**Continuous Quality Improvement**

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**Executive Summary**

**Introduction**

Since Innotec started in 1994 they have used their dedication to quality and their manufacturing process to establish themselves as a strong competitor in automotive lighting, lawn and garden equipment, LED signal lights, office technology, retail lighting, and truck trailer LED signal lights. Even though Innotec is a relatively small company, they have been continuously expanding their manufacturing locations on a national and international scale. Along with a focus on global expansion, Innotec is also focused on creating a strong team of employees whose ideals align with those of Innotec, such as creating a dynamic workplace. Innotec’s global reach and diverse teams allow them to create an atmosphere that is focused on volunteer work and stewardship, both at work and at home. Even though Innotec is an award-winning business, they still face issues in their manufacturing process that need to be addressed.

**Method**

Continuous Quality Improvement is a never-ending cycle within any organization. America really started to care about quality in the 80’s when they realized Japan was exceeding them in automobile and electronic manufacturing because Deming and Juran, two quality American gurus, were leading the charge for Japanese quality improvement. There are many tools used within organizations to reach the goal of Continuous Quality Improvement such as quality control tools. Companies can also use methodologies like Lean, which creates more value while reducing resources, Six Sigma, which reduces defects through statistics, Lean Six Sigma, which is a combination of the two and can provide more benefit to the organization, and the eight disciplines which is a problem-solving methodology developed by Ford Motor Company.

**Results**

The interview with Brendan Biesboer, aa mechanical engineer at Innotec, was conducted by Maegan Trygstad, Andrew Wieringa, Jeff Willer, and Andrew Screnock who had to show up late do to other commitments. Each group member was able to ask five questions each. Innotec has a poor-quality supplier issue and has to scrap a lot of parts, with innovative thinking they used scrap to create different parts which is great Lean and Continuous Quality Improvement. Continuous Quality Improvement is enforced since everyone within a work cell is held accountable. They are all experienced in using their two Continuous Quality Improvement tools, the Pareto Chart and Eight Disciplines model of problem solving. An example given to us by Brendan had to deal with machines creating scratched lenses which was discovered through the use of Pareto Analysis. Employees were able to solve the problem by using the eight disciplines and ultimately came up with a solution to the problem by reforming the machine’s mold to prevent scratching.

**Discussion**

Innotec has a strength in it’s work cells because they are open and non-hierarchical work stations for innovative ideas of quality and process improvement. They also possess a strength in how they produce very quality products when they are receiving many poor-quality products from their suppliers. This problem leads into their biggest weakness which is having suppliers that provide poor quality for the organization. Innotec also has a weak inspection process that is subjective due to human error. We recommended a three-step process to solve the poor-quality supplier problem by talking to the supplier first, meeting with the supplier second, and last resort if no improvements were made, terminating the supplier third.

**Introduction**

**History of Innotec**

“Excellence is not a destination; it is a journey that never ends” (Tracy, 2003). Over the past 26 years, Innotec has been using their dedication to their core vision, “To use work to make a difference,” to push them into constantly improving their manufacturing process and producing innovative technology. Innotec began their journey toward quality manufacturing in 1992 when the company was incorporated on October 9th. Even though this company has expanded their operations into major cities around the world, they started in the corner of a building in Hudsonville, Michigan with only three machines. It wouldn’t be until 1994 that Innotec would move to their own suite in Zeeland, Michigan where they would stay until present day. At the new Michigan location Innotec began installing new machines and expanding their production line, as they continued to expand Innotec realized that they would need more room to house their growing business. In 1999 they purchased more land on the same lot and added 20 more acres to their possession and created the Roosevelt Campus. Soon, Innotec realized that they could not reach their full potential simply by stay in Michigan, or even the United States, and they decided to begin their expansion across the ocean.

As global opportunities opened up for Innotec they decided to start their expansion in Hungary and in 2002 they built their first international division. When they saw how successful the Hungary division was, they decided to expand even further and began plans to open divisions in both China and Mexico. These new locations were specifically built in communities that were close in proximity to actual customers. Innotec found locations that would provide impactful opportunities to these communities through meaningful employment and stewardship. Finally, after years of focusing their efforts on the global scale Innotec refocused on their origins and bought and renovated the Colonial Clock building in historic downtown Zeeland. This multi-use facility added on new manufacturing space, office space, and condominiums. Even though Innotec has focused many of its efforts on expansion both nationally and internationally, they have still found time to focus efforts on building a team of employees with strong operational skillsets and technical mindsets.

Innotec has a specific ideology that they, “hire the person, not the position.” This means that they are dedicated to finding an employee whose vision and values align with Innotec’s. The employees at Innotec are all considered business owners that work within small, team-based, units that strive to innovate and build. By having these small teams Innotec can focus on creating a community that is based on a ‘dynamic, winning culture’ that stands behind its employees and works to support them no matter what. An example of this would be the creation of the Employee Stock Ownership Program (ESOP), a program that helps align the interests of employees with the interests of the shareholders. This type of program puts more power in the hands of the employees and encourages employee involvement.

Along with a strong dedication to their employees, Innotec is also dedicated to sustainability stewardship, which inspires them to help out communities both in Michigan and throughout their international locations. In Michigan, Innotec organized and participated in revitalizing a stretch of the Macatawa Greenway wetland that bordered their Roosevelt campus. Innotec is also involved in the Water Wins program, a non-profit well drilling program in Nigeria, that Innotec supports though technology and volunteers. Innotec encourages their employees to seek similar opportunities within their own communities so that they can have exponential impact where it is needed. The combination of Innotec’s commitment to national and international expansion, their diverse teams, and stewardship allows them to produce unique and innovative LED lighting and automotive technologies.

**Products**

For 26 years Innotec has expanded their manufacturing process to include automotive lighting, lawn and garden equipment, LED signal lights, office technology, retail lighting, and truck trailer LED signal lights. All of the products that Innotec produces relies on their own technology that has revolutionized the industry by providing lighting options that are free of polychlorinated biphenyl (PCB), a once widely distributed chemical that has been identified as a carcinogen. This new technology is both durable and flexible so that it can be used for multiple applications within the automotive and lighting industry. Within the automotive industry Innotec produces LED illuminated sills, headrest, visor assembly products, and heavy-duty signal lights. They also produce many of the unique lighting solutions for the lawn and garden equipment industry, for products like lawn mowers, snow blowers, and outdoor utility vehicles. They also have created products like Slim Glo or SpotFX, for high traffic, heavy use environments in retail. Finally, Innotec has been creating different products to be used within an office setting. In 2008, Innotec created their patented technology, Innviromass, which provides counterweight solutions for common office equipment like cabinets, elevators, storage units, and utility carts. They also produce a power distribution source called Power Base that is used to deliver power to shelving, cubicles, and product displayed, much like the power outlets in the Barsema 200 auditorium.

