

Example of defect elimination in the transportation of new cars using Toyota Business Practices for Improvement.

Ernesto L. Garcia C., PhD

2021

Summary: This is a brief example on the use of some Lean and Six-Sigma tools following the A3 process improvement methodology also known as *Toyota Business Practices* or TBP. Data and figures have been normalized for confidentiality purposes.

Genshi Genbutsu.

"It ain't the heat, it's the humility. Yogi Berra."

It was around 0400 Zulu time in this beautiful Caribbean port. The big barge, with an assorted quantity of new cars, was nicely docked and the increasing ambient humidity made me think of the challenge to work here in the middle of the day. The car manager arrived with a team of surveyors tasked with the inspection of new vehicles transported from the continental USA to their final destination in the Caribbean. It was the same lot of cars we inspected and loaded 5 days before in a US port. We were about to start *Genshi Genbutsu*.¹ *Genshi Genbutsu* reminds me that process improvement is like baseball.²

This exercise was going to be the "half physical" part of Yogi's quote: well advanced into the night, inside the dark and, briefly, cold steel hull of a very large barge, equipped with knee pads, halogen beams, helmets, eye protection, reflective vests, notepads, pencils, and very good Caribbean coffee during the breaks.

Clarify the problem.

"If the world were perfect, it wouldn't be. Yogi Berra."

The project started some days before at a corporate meeting with the VP of operations stating: "we cannot afford to have car *exceptions* no more. . . I want y'all to fix it." The VP of operations, our project sponsor³ wanted all cars without *exceptions* or defects.

A look at the data confirmed that the transportation process was deteriorating. Table 1 provides the percent of vehicles with one or more defects for the previous two years and 10 months before the start of this project. As can be seen, the percent of cars with defects just doubled.

Lawrence Peter "Yogi" Berra. American professional baseball catcher who later took on the roles of manager and coach. He is widely regarded as one of the greatest catchers in baseball history.

https://en.wikipedia.org/wiki/Yogi_Berra

¹ *Genshi Genbutsu* is Japanese for real location or real thing. In the context of process improvement it means *go and see*. This comes from the belief that, in order to truly understand a situation, one needs to observe what it is happening at the site where work actually takes place: the *gemba*.

² "Baseball is 90% mental. The other half is physical." Yogi.

³ In process improvement a project sponsor is usually a manager or executive that has high influence over the process under improvement. She periodically reviews the progress of the project, has authority to approve any financials needed for project completion, is aware of the problems and its implications from a strategic point of view, and can provide political clout for the process improvement team with her wisdom, knowledge, and authority within the organization.

Year	Shipped	With defects	% cars with defects
Two years ago	9,246	29	0.31
One year ago	10,121	36	0.36
Last 10 months	11,773	74	0.63

Table 1: Increase in the percent of cars with defects.

After the first meetings with the operations teams at both ports it became clear that we needed a better characterization of the process and operational definitions⁴ of the defects we were trying to eliminate. Also, members and managers of both teams believed that they were doing all humanly possible to eliminate defects with the tools and manpower at hand. The first meetings with the team were dedicated to get agreement and consensus on the following:

1. *Ultimate goal and responsibilities:* Provide our client with defect free quality transportation of vehicles in a timely manner.
2. *Ideal situation:* Zero defects in vehicles transported from USA to the Caribbean.
3. *Current situation:* The historical number of cars with defects is 0.63% and the team has very different hypotheses⁵ on the causes of these defects, as well as the method of calculation.
4. *Gap between the current and ideal situation:* With the data at hand we have 0.63% cars with defects and increasing. Permanent and sustainable action is needed.

⁴ An operational definition consists of three elements: A standard, a test, and a decision. During observation of the process, and conversations with managers and operators, it was evident that a common set of already stated industry operational definitions for defects needed to be refreshed, communicated, and used by all members of the operations team.

