Spring 5-1-2022

The Grate Solution: Simplifying Viking Oven Packaging Processes

Megan Jansen

The Grate Solution: Simplifying Viking Oven Packaging Processes

By

Megan Jansen

A thesis submitted to the faculty of The University of Mississippi in partial fulfillment of the requirements of the Sally McDonnell Barksdale Honors College.

Oxford, MS

May 2022

Approved By

Advisor: Dr. Jeremy Griffin

Reader: Eddie Carr

Reader: Rick Hollander

ACKNOWLEDGEMENTS

Special Thanks to:

The Viking Corporation

Kevin Vanderlip, Viking Quality Assurance Manager

The Center for Manufacturing Excellence

Eddie Carr, Manufacturing 450 Professor

ABSTRACT

The following report details work completed to improve the Viking Oven Corporation's gas oven assembly line. The current state of the line hosts an unreliable system for packaging oven grates. Viking manufactures two types of gas ovens on the same line: open burner and closed burner. These different types require different prepackaged grates to be included in the final assembly area. Viking estimates that the wrong grates are sent to the customer ten percent of the time. The following report presents research, brainstorming, problem-solving techniques, and proposed solutions to the problem. The proposed solution would solve the problem at little to no cost for Viking Oven and save them from having to resend grates to unsatisfied customers.

TABLE OF CONTENTS

LIST OF FIGURES

I. INTRODUCTION

As a member of the Center for Manufacturing Excellence, I participated in an experiential learning class at Viking Oven in Greenwood, Mississippi. After a day of lecture on problem solving techniques, a group of five fellow students and I were tasked with solving a manufacturing quality problem in which Viking Oven had been dealing with. My multidisciplinary team comprised of five engineering majors and myself, an accounting major. We then had four days onsite in the facility to utilize problem-solving techniques such as fishbone diagrams, is/is not tables, and the five why analysis to locate the root of the problem and come up with a solution. The solution needed to be practical, economical, and implementable so that Viking Oven could put our solutions into action quickly and economically. Our group was tasked with solving the problem of the wrong gas oven grates being packaged and sent out with the incorrect ovens. As a luxury brand, this type of behavior is unacceptable and needed to be prevented at all costs as soon as possible.

II. BACKGROUND INFORMATION

a. VIKING CORPORATION GAS OVENS

Viking first began manufacturing gas ovens in 1987. They originated the idea that professional-grade ovens could be available for in-home use. For example, the in-home ovens come with features such as simmer, convection broil, and infrared broil. These features along with a sleek stainless-steel appearance allow Viking appliances to be priced thousands of dollars higher than typical in-home kitchen appliances. The customers who pay top dollar for these appliances expect perfection from Viking. Viking manufactures and sells many different sizes and styles of various kitchen appliances such as ovens, cooktops, refrigerators, freezers, and more.

My team dealt specifically with Viking's gas oven side of the plant. No matter the shape or size, all Viking gas ovens are either sealed burner (VGR) or open burner (VGIC). Figure 1 depicts the difference between the two types of burners.

Figure 1: Two Types of Burners

VGIC VGR

The only differences between the two types of burners on the manufacturing side are in the final packaging stage. The VGR ovens receive one VGR specific middle grate and a burner bowl and VGR specific grate for each burner on the stove. The VGIC ovens receive one VGIC middle grate and a burner cover and VGIC grate per burner. Each Viking gas oven is custom made to order and all of the gas ovens are made on the same assembly line.

b. ASSEMBLY LINE ISSUE

The current method of packaging each individual stove's kit is unorganized and relies heavily on operator memory. While zero operator error is always the goal, the current setup at Viking makes it extremely easy for operators to accidentally select the wrong prepackaged grate. After talking to numerous assembly line operators, it was apparent that there was a problem in the system. Figure 2 illustrates how the VGR and VGIC parts are intermixed on the assembly line. Figure 3 shows the operator's view of the different grates. Figure 4 shows how similarly the different grates are packaged, allowing the operator to easily mistake a VGR grate for a VGIC grate and vice versa.