**Awards**

It is evident that Innotec has solidified itself as an exceptional company that has created a strong foundation of integrity, humility, and trust. This can be seen in their efforts to become a global powerhouse, their dedication to their employees, their strides to be an innovative manufacturer, and their dedication to stewardship through sustainability. This is why Innotec was named one of the “Best Small Companies in America,” by Forbes Magazine in 2016 for their unique business model and community impact. The criteria for this award aligns with Innotec’s personal goals, such as focusing on being great rather than big, its contributions to community and society, and strong interactions between employees and top management. Since, Innotec creates parts for larger companies such as Honda or Ford, they know that their products must meet high standards. Through the process of Continuous Quality Improvement Innotec has been able to meet these standards and even received an award from Honda for their high-quality products.

**Issues and Complaints**

Even though Innotec is a strong company with a global reach and a well-developed manufacturing process, they can still run into problems. Through the interview with Innotec, the team discovered that they are currently facing two distinct problems. The first issue is that Innotec has struggled with external operations because they do not receive high quality products from their suppliers. This becomes an issue because Innotec prides itself on making high quality items for their customers, but they cannot do that if the different components of their products are not high quality. The second issue occurs within the internal operations during inspections. Since Innotec uses visual inspection, it is up to an individual to make the decision of whether or not a part reaches the quality goal, however this is a quick process and inspectors don’t always have enough time to make a full inspection. This means that some parts that do not meet quality standards are let through, because the inspectors are worried about their time constraints. In this paper the group will define Continuous Quality Improvement, discuss the results of the interview, analyze the different issues presented, and establish recommendations for the company.

**Methods**

**Continuous Quality Improvement**

Continuous Quality Improvement is a critical factor to the success of any company no matter the industry, whether it be in the service or manufacturing industry, the pressure to continuously improve by the customer and market is always and will always be there. Before going into detail about Continuous Quality Improvement, we must understand what Continuous Quality Improvement is. While there are many different definitions for Continuous Quality Improvement, as a group we thought that this was the most accurate definition. “Continuous Quality Improvement is a never-ending process of measuring performance, finding what needs to be improved and actually improving it, and once improved, analyzing the results of your implementation,” (Rackow et al., 2013). The authors of this article also touch on something that is essential to a successful Continuous Quality Improvement program which is that:

Continuous Quality Improvement is a constant thing. The entire company is dedicated to using Quality Improvement tools to acquire the relevant data that a company needs so that the company is able to use the data to make quality improvements that will bring the company more success.

As a group, we liked how they incorporated that Continuous Quality Improvement is a constant and cyclical thing and how after implementation, the improvements that are made need to be analyzed to see if they are actually improving the process.

**History**

According to the American Society for Quality, quality became important during World War II as companies from one state would manufacture guns and a company in another state would manufacture the bullets to be used in those guns. The military used to inspect each unit individually but could no longer do that with the number of guns and bullets being manufactured. Because of this they switched to a sampling quality technique while keeping their standards just as high or even increasing their quality because malfunctioning guns would be a big safety hazard. These quality techniques used by the military for sampling inspections were assisted by the publication of the military-specification standards which were in Walter Shewart’s statistical process control techniques. In class we were taught that quality was not valued in American manufacturing until after World War II when we noticed the rise of quality in Japanese manufacturing quality. Japanese manufacturing surpassed American manufacturing due to Edward W. Deming and Joseph M. Juran a providing Japanese companies with the knowledge of their different styles and principles of quality. Being behind in both electronic and automobile quality in manufacturing to Japan prompted American companies to develop the idea of Total Quality Management, which is a companywide focus on quality instead of just an inspection station focus on quality.

**Present Day**

All of these developments in quality lead to where we are today, where, for many organizations, there was a realization of the importance of quality improvement and a focus on Continuous Quality Improvement. Companies realized that they had to have jobs and teams of people specifically focused on ways to continually improve processes within their organizations. The *Journal of Operations Management* shows the importance of Continuous Quality Improvement with this powerful excerpt, “businesses do not rely on processes anymore, they rely on the ability to continually improve their processes to keep competitive advantage over others,” (Anand et al., 2009). This is saying that company’s do not necessarily focus on creating entirely new processes for their production or services. Instead companies focus on improving the processes they currently have in place as it will be cheaper than new equipment, training, and hiring more employees. Similar to the fact of it is cheaper to retain customers than acquire new ones, it is cheaper to retain processes and improve those, then remake entirely new processes and try and implement them with uncertainty of how well the implementation will go.

**Quality Control Tools**

There are seven quality control tools that are very popular and commonly utilized within organizations to figure out problems, so the organizations can continuously improve quality. These seven quality tools, from an excerpt in a book titled *The Quality Toolbox* written by Nancy R. Tague (2005), were developed by a Japanese engineering professor at the University of Tokyo named Kaoru Ishikawa. The first of these charts is the fishbone chart which looks for the roots of the problem and puts those causes into categories to better visualize all possible causes. Then there is the check sheet which collects data to analyze and can be used for many different reasons, such as a tally system to visually track the leading reasons why a process is failing. The third chart of the seven quality charts is the control chart which is used to show how a process may act over a certain period of time. The fourth is a histogram which is well known for showing the frequency of the problem at hand. The fifth chart is the Pareto chart, which is an ordered histogram, simply meaning it is organized. Pareto charts are specifically organized in descending order, the most frequently occurring problem will be the biggest and first bar on the chart, making it easy to visually see what the recurring problem is so they can be focused on first. The sixth quality control chart is a scatter diagram which takes data and gives each type its own axis and establishes the correlation between the two. There will either be a positive, upward sloping correlation, a negative, downward sloping correlation, or no correlation where the data points are randomly scattered around the chart. The last quality control tool created by Ishikawa is the flowchart, which allows an organization to map their business process and visually see each step within a process. As a group we found these seven quality control tools laid the foundation for Continuous Quality Improvement so that organizations could address in order to keep improving the quality they have within their organization.

