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Six Sigma: The Critical Link between Process Improvements and Business Results

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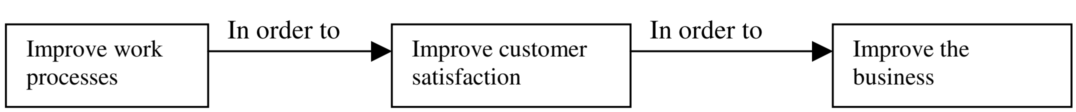
Six Sigma as a strategy is different from other conventional improvement programs in its focus on establishing relationships among business Y, customer Y, process Y, and inputs (Xs). We strongly believe that these important linkages should form the backbone for all Six Sigma projects.

We would like to present in this real-life case study how Tata Yazaki AutoComp (TYA), an automobile wiring harness assembly shop in Pune, India, turned to Six Sigma and achieved breakthrough results in delivery performance by focusing on the critical Six Sigma linkages.

Metric Linkage Model

TYA recognized that their wiring harness shop's delivery performance was the output of internal processes. To improve this output required improving the processes that generate the outputs. The Six Sigma team established a clear path: *Improve work processes to delight customers and, thereby, achieve business goals* (fig. 1).

Fig. 1 Relationship between internal processes and business goals



- In the **recognize and define phase**, we identified which processes/products to improve by considering *business Y* (measure of business goals) and *customer Y* (measures of customer satisfaction).
- In the **measure phase**, we translated the *customer Y* into individual *process Ys* (quality measures of the process output that describe the physical state of the output and are clearly linked to the customer Ys).
- In the **analyze, improve, and control phases**, we dealt with *Xs*. What are the causes of the undesirable condition of the process Ys? How can we counteract those causes? How can we keep these solutions in place over time to maintain the gains?

Fig. 2 Six Sigma metric linkage model[1]

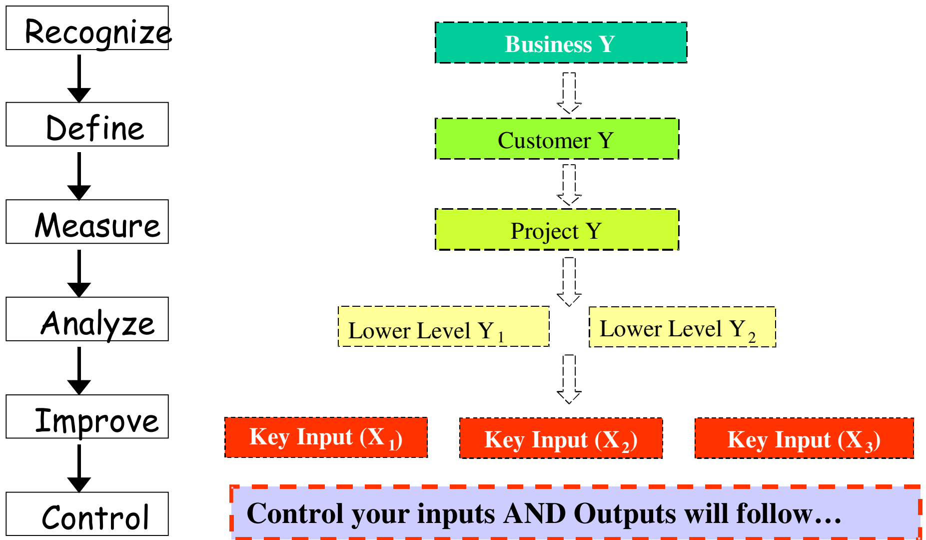


Figure 2 shows the different levels of metrics as they are linked in a Six Sigma roadmap. By controlling the Xs, TYA maintained the improved performance in the process Ys, which in turn improved business performance.