Figure 2: Current Packaging Station Set Up

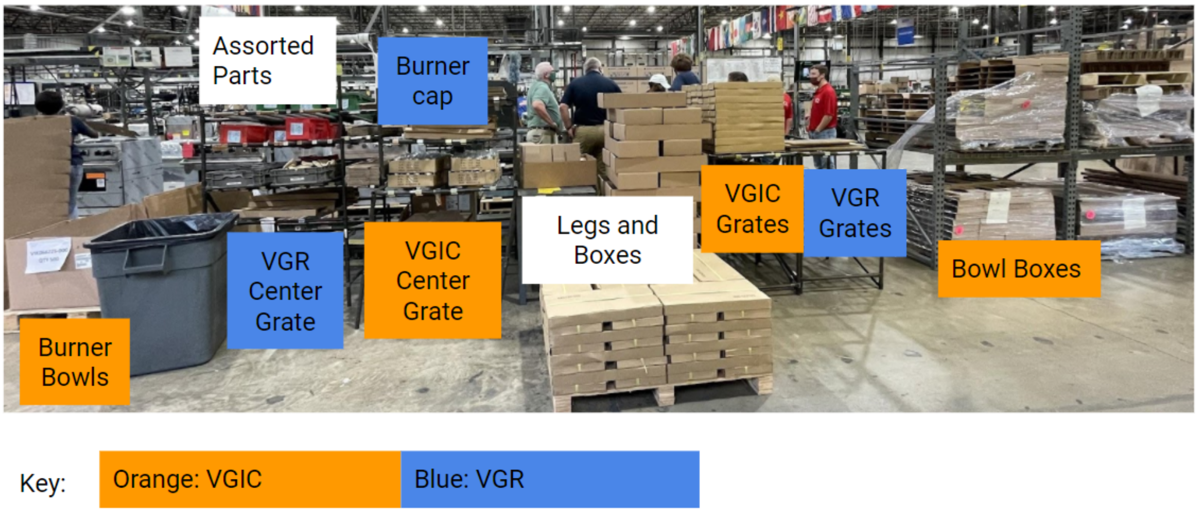


Figure 3: Current Packaging Station Grate Set Up

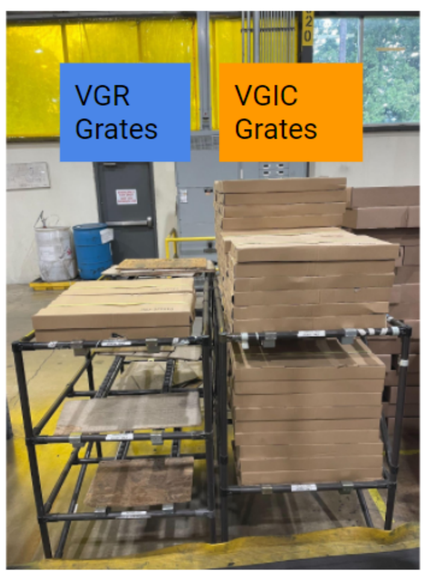
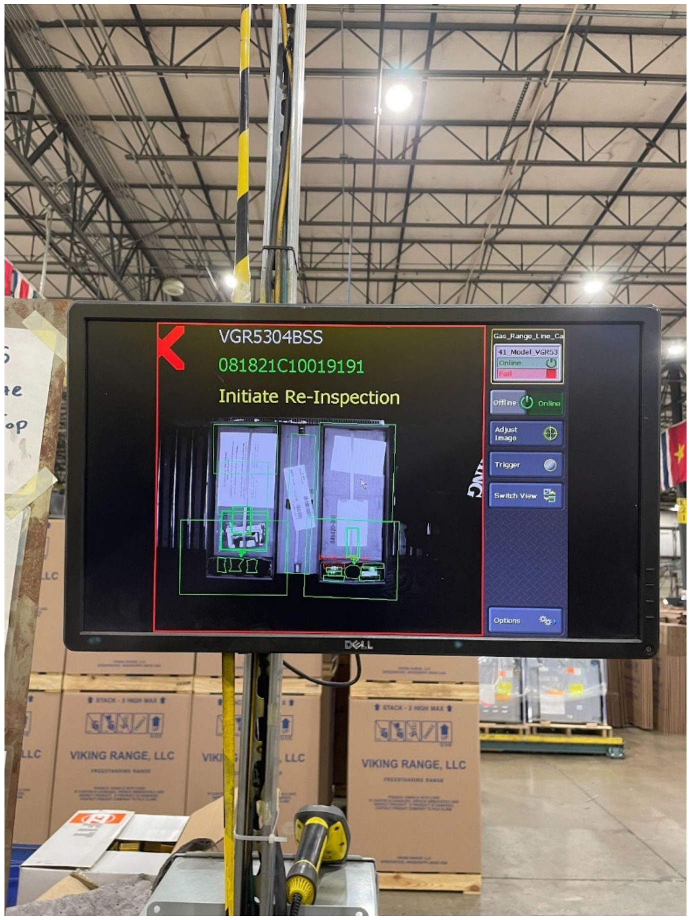