⁵ A hypothesis is a proposed explanation made on the basis of limited evidence as a starting point for further investigation.

Breakdown the problem.

"A baseball game is simply a nervous breakdown divided into nine innings. Robert Earl Wilson."

The team divided the process in four high level phases, as presented in Figure 1. Drivers from the Japanese manufacturer transported the cars from their facilities to the carrier's waiting area located inside the US yard. A team of surveyors registered all cars, inspected them for incoming defects, and prepared the cars for sailing. Once the cars were properly documented, and inspected, a crew of drivers moved the cars from the parking area into the barge. After sailing for about 5 days, the barge arrived at the Caribbean port where a local crew unloaded the cars and parked them in the inspection area. At the Caribbean yard a contractor from the Japanese car manufacturer performed a final inspection of the vehicles and uploaded the defects collected in a data base.

Robert Earl Wilson. American professional baseball pitcher. He played all or part of eleven seasons in Major League Baseball for the Boston Red Sox, Detroit Tigers and San Diego Padres, primarily as a starting pitcher.

[https://en.wikipedia.org/wiki/Earl_Wilson_\(baseball\)](https://en.wikipedia.org/wiki/Earl_Wilson_(baseball))



Figure 1: High level process.

Once the process was broken down, the team divided efforts observing the end-to-end transportation of vehicles during 45 days. The team was trained to record all defects incurred as well as other relevant process conditions⁶. Genshi Genbutsu and manual data collection was performed more than once across all steps of the process.

It was also agreed by the team that cars defective was not as good a measurement as classifying defects by their quantity, car make, type, size, and location. A summary of results for these 45 days of observation is presented in Figure 2.

⁶ Usually recording variation or changes in methods, personnel, environmental conditions, measurement systems, equipment fixtures and machines used for loading and unloading, as well as the car make.

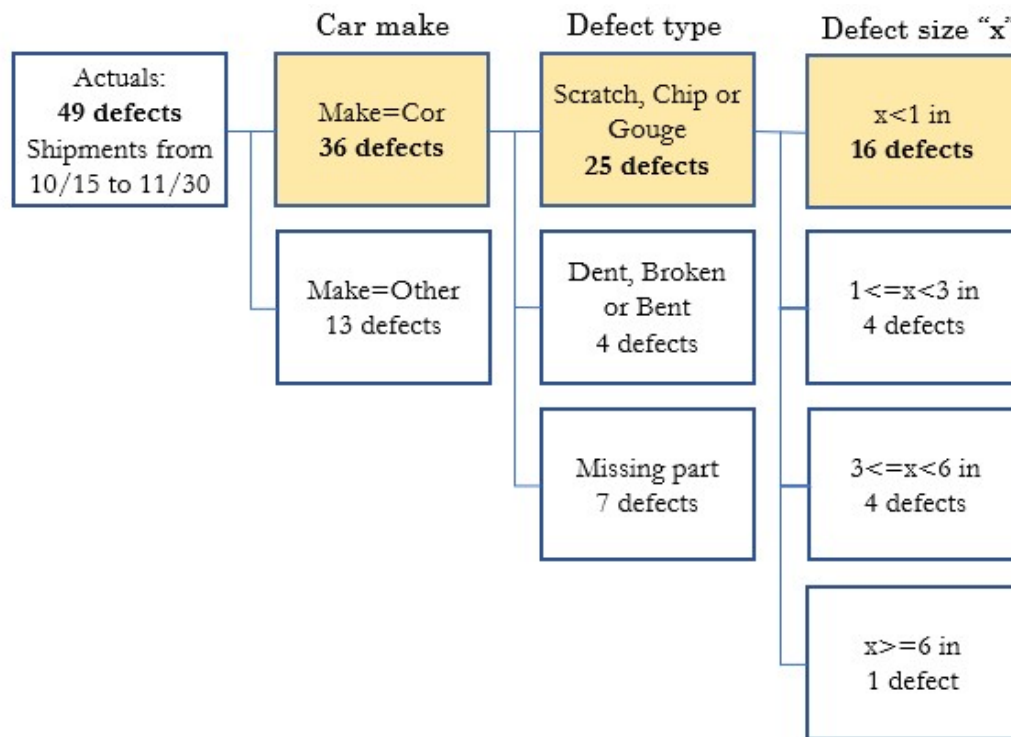


Figure 2: Breakdown of defects.