Our Improvement Journey Begins: Define and Measure Phases

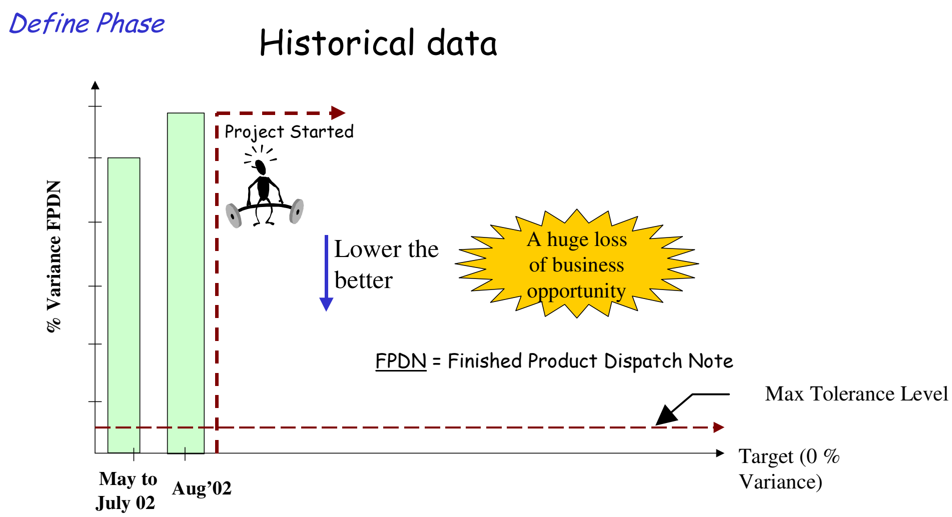
Define Phase: *Identify what's important to the customer and scope the project*

One of our customers was not satisfied with TYA's delivery performance.[2] This situation not only had a major effect on business performance but also resulted in loss of customer goodwill—a huge intangible. We embarked on our improvement journey with our Six Sigma armory in August 2002, forming a problem-solving team to thoroughly investigate and improve shortages in harness supplies.

Analysis of past performance portrayed a grim picture. We observed a wide gap between customer demand and TYA's delivery performance, causing loss of sales and customer dissatisfaction.

For example, in August 2002, about US $62,000 was lost in assured sales revenue. Figure 3 shows that the company lagged behind % variance[3] in FPDN (Finished Product Dispatch Note) to the customer. In other words, even with having the capacity to produce, TYA was producing far fewer harness sets than the customer was requesting, resulting in significant losses to the company. This troublesome situation also forced our customer to buy harnesses from another vendor.

Fig. 3 Customer Y[4]



The team found that two wiring harness models constituted more than 80% of the overall business for this customer. Hence, we decided to scope the project on these two models. Each model is supplied to the customer as a set, with each set being made up of three wiring harnesses–engine, main, and floor harnesses.

A **Statement of Work** (SOW) signed by the champion, process owner, team members, Master Black Belt (MBB) and Black Belt (BB) documented the problem statement, the project objective, financial benefits, project scope and boundaries, etc. The SOW also included a detailed project time line along with a signed time commitment from all involved in the project.

Measure Phase: *Establish a measurement system and quantify current performance*

The team realized that it would be difficult to address all of the issues (generic and specific) that would come up during the course of the project. Clear demarcation of starting and ending project boundaries helped us to maintain focus.

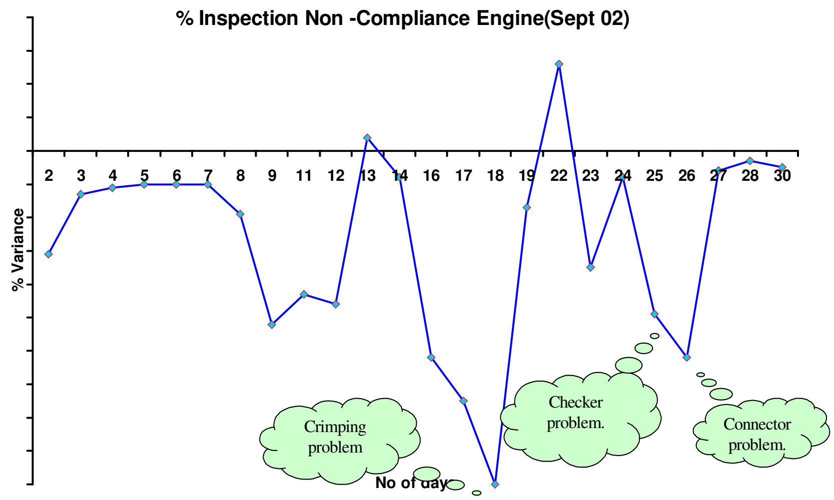
In the define phase we looked at the customer Y, i.e., the % monthly variance in FPDN. In the measure phase, we attempted to quantify the current performance of the three harnesses:

- Completed a high-level "as is" process map.
- Prepared "dashboards" to monitor daily production quantity against planned production for each of the three harnesses (Process Ys) that went into making a set for the two models.