**Six Sigma**

 Additionally, there are many other methodologies and process approaches to improvement that all contribute to company’s success with Continuous Quality Improvement. As discussed, quality control tools help to identify the problem and the methodologies and ideas are what organizations use to solve the problem. From the last article in the *Journal of Operations Management*, Six Sigma was mentioned as one of the most used process improvement techniques due to DMAIC, a set of steps that are commonly associated with Six Sigma. Six Sigma is the idea of process quality improvement through the use of statistics to figure out how to remove defects from a process. By producing less defects, a company will be able to sell more products to the customers, which in turn leads to having a better financial return. To be six Sigma certified means an organization must have 3.4 or less defects per one million opportunities, whether that be in manufacturing or the service industry.

*Figure 1.* Six Sigma Road Map

DMAIC, as mentioned in class, stands for Define, Measure, Analyze, Implement, and Control. The DMAIC model can be found in many Fortune 500 companies that pursue Continuous Quality Improvement because it provides a great set of steps to follow to ensure organizations are taking the necessary steps to implement something that will improve the quality of the process. Another aspect of DMAIC that stood out in the article, is that once each step is completed, each is treated as its own achievement and is analyzed as such. Organizations do not wait to look at the results once the implementation is completely done, they check step by step to see if what they are implementing is improving the process quality. That way, if it will not work like they suspected it would, they can cut it as soon as possible, and save money. If an organization waited until the end of the process to check the results an entire improvement process could fail, causing the organization a significant amount of money. By checking in on a process improvement an organization will not have to worry about productions or services being down for an extended period of time.

**Lean Process Improvement**

Another idea used by many organizations to continuously improve quality is the idea of Lean process improvement. Lean Enterprise Institute stated, “Lean process improvement is generating more worth for your customer while using less supplies in the same process,” According to *Lean Synergistic: A Synergistic Approach to Minimizing Waste* written by Raymond and Rerick (2002), there are seven different definitions of waste in a process. These seven wastes are

1. Overproduction

2. Waiting Time in Queue

3. Transportation

4. Non-Value-Adding Processes

5. Inventory

6. Motion

7. Costs of Quality: Scrap, Rework, and Inspection

While part of the goal in Lean is to reduce one or more of these seven wastes, Lean also has a methodology they follow to achieve waste reduction. Like Six Sigma has the DMAIC methodology, Lean process improvement follows the 5s approach, which, according to an article written by Jimenez et al. (2015), originated in Japan and was first implemented in a business setting by Takashi Osada because he felt Continuous Quality Improvement needed to be escalated in business. He did this with the Japanese terms seiri, seiton, seiso, seiketsu, and shitsuke which translate in English to Sort, Straighten, Shine, Standardize, Sustain. This 5s methodology ultimately has led to the Toyota Production System to be put in place which was a ground-breaking system that increased the popularity of Lean process improvement and also reduced the waste in processes for Toyota tremendously. Like mentioned before, following through with these five steps correctly will decrease the scrap and increase the efficiency within an organization.

*Figure 2.* 5s Diagram

**Lean Six Sigma**

While Lean and Six Sigma are two separate methodologies, that doesn’t mean that they are mutually exclusive. Actually, including both into an organization may provide even better results for an organization than just one. An example of this can be seen in a research paper conducted on the co-implementation of Lean and Six Sigma, called Lean Six Sigma, within hospitals. In the article about the benefits of co-implementation of Lean Six Sigma it states, “the implementation of Lean and Six Sigma together should result in greater overall benefit,” (Lee et al., 2016). The benefits of co-implementation can be seen in the process of improving the 41 causes of hand hygiene noncompliance within hospitals. Eight hospitals applied the Lean Six Sigma methodology to the hand hygiene noncompliance, which was initially at 47%. After the implementation the compliance jumped a significant percentage up to 81% compliance throughout the rest of the year. Regarding this past study, the article continues to say:

Case studies have shown the ability of our medical Lean Six Sigma programs to have the ability of reducing many important costs, medical errors, wait time for emergency rooms, the hiring process, begin times, and overall maintenance costs within the hospital.

Lastly, the section finishes with stating that co-implementation of Lean Six Sigma may be something beneficial to hospitals in this specific case, but overall it can be beneficial to all types of organizations.

**Eight Disciplines**

Another problem-solving methodology that applies to our project is the Eight Disciplines (8D) model of problem solving. The American Society for Quality defines 8D as a model that “points out, improves, and terminates repeating issues and is mostly used by quality engineers in product and process improvement,” (2018). According to Quality-One’s website, 8D was developed by Ford Motor company in the 1980s, and was previously named the Team Oriented Problem Solving (TOPS) model. 8D became the main problem-solving methodology used by Ford Motor company and it is still used by them today. The 8D model is technically a nine-step process, that starts at step zero. Step 0 is about getting to the root cause of the problem, much like other methodologies talked about such as DMAIC and 5s. From a book titled *Modular Kaizen: Continuous and Breakthrough Improvement* (Duffy, 2014) the nine steps of 8D are defined as:

D0: Plan

D1: Utilize People

D2: Determine and Describe the Problem

D3: Create a Short-Term Plan

D4: Define, Pick, and Confirm Root Causes and Escape Points

D5: Pick and Correct Long-term Solutions

D6: Instill and Verify the Improved Steps

D7: Take Necessary Precaution

D8: Reward your Group.

D0 is the planning stage where an organization should identify the problem, possible solutions, and determine the prerequisites. D1 focuses on establishing a team of people that have the proper knowledge of the product or process, this can mean establishing a team from multiple departments. D2 is where the organization defines the problem by identifying quantifiable terms such as who, what, where, when, why, how, and how many. Next, an organization moves onto D3 by isolating the problem from the customers. In D4 they should identify all of the potential causes of the problem and prove that they are accurate. Then, in D5 the organization should confirm which corrective action will resolve the problem before moving onto the implementation in D6. Finally, in D7 an organization should modify any other process that could also be affected by the same process and move on to congratulating the team’s efforts in D8.