Figure 4: VGR vs. VGIC Packaging

At the end of the assembly line, Viking has a visual system quality check in place to verify that the correct number of boxes have been included with each oven. The system makes sure the burner bowls and grates are in place. However, because the boxes are so similar for the different types of grates, the camera can ensure only that the boxes are present but cannot verify that the boxes are the correct type. Figure 5 depicts the visual system quality check in place.

Figure 5: Quality Check Visual System



III. THE PROBLEM

Viking stated that ten percent of their customers received at least one wrong grate with their oven. They noticed that most of the time the individual burner grates were wrong, but the center grates were not always correct either. This defect is not detected until Viking's customers open the oven in their individual homes, making it too late to remediate. Because Viking is at fault, they typically overnight ship new grates to the customer free of charge and do not ask for the wrong grates back in return to avoid annoying customers. Viking estimated that each mismatched grate costs them $100 to replace. At an estimated ten percent error rate of 45 ovens per day five days a week, Viking loses $117,000 annually due to this issue.

This simple issue has a ripple effect on Vikings internal inventory supply. When ordering grates from the supplier, Viking does not account for a ten percent mistake rate. Therefore, when they ship the wrong grates to customers and have to replace them, it disrupts their just-in-time inventory manufacturing process. Also, the customer service department often did not go through a proper process when replacing grates for customers. This made inventory numbers inaccurate. In fact, when the team was observing the line, Viking was totally out of VGR grates. Because adding the grates was the last step, if a VGR oven came down the line, they would set it aside to wait for their grates to arrive. We observed 17 ovens waiting to receive grates from the supplier. This blocked walkways and cluttered workspaces, causing unacceptable safety issues. It also caused the customers to wait an additional amount of time to receive their custom ordered stove.

As a luxury brand, any mistake hurts Viking’s reputation. Viking’s customers pay top dollar for their ovens and expect perfection. Opening up a new, $10,000 stove that took months to arrive just to find out that the grates are wrong is not the ideal customer experience. For every customer-serving industry, customer satisfaction is of the utmost importance. Each mistake hurts Viking’s image and brand reputation which is what allows them to charge so much for their products.