- Initiated day-to-day monitoring for Process Ys.
- Began noting high-level causes (when actual production was less than planned production) on the individual dashboards.

Figure 4 shows a sample dashboard for one of the Process Ys (engine harness % non-compliance against production plan). These dashboards helped us to look critically at daily performance and thus formed an essential platform for discussions.

Fig. 4 Sample dashboard for harnesses



Analyze Phase: *Discover and verify the causes (Xs) of the undesirable performance in the Ys*

As daily monitoring progressed, the team started forming insights into different causes. We developed a comprehensive system to quantify the reasons for "sets lost" and conducted a detailed Pareto analysis of the high-level Xs (fig. 5) to focus on specific causes.

The team quickly realized that attacking each of the Xs in itself was a mini Six Sigma project. A process owner and team members were identified for each of these improvement projects. The MBB and BB started working with individual teams to lead them through the improvement cycle. Based on "sets lost" data, five different subprojects, as shown in figure 6, were initiated.

Fig. 5 Major areas of concern

(Based on Sets Lost for the Month of Sept and Oct)

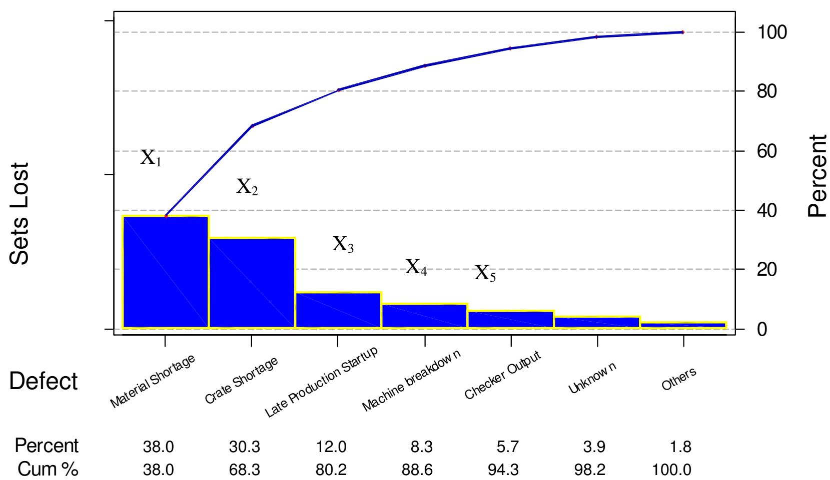
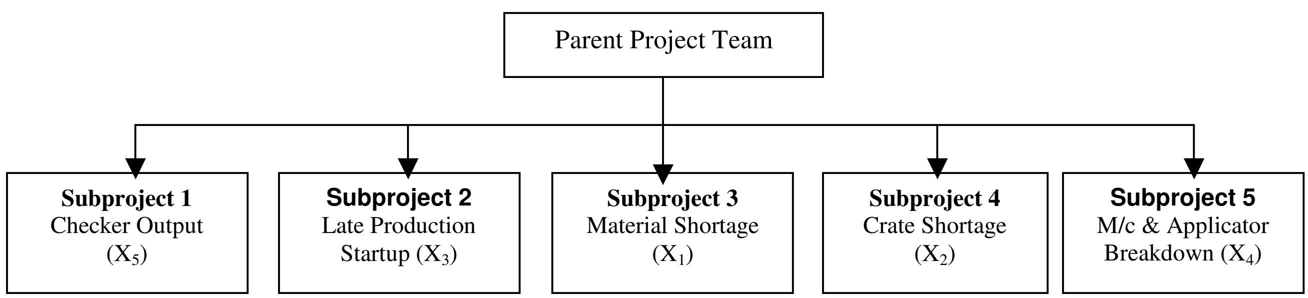