The Eight Disciplines are a thorough set of problem solving steps and unlike Six Sigma and Lean, they focus on reducing errors and waste throughout an entire process. 8D is a problem by problem process which makes it unique and practical to deal with any number of issues within an organization. As stated earlier, Continuous Quality Improvement is a never ending, stressful cycle for any organization. To ease the stress of these problems and assist and with an organizations effort in Continuous Quality Improvement are the seven quality control tools and the three methodologies mentioned, Six Sigma, Lean Process Improvement, and the Eight Disciplines.

**Results**

**Interview**

As a group we conducted our interview with Brendan Biesboer, who is a mechanical engineer at Innotec. Since Inonotec is located in Michigan, we chose to do our interview with Brendan over a FaceTime call. This was the most plausible option to get face to face with Brendan. At Innotec, production is broken up into work cells. Brendan is in charge of quality within his work cell, as every other member within his cell is since they are free to solve quality problems and is also in charge of some light fixture production lines. Before becoming a full-time employee at Innotec, Brendan was an intern there for two years and he has currently been full-time for over a year now. When we did the interview, we had three of our four members start it. It was Andrew Wieringa, Maegan Trygstad, and Jeff Willer. Our fourth member, Andrew Screnock, did show up a little late, but was still ask able to ask a few questions towards the end. The style in which we conducted the interview was done by question order. Andrew Wieringa asked questions 1-6, Maegan asked questions 7-13, Jeff asked questions 14-20, and Andrew Screnock asked questions 21-25. Unfortunately, Innotec prefers to keep a lot of their company information in secret, so we as a group were not given any pictures or diagrams for documentation. However, we do include two pictures later in this section to help us represent what Innotec uses within their quality improvement techniques, this being a diagram of the eight disciplines.

**Process Problems**

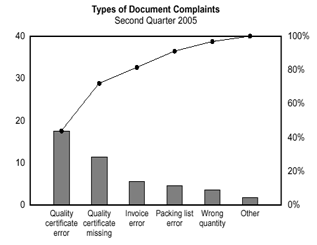
Innotec actively uses Continuous Quality Improvement as a key factor within their operations and processes that play a major role within the success of the company. Our first question that we asked Brendan was, “What is a problem or process at Innotec that needs to be improved?”In his response, we uncovered some of the main problems that Innotec faces with quality on a day to day basis. Although the problems were already mentioned in the Introduction, we feel it is important to reiterate in order to capture the benefit of Innotec using Lean manufacturing, which was talked about in the Methods section. A big problem that they are faced with comes from their supplier. Brendan feels that their supplier does not value quality on the same level as Innotec, or Innotec’s customer base. Both Honda and Ford are two companies that are expecting high quality products from Innotec. In return, Innotec feels the suppliers are not meeting this expectation. When communicating with the supplier, there are many occasions where supplier will argue if their product is good or poor quality. However, quality is something that needs to be determined by the customer in all cases. The problem is coming from the supplier’s own operations because they do not put as much time and effort into quality as Innotec or follow Innotec’s quality processes. This results in Innotec receiving a lot of poor quality parts. Brendan stated they would like to have zero defects, but he realizes that it isn’t always possible. Innotec has recognized this issue, seeing how much their scrap rate was increasing, and used lean manufacturing to make the most of this increasing problem. They found they could take some of these scrapped parts that were meant for other products and use them on some of their other manufacturing processes for different products. Instead of just letting the materials go to waste, they found use for them in other areas of the company, which is great thinking from a Lean manufacturing viewpoint and ultimately a Continuous Quality Improvement viewpoint.

**Quality Implementation Within the Employees**

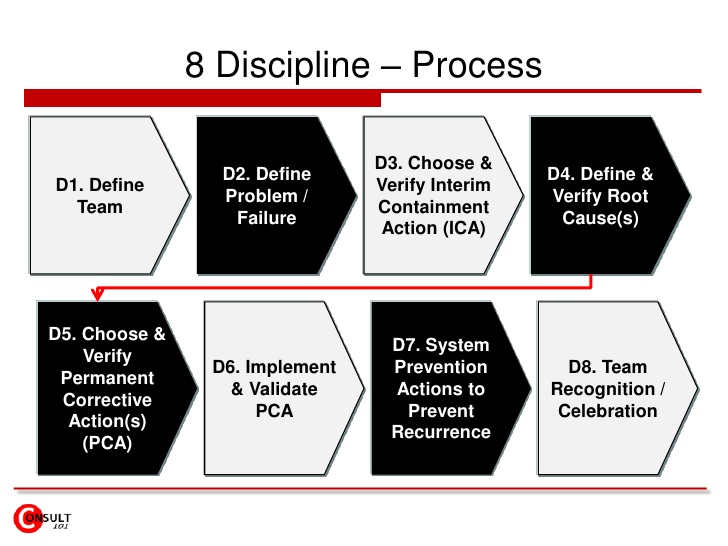
In another question to Brendan we asked, “Does Innotec have any core principles or steps that are used at all of your plants that are the foundation of your continuous improvement approach?”In response, he stated that Innotec used a grading/point system each month as a competition between the work cells. Work cells are divisions of employees within the company that determines the layout of their working facility. If a cell does better one month than the previous month before, they are given a small reward for each improvement. On top of that, if they outscore every other cell within the organization they are treated with a larger prize such as an outing to a restaurant paid for by the company or receive gift cards to places the cell enjoys. This enforces the quality that they value at Innotec and may be a major reason for why they are successful with delivering quality products.

Quality is the highest graded factor within each month’s score. The better a cell does, the more points they acquire, and they receive a higher grade level. This promotes Continuous Quality Improvements on a month to month basis. He also made it clear that at Innotec, quality is second on their list of Vision and Values. Innotec is also successful with the methods they use for solving problems dealing with Continuous Quality Improvement by using Pareto Charts and the eight disciplines problem solving model which was discussed in Methods section and will be discussed in the next paragraph while addressing these two quality tools in action at Innotec. Each member at Innotec is experienced with Pareto Charts and 8D because they have been working with them for years. Even though Brendon has only been there for three years he said they are consistent with what they do and have been using these processes for a long time, much like their work cells which were established when the company was established in 1992.