The occurrence of defects by car location concentrated on the front and rear bumpers, rocker panel and right front door edge, as presented in the concentration diagram on Figure 3.

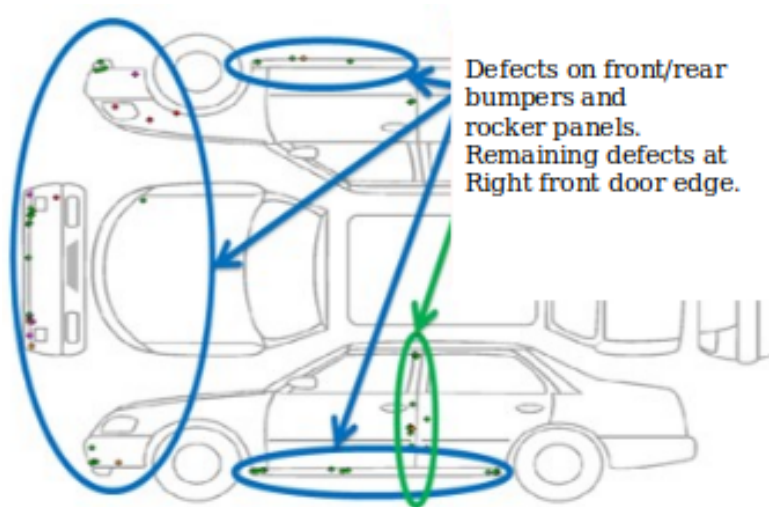


Figure 3: Occurrence of defects by location in the vehicle.

Selection of prioritized problem.

After collecting, summarizing and discussing data findings, the team defined a prioritized problem. See Figure 4.

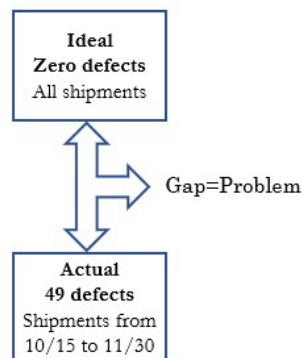


Figure 4: The gap is the problem.

And a 30 second speech, presented to the sponsor:

"Data collection and observations from 10/15 through 11/30 show that scratches, chips, and gouges of less than one inch appear mainly on vehicles of Cor make at the rocker panels and front bumpers as reported in our point of delivery at the Caribbean port."

Set the target condition.

"Just take the ball and throw it where you want to. Throw strikes. Home plate don't move. Satchel Paige."

Next step for the team and the sponsor was to make a measurable, concrete and challenging commitment for improvement: a *target condition* or goal. The team used SMART⁷ and stated the target condition as follows:

"The team will achieve a 50% reduction of defects at point of delivery during the next 4 months."

Perform root cause analysis.

"It's unbelievable how much you don't know about the game you've been playing your whole life. Mickey Mantle."

Up to this point all meetings had been remote, one-on-one or only with the members of one port physically present. During status reports with the sponsor it was noted that the expressed root causes of the problems were very different depending on the port personnel being asked. To promote joint root cause finding it was agreed to get all teams together. After applying 5 Why's⁸ a summary of root causes resulted:

1. Operational definitions on how to perform and interpret standards for defects were not uniform among the client's inspector at point of delivery, and the operation teams at each port.
2. The type of equipment, and lighting conditions, were not the same at both ports. Some inspectors used very potent halogen lamps capable of *showing the color of your socks when wearing Texan boots*, and others used *\$5 portable lamps not even good for night fishing in Florida during a Full Moon*.
3. The US team was not detecting the smallest defects in detail and, thus, differed dramatically from the inspection results at the Caribbean port.
4. A majority of defects that cars already had when entering the yard at the US port were not being segregated, and some were not corrected, from the defects attributed to the carrier's transportation process. This also explained the large discrepancy between defects collected at the ports and the quantity and cost of defects being billed by our customer.