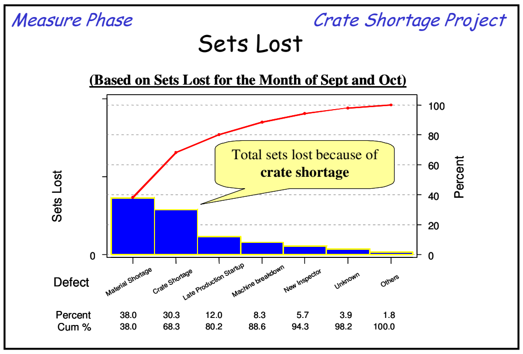
Fig. 6 Parent & subproject teams



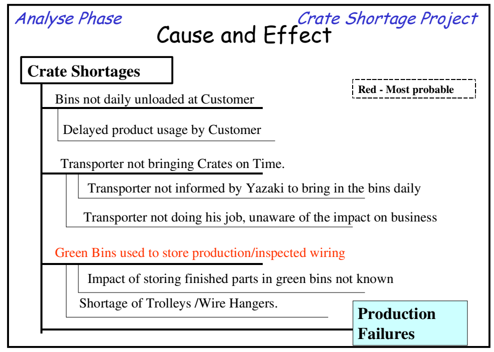
MAIC for Each Subproject (deeper analysis for each X)

Each subproject team started working on identifying subcauses for each project. For example, during analysis, the team quantified the total number of cumulative sets lost (recall figure 5) in the months of September and October due to crate shortage (X_2). The "Crate Shortage" team then brainstormed reasons and solutions for crate shortages. The diagrams in figure 7 illustrate in detail the Crate Shortage subproject improvement journey. By December 2002, the "sets lost" due to "crate shortages" were reduced to 0 sets.

Fig. 7 MAIC storyboard for Crate Shortage project



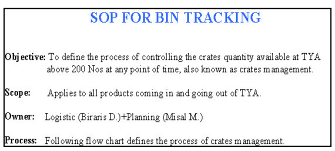
Measure Phase

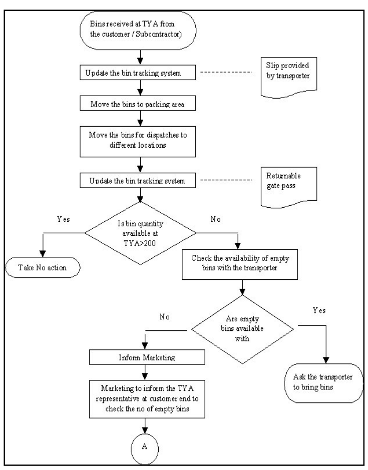


Analyze Phase

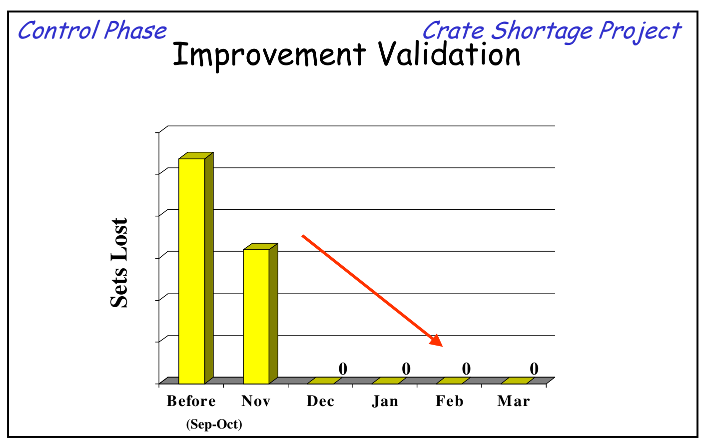
Cause	Action Item	When	Who	Support	Remark	Status
Crate Management Not in place	Develop a System to track numbers bin at the customer end and TYA		Maruti	Birarish		Complete
	Ask the transporter to bring empty crates everyday and explain him the criticality		Maruti			Complete
No proper calculation done on number of crates required	Calculate Additional crate requirements		Maruti			Complete
	Order new crates		Maruti			Complete
Green Bin used to store /inspect wiring harnesses	All green bins on shop floor to be tracked and replaced, transfer the blue bins. Green bins to be released	1-Feb	Maruti			Complete
Dirty Bins	Crates to be cleaned by regular house keeping personnel, confirm this option - Apurv	19th Feb	Maruti / Apurv	Rajiv Parashar		Complete