**Process Improvement Technique at Innotec**

A specific example of implementing Continuous Quality Improvement we were given had to deal with the scrapping of parts, which was mentioned in the Methods section as the seventh of the seven wastes within Lean. Innotec makes a lot of lighting parts within their production processes. As mentioned earlier, many of the parts being received by the supplier are coming in as defects and need to be scrapped. Some components being added into these light fixtures have scratches and dents in them. If these components do have one of these defects, then it cannot be used. Therefore, it leads to the item being scrapped, which creates a higher scrap rate for Innotec. Unfortunately, this is not the only issue that comes with the manufacturing of their products. Another area where they were having major processing problems, was in production of two of their parts, the lenses and reflectors for overhead consoles. Eventually, Innotec realized that when these parts were coming off the production line, they were scratched and therefore could not be sold to the customers due to poor quality. Over time it became more apparent that the issue was happening more and more which led them to believe they had a problem. At Innotec, when an employee scraps a part, they must put a reason for why they did so, this reasoning is compiled into one of their machines. At the end of each day each person involved in the quality improvement process receives a Pareto chart, one of the seven quality control tools mentioned in the Methods section, that details the biggest problems they are experiencing. From this Pareto chart they can determine the most prominent problem and try and solve. Once the problem is identified, they use the eight disciplines problem solving methodology to dissect the issue and fix it. The Methods section walked us through what each step in the 8D model is and consists of, this image below also shows a visual on what 8D looks like.

*Figure 3.* Types of Document Completion



*Figure 4.* 8 Discipline Problem Solving Process

After going through this process, Brendan and his team came up with the main source of the problem. The machine that molds the lenses had damage within the mold itself. Every time a lens was going into this machine its chances of getting scratched were significantly higher. Since they were able to pinpoint the problem, they were able to fix the mold in the machine. It was through their quality process that they had found the problem and came up with a solution. Once the mold had been replaced, the number of lenses being scratched dropped significantly. We would’ve liked to have followed through the steps of 8D with Brendan but when asked, we were given a similar answer to when we tried to receive the data mentioned in the opening paragraph. However, he was not able to share what they did for each step because he had been instructed not to share any specific process information and specifics about products by upper level employees within his company. H stated that this was because, “automotive manufactures like Innotec are secretive about information being shared.”

**Discussion**

**Strengths**

Throughout this paper we have seen that Innotec is consistently working on improving their manufacturing process, so they can produce high quality items for their customers. They have been able to create and maintain their process for a multitude of different reasons. However, the team determined two distinct strengths that Innotec used to support their company. These two strengths are Innotec’s work cells and their ability to produce high quality goods from low quality supplies.

**Innotec’s Work Cells**

One of the biggest strengths of Innotec is their cell station work system. They have cells that people work in, and these cells compete with other cells for monthly bonuses like mentioned beforehand in the Results section. Each cell gets rated every month in eleven different categories. These categories have different weights to them, such as quality having the most weight in the total score. This system allows the employees to have clear goals, and a clear list of what they should be striving for. With the monthly competition, the cells are motivated to perform to the best of their abilities. In these cells they don’t use job titles, each person is an equal team-member, and so there is a much higher potential for collaboration which leads to quality improvements which is the ultimate goal of the work cells. Another strength within their work cells is associated with the collaboration of teammates within each cell. As we know, Innotec does not have job titles for their employees, they have never done, even when they started in 1992. This helps to eliminate the fear within a work cell that may exist if Innotec were to have a hierarchical structure. We found that this small, but innovative decision made by Innotec contributes to Continuous Quality Improvement much more than a person may think. When a worker within a cell wants to make a decision regarding quality or make a comment on how something may be improved within their work cell, they can do it openly and freely since everyone is an equal in status within the cells. They will not have the fear of giving a poor suggestion in front of a superior, this may lead to innovative ideas within the cell on ways to improve quality.

**High Quality Products**

One of Innotec’s biggest strengths is actually due to one of their biggest weaknesses. Innotec is able to perform at a high level when it comes to producing quality products even when they are not receiving high-quality parts from their suppliers. Proof of Innotec and their employees’ ability to adapt to these poor supplier situations can be seen in the awards that they have won for quality as a company, which are mentioned in the Introduction. These awards come from large scale companies such as Honda and being recognized by a company of that size is a very significant feat for Innotec or any company in a normal situation. But, Innotec stands out because they must overcome having to scrap so many parts from their suppliers but the quality and care that they produce their products with is still outstanding.

**Weaknesses**

Even though Innotec is a strong company, as evident by the previous section, they are fallible. Innotec still has weaknesses within their quality process, which is why they are so dedicated to Continuous Quality Improvement. By frequently checking in on their processes they can catch issues sooner and work toward eliminating their weaknesses. At the time of our interview we identified two different weaknesses at Innotec, their suppliers and the inspection process.

**Suppliers**

As mentioned previously about how impressive it is to produce such the kind of high quality parts that Innotec is able to produce while receiving poor quality parts from suppliers was a strength of the organization, their suppliers are their biggest weakness. While Innotec is still performing exceptionally well as a company, as we can see from them being named to the Forbes’ “Best Small Companies in America” list in 2016 as also mentioned in the Introduction, they may even be performing at a higher level in quality if they had better suppliers. While conducting the interview, Brendan, who we interviewed from Innotec, acknowledged that their suppliers could and should be shipping out better quality parts and also acknowledged the fact that if they were it would lead to more production from their organization. In the interview he also mentioned that they had poor collaboration with some of their suppliers which feeds into this weakness of receiving poor quality parts because the suppliers need to know they are doing a poor job so they may address the issue and also the supply chain needs to be on the same page in order for everyone to maximize their benefits. Brendan even mentioned speaking with one of their suppliers on the matter of receiving poor quality parts and it turned into a matter of the supplier saying they weren’t of poor quality. Quality is in the eye of the beholder, and in this case that is Innotec and the supplier needs to recognize that and listen to their customer.

**Inspection Process**

The inspection process is also a weakness of their Continuous Quality Improvement program due to the fact that it is all done visually by human beings. As we know, visual inspection may have some guidelines to follow as to what is accepted and what is rejected, such as physical damage, but it may and does become subjective with some parts that are on the border of being accepted or rejected. Brendan acknowledged that the inspectors are trained properly on how to decipher between accepted and rejected but he also acknowledged that some parts get accepted that should not get accepted and that is due to subjectivity on what is a good quality product.