Satchel Paige, American professional baseball pitcher. His career spanned five decades and culminated with his induction into the National Baseball Hall of Fame. A right-handed pitcher, Paige would sometimes have his infielders sit down behind him and then routinely strike out the side.

https://en.wikipedia.org/wiki/Satchel_Paige

⁷ A goal or target condition is SMART if it is: Specific, Measurable, Attainable but challenging, Relevant, and Time bound.

Mickey Charles Mantle, nicknamed *The Commerce Comet* and *The Mick*. Mantle played his entire Major League Baseball career with the New York Yankees. He was one of the greatest offensive threats of any center fielder in baseball history.

https://en.wikipedia.org/wiki/Mickey_Mantle

⁸ 5 Why's is an iterative interrogative tool used to explore the cause-and-effect relationships underlying a particular problem. The main goal of the tool is to find the root cause of a defect or problem by repeating the question "Why?". Each answer forms the basis of the next question. The *five* in the name derives from an anecdotal observation on the number of iterations needed to find the root cause. This technique is highly dependent on the facilitation skills of the team leader and the subject matter knowledge of the team members.

5. The combination of driving speed and ramp inclination during the unloading of cars at the Caribbean port sometimes generated contact of the car with the pavement.

Develop countermeasures.

"Catching a fly ball is a pleasure, but knowing what to do with it after you catch it is a business. Tommy Henrich."

The team developed the following list of counter measures:

1. Standardize inspections between the two ports reviewing and establishing the same process. Create new standard operating procedures and on-the-job training.
2. Utilize the same equipment and lighting conditions to inspect vehicles at each port. Acquire concave mirrors and flashlights with xenon bulbs.
3. Design and establish a process to communicate, review and feedback findings between the two ports. Create dynamic dashboards.
4. Review, re-design and implement process to correct all cars with defects coming to the US yard and eliminate the large discrepancy between defects collected at the ports and the quantity and cost of defects being billed by our customer.
5. Design and install a ramp with better slope at point of discharge. This to eliminate the possibility of cars hitting the pavement.

A detailed action plan establishing the what, who, when and where was developed by the team. Some countermeasures were temporary while waiting for the construction of permanent fixtures and systems.

See countermeasures through.

"The difference between the possible and the impossible lies in a man's determination. Tommy Lasorda."

The plan to implement countermeasures was managed by the team leader with weekly status reports to the sponsor showing progress, deviations from plan and corrective actions.

Changes were explained to port operators by all team members. Positive and negative feedback from the operators was considered and, more than once, modified the design of procedures, buying of equipment or re-design of fixtures.

Thomas David Henrich, nicknamed "The Clutch" and "Old Reliable", right fielder and first baseman for the New York Yankees.

https://en.wikipedia.org/wiki/Tommy_Henrich

Thomas Charles Lasorda. Professional baseball pitcher and manager. Managed Los Angeles Dodgers and was inducted into the National Baseball Hall of Fame as a manager in 1997.

https://en.wikipedia.org/wiki/Tommy_Lasorda

Monitor results and process.

"It ain't nothin' until I call it. Bill Klem."

Figure 5 shows the percent of cars with defects for 30 voyages after the implementation of countermeasures.

The number of cars with defects increased in two of the voyages due to liquids dropping on a group of cars. The team got together and establish new countermeasures to avoid spills in the future. The results presented a record of voyages without defects for the carrier company. The client was satisfied by the performance and agreed to have an increase in the transportation rates.