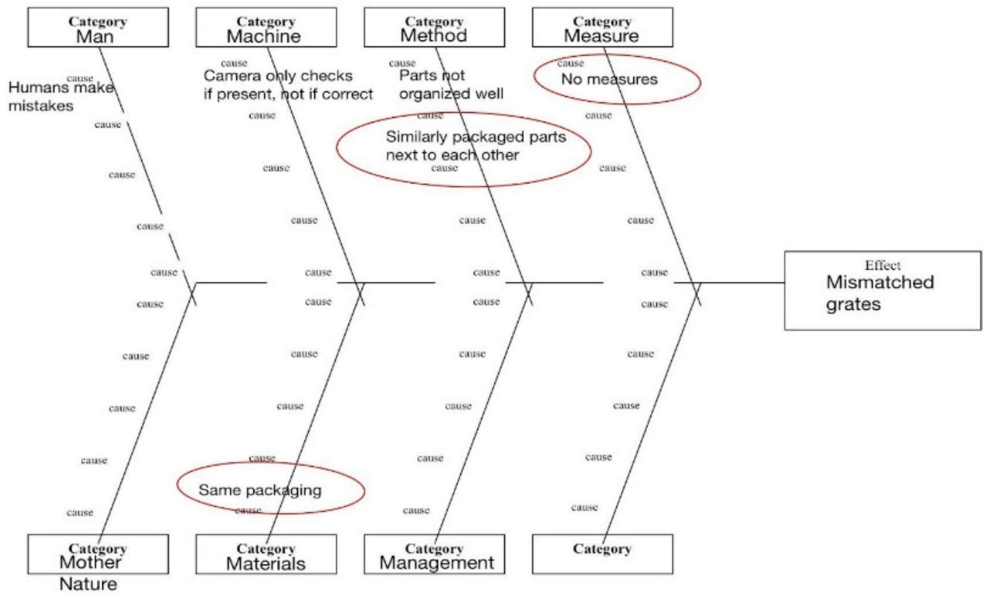
Considering all of the facts, the problem at Viking is that there is no system in place to prevent incorrect grates from being kitted or to verify that correct grates have been placed with VGR and VGIC ovens. Our team was tasked with using the 8-D problem solving method to solve the problem. This method works to establish a permanent corrective action based on numerous statistical analyses. To come up with this problem description, the is/is not tool was used. This problem-solving method challenges users to ask of number of questions about the problem before digging deeper into the generation of possible causes. It helps users focus their attention on the important parts of the process and not waste valuable time on irrelevant matters. My team came up with the fact that the problem is affecting the customer, including the retailer, warranty teams, and customer service teams, but not the process. The problem is that the incorrect parts are packaged, not the incorrect number of parts. And finally, the problem is critical to the customer to use their stove, not critical to the manufacturing process because it is not shutting down production. With this problem description in mind, we began to use the tools and diagrams we learned in class to pinpoint the root cause.

IV. ROOT CAUSE ANALYSIS

. Fish Bone Diagram

A fishbone diagram is a visual representation of cause and effect used for brainstorming the cause of a problem. It was one of the diagrams that the lecture portion of our class covered in great detail. The effect, or problem, is placed at the "head" of the fish. The seven "Ms" are then placed on each "bone" of the diagram; man, machine, method, measure, mother nature, materials, and management. A user then brainstorms and records potential causes that relate to each category. Once all of the causes are in place, a few main causes are decided on. Figure 6 shows the fishbone diagram for the mismatched grates effect. The fishbone diagram led the team to the main causes of: no measures in place to prevent or detect the wrong grates from being selected, the two types of parts are next to each other and mixed between VGR and VGIC, and the fact that the two parts have identical packaging.

Figure 6: Fishbone Diagram



b. Five Why Analysis

The five why technique is one of the most effective root cause analysis in Lean manufacturing. For the five why technique, a user must start by determining the specific problem and ask the question "why?" Once there is an answer, the user asks the question "why?" again. This repeats until there is a solvable "why." In some cases, it may take more or less than five whys, depending on the complexity of the root cause. Not only does this process help determine the root cause, but it also helps the user understand how one process can cause a chain of problems to occur and determine the relationship between different root causes. It is a very simple and user-friendly technique but is also highly effective.

The team discovered that the specific problem was that the customer was receiving the oven with the wrong grates. After asking "why?", we discovered that this was due to the wrong grates being packaged into the box and shipped. This was because of the team member grabbing the wrong grate, which was due to either the wrong grate being on the rack or the team member grabbing from the wrong rack. Our final "why?" gave us the answer that grate packaging looks similar and it is hard to see a difference in the different grates, especially when they are located right next to each other.

V. ROOT CAUSE

After completing the fishbone diagram and five why analysis along with general brainstorming, the team decided that the overarching root cause of the problem was that the grate packaging looks extremely similar, making it hard to distinguish between the different grates, compounded by the fact that they are located right next to each other.

VI. INTERIM CONTAINMENT

To immediately stop the problem until further measures could be taken, three interim solutions were implemented. All of these solutions were implemented instantly with the resources on hand at little to no extra cost to Viking. They are all very simple to implement and understand and require no additional training. All solutions were discussed with team members on the factory floor before being presented to Viking. The team members on the floor gave us valuable insight into what they thought would work and actually be used on the factory floor. We interviewed multiple operators who worked the different shifts in the packing position. Each team member's own ideas and comments were very similar and in line with the strategies our team pursued. Using the team member's own ideas makes them feel important and more likely to follow the strategies put in place.