**Implementation of Continuous Quality Improvement**

As mentioned before in the Results, Brendan gave us the example of a time they went through the Trend Pareto Process Project and eight disciplines of problem solving to figure out the problem of the damaged lenses. These processes led to a successful fix and increased their quality due to the fact that they were not scratching lenses anymore, this is a great example of a successful implementation of Continuous Quality Improvement. Using question four from the interview, “An Example where they used the Trend Pareto Process to come up with a solution?” we found out that Innotec uses a machine that pools together all the reasons for the scraps of that day. The machine then generates a Pareto chart based on descriptions for the reasons they were scrapped from the employees. This chart is sent to quality workers, like Brendan, and can be used to identify a problem so employees can attack it with the eight disciplines problem solving model to find a solution. As a group, we think that this is an effective way to go about Continuous Quality Improvement within an organization because employees are going after problems that they’re personally concerned with and they have well-respected methodology to do so. In question sixteen, regarding if they have ever failed on projects, Brendan said that since he has been working at Innotec he has not been a part of a project that has failed. Because of this we can confidently say they have an effective Continuous Quality Improvement process in place.

**Poor Supplier Recommendation**

On the matter of Innotec having poor quality suppliers, we are recommending a three-step approach to try and get the supplier to improve their quality to the level Innotec expects. The first step of our three-step approach is simply to reach out to the supplier and talk with them about how Innotec is receiving poor quality parts and that it is unacceptable. Also, Innotec could ask the supplier about the monthly scorecards that they send the suppliers and ask if they look at them and encourage the supplier to consider the critiques made on there when improving their processes. The second step we recommend is to schedule a plant visit to the suppliers’ plant as where Innotec could take note on the areas that they think the supplier can improve on in order to produce higher quality parts. They could also bring the supplier to Innotec’s plant where they can observe how things are ran and possibly try to implement some of these back into their facility. After the plant visits are over, they should schedule a time to meet with a group of people from the supplier who are all associated with quality management to create a cross functional team in order to establish a common measurement of quality that can be shared at the supplier’s facility. In this meeting they can discuss and brainstorm ideas on how the supplier can improve its quality operations and how they can conform to Innotec’s processes. We know that these processes are proven to work because it is something Brendan also mentioned while answering the first question of the interview we conducted with him. After this meeting, Innotec should give the suppliers more time to allow for implementation and see if they are acting on what was discussed at the meeting. If what was discussed at the meeting was not put into place and the supplier continues to deliver poor quality, the third step and last resort, Innotec should take is to terminate the contract with their supplier due to consistently receiving poor quality and build a relationship with a new supplier. We see this termination as a last resort because we compared it to firing an employee. If a company has invested resources and time into a supplier and has built a relationship with them, the last thing they want to do is terminate the relationship and try and find a replacement due to time and need for parts, just like firing an employee.

**Poor Inspection Recommendation**

One of recommendations we have developed for Innotec on the matter of there being poor inspection at times is to add another inspector to their process line. The reason we chose this is to add another layer of defense. The inspector is missing defects in the products, so if they add a second inspector, they will be able to catch some of the defects that the first inspector made, this is the same exact concept as Reason’s Swiss Cheese Model. This won’t be a perfect solution, but the chances of defective parts leaving their plant are decreased. One benefit to Innotec being strong in continuous improvement, is that this problem will only get better moving forward, since they will continue to use their Pareto Project Process System to improve the quality of their parts. This will in turn give the inspector less defects to spend time on, and ultimately allow them to reduce the amount of defective parts that they ship out. The only recommendation for this is that they use their Pareto System to figure out the issues sooner rather than later.

A second recommendation to poor inspection would be to improve other areas of the production line to give the inspectors more time. For example, if Innotec created a Pareto chart and determined that the Packaging department took the most time in process, they could focus their attention on improving this division. By reducing the production time in the Packaging department, they can allocate more time to the inspectors and allow them to take more time to look over the goods. By adding on time to this process the inspectors would be able to thoroughly inspect the products and catch more defects, thus reducing their scrap and increasing their profit. As a group we plan to bring these recommendations to Brendan and we are curious to see what he has to say on these matters or if they have thought of and tried any of these already and they failed with them.

**Direction of Innotec**

Question ten of the interview we asked Brendan, “What kind of changes is Innotec looking to make in the next five years? Are you looking to improve current products? Or are you looking to expand into new product lines?” and he gave us a very positive answer about Innotec. Although not being able to discuss much about current or future products, as mentioned before about Innotec keeping quiet on their products, he said they are always looking to further improve the quality of their products and processes. At Innotec they want to continue to build upon their already great reputation as a quality provider and use that in order to start supplying other large companies the size of Honda and Ford.

**Lessons Learned**

Throughout this project, our team has learned countless things about Continuous Quality Improvement in the real-world. Being able to speak to a professional about the quality of a process line has given us many insights to this topic. One thing that we learned is the importance of finding what works and sticking with it. For Innotec, their Pareto Project Process System has worked for them through many projects and process improvements. It’s easy to understand, it’s clear, concise, and to the point. This clearly works well for them, and they know it. They have invested money to have machines collect this data for them, because they know that they are going to use it in the future. Instead of jumping between different continuous improvement techniques, they have mainly stuck with this one. This lesson can be used and applied in all different work environments, regardless of where we find employment. This isn’t saying that we should always put all our eggs in one basket, it is saying that we should stick to techniques that are tried-and-true in our work environments.

Another lesson that we have learned is simply the value that is in good quality products. Innotec has acquired very valuable customers, such as Honda and Ford, simply by providing quality products. They are also able to save money on scrap and rework by reducing the number of defects they have and reusing defective products. By making products right the first time, they can focus their time on continuing to make new products, instead of putting time, effort, and money into the same product over and over to get it right. This approach is crucial in continuous improvement. If a company is producing poor quality products over and over, they are showing that continuous improvement isn’t a priority. A company dedicated to continuous improvement would find products or processes where they make mistakes and take action against it. Innotec has proved this to be true because of their focus on quality in their cell grading scores for continuous improvement.

Studying the continuous improvement techniques of Innotec has allowed us to see the value of doing things right the first time and improving processes that are slowing the company down. Their innovation and improvement has allowed them to become important suppliers to big name companies such as Ford and Honda. Their commitment to quality has brought them to a place where they are one of the fields best suppliers. Innotec has been a great example of a company dedicated to quality and improvement. They have shown what benefits can come through these dedications, and how they can propel a company to the top of the field. Throughout this project, our eyes have really been opened to the importance of good quality and making sure that the processes are the best that they can be.