William Joseph Klem, known as the "Old Arbitrator" and the "father of baseball umpires". He worked 18 World Series, which is a major league record. Klem was posthumously inducted into the Baseball Hall of Fame.

https://en.wikipedia.org/wiki/Bill_Klem

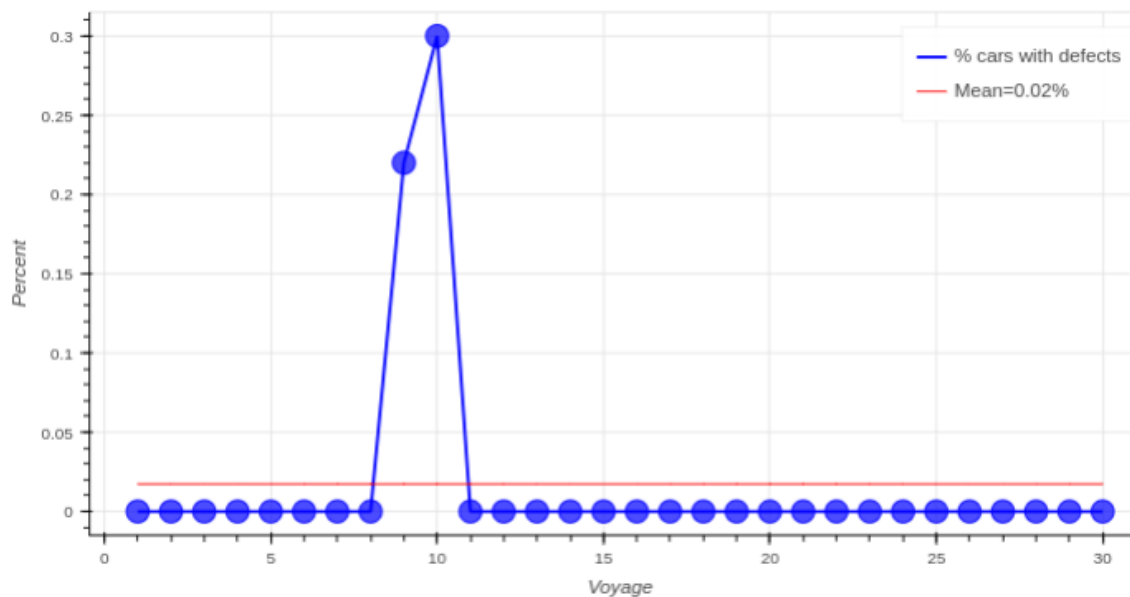


Figure 5: Results after improvements.

Standardize the better process.

"Early in my career, I decided I never wanted to get out of shape.

Carl Ripken."

The team made a final presentation of results to the sponsor, performed a project closing ceremony and prepared for *Yokoten*⁹, where the new standards for loading and unloading of cars could be extended to all ports and clients of the company.


Calvin Edwin Ripken Jr. nicknamed "The Iron Man". One of his position's most offensively productive players, Ripken holds the record for consecutive games played, 2,632, surpassing Lou Gehrig's streak of 2,130 that had stood for 56 years and that many deemed unbreakable. He was elected to the National Baseball Hall of Fame in his first year of eligibility with 98.53% of votes.

https://en.wikipedia.org/wiki/Cal_Ripken_Jr.

⁹ Yokoten is a Japanese word roughly translated as *across everywhere*. In process improvement it is used to mean "best practice sharing." Yokoten is used to transfer best knowledge and practices from one operation to another.

About the author

Ernesto L. Garcia C is Managing Director of Appaloosa Engineering LLC, a consulting company specialized in applied optimization, data science, and process improvement. Ernesto received a PhD in industrial engineering from the University of Missouri-Columbia. You can contact Ernesto at: gauchecolibri@gmail.com

 Except where otherwise noted, this work is licensed under <http://creativecommons.org/licenses/by-nc-sa/3.0/>