Improve Phase





Control Phase



Improvement validation

Similarly, as other subproject teams implemented counteractions with appropriate controls, the % FPDN variance (Y) started dropping from historic high values to closer to target values. Figures 8 and 9 both present the before and after comparison.

Fig. 8 Before and after performance (improvement validation)

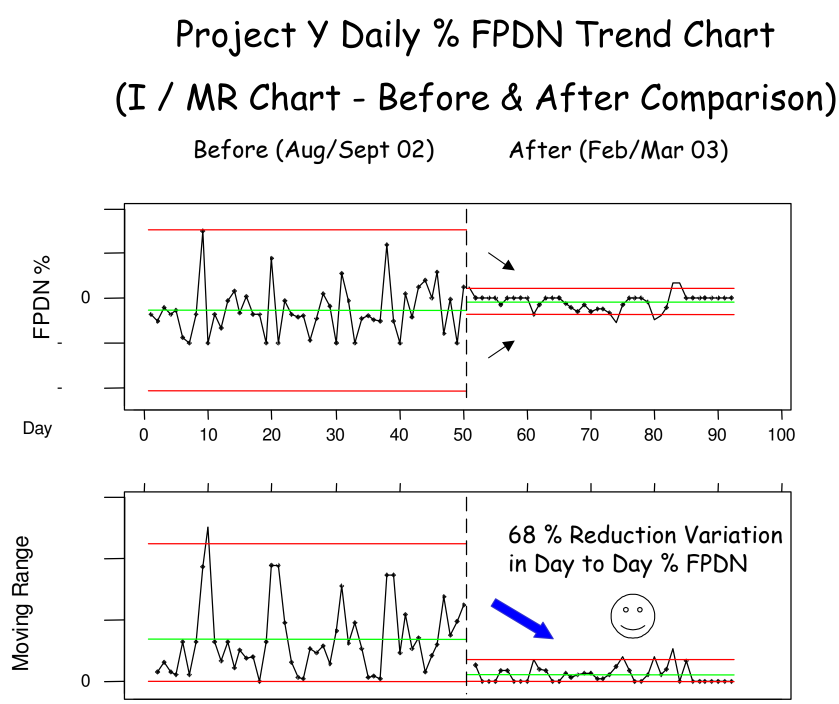


Fig. 9 Customer Y

Monthly % FPDN Non-Compliance

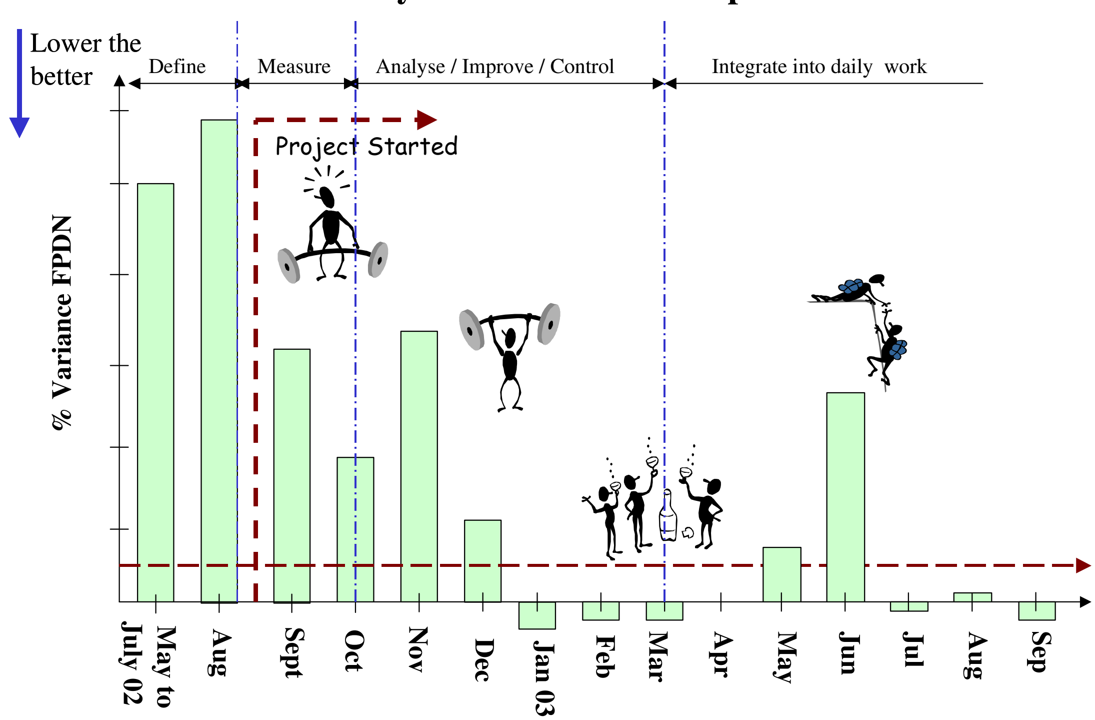


Figure 8 presents an I/MR chart showing daily % FPDN. As we can see, there was a noticeable variation reduction in daily FPDN variance between “before” and “after” figures. Also, the monthly % FPDN figures started showing dramatic improvements (see figure 9). TYA went from negative FPDN variances (i.e., shipping less than plan) to meeting the customer demand and shipping close to what the customer demanded. This had a huge impact on TYA’s bottom line.

Control Phase: *Put a plan in place to make sure problems stay fixed and sustain the gains*

Teams from each subproject wrote detailed control plans to hold on to their gains. For example, for the Crate Shortage project (shown in figure 7) a new detailed standard operating procedure (SOP) enforced a control mechanism for ensuring availability of the required number of crates at any given point of time in TYA.

The importance of the control phase cannot be over-emphasized. Without proper controls in place, any improved process can easily slide back to its previous performance levels.

The test of this came in May/June 2003 (the project was already three months into the control phase) when we noticed a quality problem with a vendor-supplied part that led to material shortages on the shop floor. As a result, % FPDN exceeded target levels for the months of May and June 2003. The team tackled the problem at the grassroots level with the help of the vendor, putting the project Y back on track from July 2003 onwards (fig. 9).

An important lesson was learned: *“Even after closing the Six Sigma project (with a traditional three-month monitoring period), the process owner and champion have to keep monitoring the dashboard and follow the control and corrective action plan meticulously to tackle any unexpected issues.”*

March of TYA from Dependence to Independence

This eight-month-long comprehensive initiative helped TYA to achieve about US $730,000 of additional sales for the current financial year. Also the team realized how each operation in the organization is linked to overall business operation (shown in figure 10). In other words, improving the Xs improved process Ys, which in turn resulted in huge financial gains for this company.