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**Image Sources**

*Cover Image.* Innotec Logo from https://www.innotecgroup.com

*Figure 1.* Six Sigma Road Map from https://www.softexpert.com/solucao/six-sigma/

*Figure 2.* 5s Diagramfrom https://www.5stoday.com/what-is-5s/

*Figure 3.* Types of Document Complaints from http://asq.org/learn-about-quality/cause-analysis-tools/overview/pareto.html

*Figure 4.*8 Disciplines Problem Solving Process from https://www.slideshare.net/anandsubramaniam/8-d-problem-solving-process

**Appendix**

**Interview Questions: Continuous Quality Improvement**

**Q1. What is a problem or process at Innotec that needs to be improved?**

A1. They are often held to a very high-quality standard by Honda or Ford for example and sometimes they do not hold their suppliers to that standard such as they are receiving poor products. They struggle with their external operations because they struggle to receive high quality products from their suppliers and its difficult for them to promote high quality from their supplier because they try to promote them to use the same processes such as lean manufacturing and Trend Pareto Problem processing, it is difficult for them to keep their suppliers to a high level of quality when they are held to a high level of quality by their Customers. A lot of times their suppliers like to argue what is good or bad quality with them when the customer should determine quality. He sees a problem with their supplier’s operations messing up their own operations because they are not collaborating on using the same quality improvement processes which leads to them receiving poor quality parts a lot, they receive more poor-quality parts than they send to their own customers which also slows down production. The goal is to have zero defects but that may not be reasonable, so you want to be as close as possible to that and their suppliers are making it hard to do so.

Another problem is that they use visual inspection and it is up to them to make a decision on what part is good or not, which they are trained well on quality, but they also need to work with speed and it is up to them on whether the part is good or not. Sometimes they completely miss a part also. If they get a part shipped back to them and it is because of poor judgment by the visual inspectors the questions will rise of, do we need to train them better or change something in their training. It is difficult for them to give them feedback on the process as well because they don’t understand the process and they can’t take the time and money to train them on the process. They keep doing their job the way they are trained and don’t raise problems as much as they should maybe out of fear or out of lack of notice for the problem.

**Q2. Specific Examples of the Problem.**

A2. They have to scrap a lot of their resources given to them by their suppliers which is an annoyance to Innotec as a company because they have many important customers such as Honda and Ford to supply parts to and they are held to a very high standard by them. They make a lot of lighting parts and some of the components they have to put in their lighting fixtures come with scratches or dents in them and they cannot use those parts to make their lighting fixtures and sell so they have a higher scrap rate because of it but he said it still makes more sense for them as a company to outsource for these materials. He said it is not encouraged at Innotec to share any of their Pareto Charts and materials, as a company they are not encouraged to share a lot of their information such as their Boardfree technology. Automotive manufacturers like Innotec are mostly secretive about their information shared.

**Q3. At Innotec, have you ever utilized the PDCA (Cycle/Wheel) Cycle, the FADE model or Juran’s Breakthrough Sequence to improve any processes within your organization?**

A3. They use a Trend Pareto Processing Project, take the issues of the most common failures and you pick a project based on whatever one you want to try and improve and go at it using the 8 disciplines of quality steps to problem solve with the approach and they find a solution from that.

**Q4. An Example where they used the Trend Pareto Process to come up with a solution?**

A4. They make lenses and reflectors for overhead consoles and they will get a scratched or damaged part and they have to scrap it and the machines provide the high scrap rates of the week which is like what the quality control Trend Pareto Chart does and going off of that they are able to look at what is causing them problems, in this example it was scratched lenses and they were able to look at the machine that molds the lenses and that was scratching them because there was damage in the mold and off of that they were able to fix that. If someone scraps a part they have to say why they are scrapping the part and they get a report at the end of day in this Pareto form that shows the problems and as long as they are getting accurate reasons for scrapping from their employees, they are able to pursue the problem to find a solution.

**Q5. While Toyota is a much larger company with their manufacturing process, they have implemented their own lean production system called the Toyota Production System (TPS) which maintained the highest level of quality, lowest costs and the shortest throughput time. At Innotec, do you use a specialized quality improvement system or was yours modeled after other companies or employee’s experiences?**

A5. Innotec’s is unique, each cell in the company gets a monthly score based on 11 different sections per month with quality being worth the most points per monthly score. They look at external parts per million in quality, which is how many parts are shipped back and you get points, supposed to complete two quality related projects per month which is used in the TPP system (Trend Pareto Project System). If they receive a part back from a customer they fill out an 8D form which is the 8 disciplines of quality which says what is the root cause and basically how they are going to fix the problem, it is their formal return policy for quality.

**Q6. Does Innotec have any core principles or steps you use at all your plants that are the foundation of your continuous improvement approach?**

A6. Graded on it monthly, you want to do as best you can for your cells monthly score. You also get points for doing better than last months’ score. Quality is also #2 on Innotec’s Vision and Values. Honda uses Innotec as a supplier for parts and Honda is very highly rated in quality for cars so that speaks to the quality that Innotec has and this is due in part from the commitment to quality from the company and from the continuous quality processes they use such as Trend Pareto Project Processing.

**Q7. In our Quality and Processes Improvement class we discussed 7 tools to see quality on a visual level and they are histograms, pareto charts, run charts, scatter diagram, flow chart, fishbone diagrams, and check sheets. At Innotec, do you utilize any of these 7 tools to view your quality in manufacturing? If you do, how so?**

A7. Use a lot of Pareto tools for fixing their problems, also use the 8 disciplines for quality.

**Q8. Reducing defects within your manufacturing processes I am sure is a priority of Innotec as an organization, has your organization considered becoming Six Sigma certified as that is having 3.4 defects out of every 1 million products manufactured? If not, what quality improvement steps would you take to reduce defects within your processes?**

A8. Not Six Sigma qualified, average is 80 defects parts per million in his current cell. In the company’s Vision and Values there is a goal to ultimately become Six Sigma certified.

**Q9. Does your organization use any types of practices for Lean/JIT/Kaizen manufacturing? If so, which methods and how so?**

A9. Use the KanBan system for ordering materials. They use this for suppliers to send them materials because it alerts suppliers when they need more resources. Part of their monthly score is also based on reducing your internal scrap while trying to improve off of last months’ score.