The first interim containment strategy was to add an additional quality alert to the line. Quality alerts bring an issue to the attention of line operators and keep it in the forefront of their mind. While even some experienced team members may not refer to the quality alert every time, new or temporary workers would definitely refer back to it. In manufacturing, an assembly line cannot function with even one member missing. Therefore, if an operator is sick or not able to come to work, another person will be placed in the position. The quality alert will help ensure that the new operator is paying close attention to risky areas of the process. It is also a no-cost process, so even if it prevents one grate from being mismatched, it will have saved the company money. Figure 7 illustrates an example of a current quality check that Viking has in place on the assembly line.

Figure 7: Quality Check on Assembly Line

The second interim containment was having the final inspection team member underline the part type printed on the grate box and on the part order sheet. If done correctly, this would ensure that the correct grates were in each box. Underlining the part type prohibits the "autopilot" grabbing of the wrong part, lessening the incidence of mismatching. This would require operators to double check the part type needed before grabbing a grate box and to make sure the grate box matches the part type. Visual inspection alone has an 85 percent efficiency rate, but visual cues with an action bring the efficiency rate into the low 90s.

Our final no cost interim containment was an eighth quality check on the preexisting quality check sheet. The eighth check would state, "all grates match the part numbers called out in the bill of materials." This checkbox would require a signoff before being packaged up and sent to the customer. Figure 8 depicts the already existing quality check sheet that gets sent down the assembly line with each oven.

Figure 8: Pre-Existing Quality Check Sheet

These three containment strategies are simple yet effective. They were available to implement immediately at virtually no additional cost to Viking. Unfortunately, they are detective measures that do not combat the root cause of the problem, but rather help catch mistakes in the event that they occur. Thus, my team continued to search for long-term preventive measures that would not allow the issue to occur in the first place.

VII. LONG TERM SOLUTIONS

After helping to implement the interim containment strategies, the team shifted focus to long-term solutions. These solutions focused on extinguishing the root cause. We presented our final solution in a two-phase process, allowing Viking to choose what they wanted to implement. Each phase is more expensive, but also more effective.

Phase one of our solution is a simple rearrangement of supplies. Figure 9 depicts a spaghetti diagram of the current state. A spaghetti diagram is a visual representation using a continuous flow line that traces the path of an item or person through a process. In this case the red line represents the operator's motion to and from the Kanban carts when gathering all of the spare, prepackaged parts to be packaged and sent out with a VGIC oven. The process for a VGR oven is similar, but would include trips to the blue boxes instead of the oven.

Figure 9: Current State Spaghetti Diagram

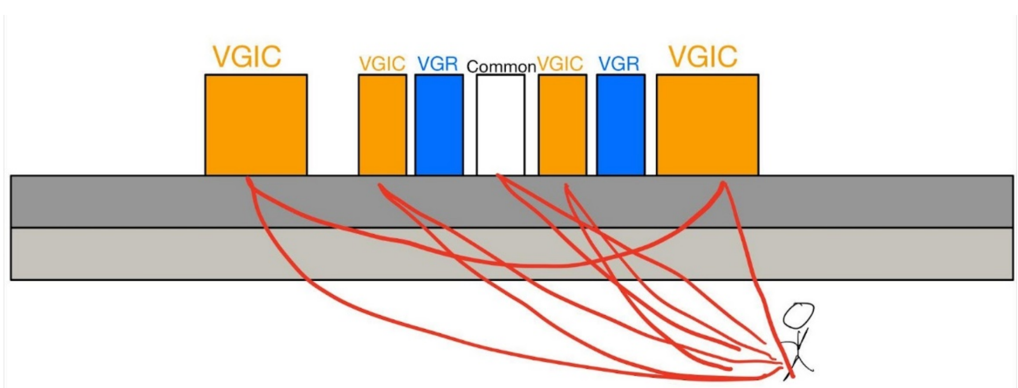


Figure 9 illustrates that there is a lot of movement when grabbing the parts to be kitted with each oven. It also shows how easy it would be to grab an item off of the wrong shelf since they are all intermingled. To combat this problem, we proposed moving the Kanban carts to a distinguished VGR station and a VGIC station so that each has their own areas. The sections would then be distinctly labeled to ensure that every employee knows which parts are located in each station. Figure 10 depicts the spaghetti diagram for the proposed set up.