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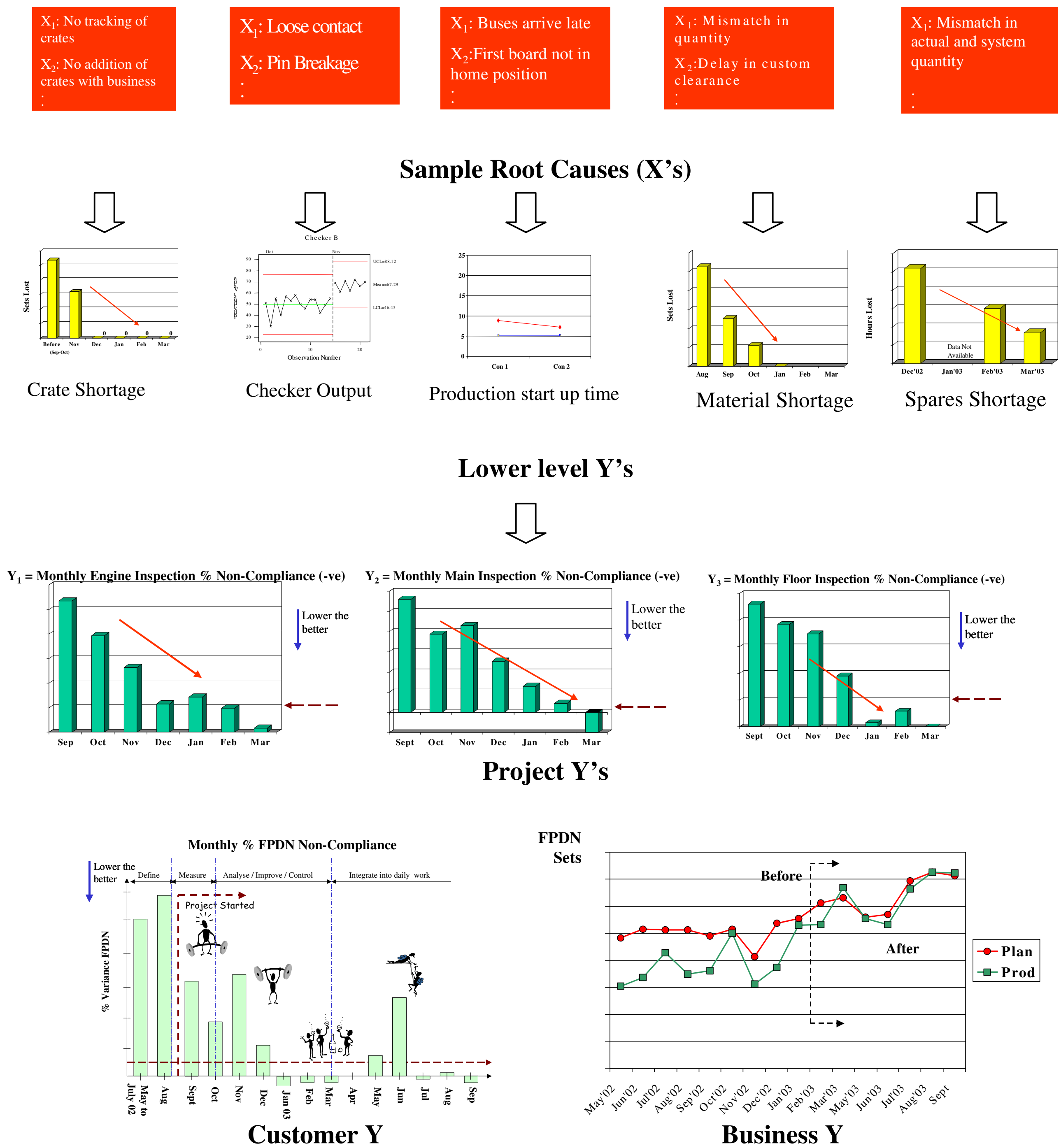
Fig. 10 Linkages between metrics



As corporate MBB/BB resources and TYA production manager (project champion), the authors facilitated and guided this crucial Six Sigma project. Since its success, TYA has begun to institutionalize Six Sigma, pursuing further quality and delivery performance improvements resulting in even better financial performance.

TYA is actively developing in-house Six Sigma expertise, training champions, Green Belts, and Black Belts to assist in the Six Sigma transformation from "corporate dependence" to "self-sustenance" or "independence." Time will bear witness to the efficacy and extent of this transformation.

Acknowledgements

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About TYA

Tata Yazaki AutoComp (TYA), a subsidiary of TATA Auto Components Systems (TACO), is a supplier of automobile wiring harness assemblies to many Indian and overseas customers. Major customers include Tata Motors, BEHR, Honda, General Motors, and Toyota.

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References

[1] Metric linkage model based on Johnson Controls Black Belt Training Program.

[2] To preserve business confidentiality, the specific identity of the customer involved in this case study and the actual delivery levels are not disclosed in this article.

[3] Variance is defined here as the gap in actual dispatch vs. planned dispatch expressed as a percentage of planned dispatch.

[4] The actual % negative variance of FPDN levels is not shown for business confidentiality reasons; however, we clearly were nowhere close to our target.