**Q10. What kind of changes is Innotec looking to make in the next five years? Are you looking to improve current products? Or are you looking to expand into new product lines?**

A10. Both, always looking to improve the current quality of their products and also always looking for ways to come up with new products. Innotec ships a lot of products to Honda and they have received awards from Honda for high quality, so they are looking to up that in the next 5 years of continuing to have a good reputation of a quality supplier.

**Q11. When dealing with large projects, what steps do you take to ensure that every new project is more successful than the last?**

A11. They follow the 8 disciplines of quality model; it is a problem-solving model, so the steps are the same for each project in problem solving but each project is different, so they are constantly coming up with new solutions to continuously improve their quality in processes.

**Q12. What type of improvements did Innotec have to make to their manufacturing process to become ISO/TS16949 certified?**

A12. All of their quality documents have to be up to date, everyone requires proper dating, they get audited every month on their quality documents and they cannot contain any mistakes. Constantly keeping quality documentation up to date, he believes you have to renew it yearly but not 100% sure.

**Q13. Does Innotec offer incentives to its employees for developing new ways of improving manufacturing processes or product designs? If so, what kind of incentives?**

A13. This goes off of the Cells competing for the most points every month with quality being the most important factor in the competition. Cell that wins the monthly quality award gets a funded outing they can do, or they are given different kinds of gift cards. It varies month to month but there is always some type of incentive offered for accumulating the most points.

**Q14. What type of process improvement does Innotec use on their product line? Are they more focused on quality assurance or quality control of process improvement? Why have you chosen to use this type of process improvement?**

A14. They end up working on more Quality control projects using things already mentioned like the Pareto Charts and they go in and try and fix the current problems they are having. In manufacturing there will usually always be more quality control in you need to fix the problems that arise, but they try and create a defect free process before implementing but that is not much of a realistic goal.

**Q15. At Innotec you guys use Eco-Sensitive Products, what kind of challenges were faced when making the transition to this method in the manufacturing process? Did it make you more efficient, if yes, how so?**

A15. Use 100% recycled material to make that certain product, they have been using it since early 2000s, so he hasn’t been employed that long to see the difference. It is using the waste from other products to make more products which eliminates waste (Lean Process Improvement) and also makes Innotec more money because they are maximizing their materials being used.

**Q16. What projects, if any, have failed to bring Innotec their anticipated value?  What has Innotec done since then to ensure that the same mistakes aren’t made again?**

A16. They get stuck trying to figure out what is causing the real problem of projects every once in a while and the project sits for a little bit and they keep thinking about it and going after it, can’t give an example where something has failed on a project and they have had to redo the process because if it didn’t work how they thought it would, it still did not hurt the process and therefore did not need to be redone.

**Q17. Does Innotec use the Malcolm Baldrige National Quality Award winners as a standard to compare themselves to in quality?**

**Q18. What has been the most important improvement that has led to less waste in production?**

A18. One of the biggest issues they have is when they are scrapping parts the people running the machines won’t try and fix it and halt the line, they will keep the line going to look for the quantity. They are changing their mindsets to have them realize that stopping the line to get it fixed is more beneficial to the company than to have the line keep producing low quality parts, but they still keep getting a high quantity.

**Q19. Phillip B. Crosby is quoted as saying “Quality is free.  It’s not a gift, but it is free. What costs money are the low-quality things – all the actions that involve not doing jobs right the first time.”  Would you say this is a quote that Innotec’s principles agree with?**

A19. Fits well with the question above. “Cheaper to make quality parts the first time, then have to come back and fix it all first. It is faster to keep the quality parts going because with poor quality parts you will have to come back and redo the process later even though in the time it may seem like the right thing to do to keep the production and quantity numbers up.

**Q20. In 2016 Innotec was listed on Forbes’ list of America’s Best Small Companies, and the article noted Innotec’s decentralized organizational structure.  Has Innotec always had this structure?  If not, how difficult was it to implement this structure?**

A20. They have always used this Cell structure. The main idea behind it is that they don’t use job titles, each person is considered a valued member of their team. No one person is really in charge of anyone else, everyone is given a lot of responsibility and autonomy to work. When they were formed in 1992 this was the idea to always have them in their Cells and everyone there are equals to work and they did this to rid the workplace of status and hierarchical intimidation.

**Q21. When developing new products such as BoardFree technology, does Innotec approach each project the same?**

A21. They approach it like each project done already mentioned, with the Pareto Project Process System. They use that a lot. The BoardFree technology is a trade secret and he couldn’t talk about it much more than just what the website has listed about it.

**Q22. How does Innotec decide which processes they invest their money into when is technology always improving?**

A22. Through their marketing team they take recommendations from other companies, doesn’t know much about how they choose to invest their money in. They go to trade shows and show off their lighting and companies approach them at these shows and ask to use their lighting in their products so that is a way companies invest in them.

**Q23. When Innotec hires new employees, what can they expect to do for on job training? What is the overall process and how long does it usually go for?**

A23. You are expected to abide by the vision and values statements and uphold high quality within the company. You are expected to learn within the first month of training with how Innotec does stuff and how you are going to fulfill the role, you are trained in a certain way to uphold high quality and once you are put into a cell you are trained more by the other employees already in the cell, which they keep the influence on quality standards. Each person in the Cell has to depend on the other so they keep their quality high for each other in the Cell. One of their suppliers were shipping them poor quality parts and he was speaking to the quality person in other company and the person wasn’t able to explain how the parts were made with their quality processes, yet she was in charge of quality at the company supplying them. At Innotec everyone in the Cells know the processes and how they work and how they are able to obtain high quality. Each person is expected to keep quality high and if they see quality slipping they have the freedom to be able to make a change to it, they do not need to go up a chain of command in order to do so.

**Q24. Any manufacturing company has to be focused on safety regulations, what kind of safety precautions has Innotec implemented? Do you follow James Reason’s Swiss Cheese Model?**

**Q25. At Innotec what kind of leadership style is presented at your facilities, transformational, transactional, or laissez-faire leadership? Depending on which one, what are some of the reason you believe this?**

**Q26. Quality is about satisfying the customer and meeting their needs and wants. How does Innotec continue to make quality improvements and raise the bar to satisfy customers? What kind of feedback do you receive from customers and what changes do you make.**

A26. They get score cards from their customers based on things such as shipments and bad parts back and if they maintain a certain level for a certain while with a company they are potentially given an award like he mentioned they were awarded by Honda for their quality parts.