1 billion in sales, this means up to 45 million in annual savings!

Sigma is the designation for the standard deviation, and six standard deviations equals 3 defect per million opportunities. It requires continuous improvement and focus on understanding variation to reduce the number of defects. When an American company on average spends 10-15% of their turnover on quality costs, this says something about the potential for using Six Sigma tools.

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