Figure 10: Proposed State Spaghetti Diagram

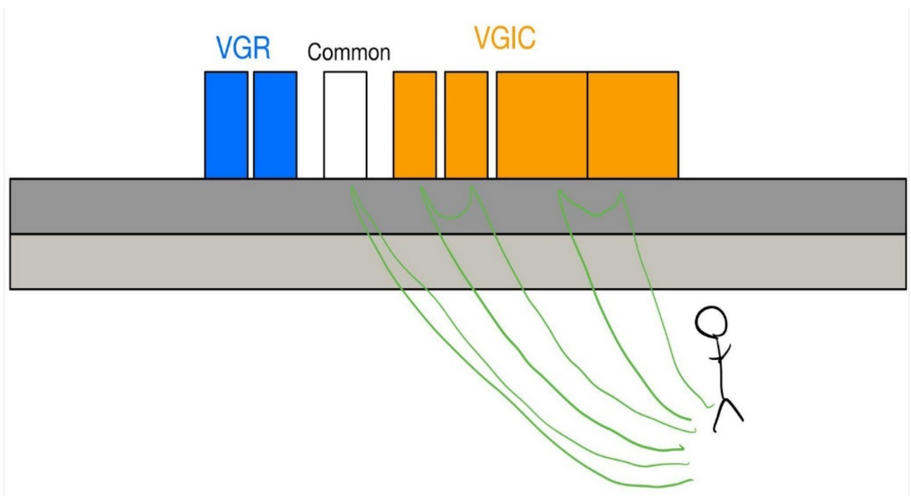


Figure 11 illustrates the proposed layout. Not only does this set up reduce the operator's transportation time and transportation waste, but it also significantly reduces the likelihood of grabbing the wrong parts. This solution is a zero-cost solution. It would require no new equipment to be purchased or additional operators on the line. All it requires is moving the existing carts around. This solution significantly reduces the chance of operator error, although it does not completely eliminate it.

Figure 11: Proposed Part Layout

Phase two of our long-term solution adds computerization so that there is virtually a 100 percent guarantee that the correct grates are kitted with the correct ovens. This solution is more involved and costlier than phase one. However, since the two phases are not codependent, Viking could implement phase one and not phase two if they did not wish to spend additional funds on this project. It also involves reliance from suppliers and outsourced companies so it will take more time to implement.

Phase two of our solution is changing the color of the packaging strap on the grates. This will not only make it easier for the operator to see if the grates matched or if they have the right one, but the quality visual system would be able to signal the color difference and note if it is inaccurate. Viking receives the grates from a supplier. To change this color, they would have to contact their supplier. There would be no additional cost to change the color of the strap. After researching the vision system's capabilities, the team recommended yellow and black straps. The vision system compares contrast so black and yellow would be ideal. Also, this would allow the supplier to change only one of the boxes strap colors and not waste the yellow straps. The VGIC and VGR stations as mentioned in phase one would be labeled in these colors as well. Viking stated that they have a few months lead time on grates from the supplier, so it would take a while for the new grates and system to take place. Figure 12 illustrates the current yellow packaging strap for both the VGR and the VGIC grates.

Figure 12: Grate Packaging Strap Depiction

In addition to contacting the supplier about the new colored straps, Viking would also have to contact their quality visual system supplier and IT team. The team would have to reprogram the system to notice the different color straps and match them with the correct part numbers. This would include some professional fees but no significant investments. Figure 13 shows the vision system's view of the box straps in the package.

Figure 13: Visual System's View

With this system in place, there is little to no chance of the wrong grates being placed with a oven, saving Viking an estimated $117,000 annually. This would more than make up for the cost of implementing the solutions the team recommended in just the first year.

VIII. PREVENTION

Along with the implementation of our solutions, Viking could implement certain procedures to prevent further mistakes in this area and others. Manufacturers should never be satisfied and always focus on continuous improvement. Viking could also develop specific work instructions and reinforce operator training.

IX. CONCLUSION

In conclusion, the team recommended several ideas for Viking to implement in order to mitigate the chances of placing the wrong grates in with an oven and sending it to a customer. All of the solutions were immaterial costs compared to the money that they will save Viking. The lack of errors will also help keep Viking's image as a luxury brand.