

## **A Needs Assessment on Quality Control and Performance Issues at a Manufacturing Company**

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*Tales from the Field, a monthly column, consists of reports of evidence-based performance improvement practice and advice, presented by graduate students, alumni, and faculty of Boise State University's Instructional and Performance Technology department.*

### **Company**

Company X (hereafter referred to as 'the company') is a manufacturing company that produces precision wire pins which are used primarily in the connector, transistor relay, and hydraulic industries. The company has 3 employees: the owner (referred to as E1), and two specialists who work with particular equipment, the machinist (E2) and the tumbler (E3). E2 and E3 have been with the company for relatively short periods of time. E1 is responsible for sales, quoting, inspection, quality assurance (QA), shipping and invoicing. E2 and E3 accomplish machining, inspection, quality assurance and shipping.

### **Performance Problem**

The current owner of the company plans to step down within the next year and invited our team to examine the manufacturing processes to help create job and task descriptions to aid in creating a succession plan that would assist in the transition to a new owner. However, during the initial discovery phase of the project, we became aware of monthly quality scorecards from a major client detailing a pattern of part rejections due to substandard quality. This presented us with an identified performance gap in quality control, which threatened sales and thus the sustainability of the company.

We determined that this gap in quality needed to be resolved before job descriptions could be written effectively and, in consultation with E1, agreed on the need to address the quality control (QC) issue before addressing other needs assessment topics.

### **Approach**

Our needs assessment incorporated elements of both a knowledge and skills assessment and job and task analysis (Gupta, Sleezer & Russ-Eft, 2007) and used Gilbert's Behavior Engineering Model (BEM) (1996) and Langdon's Language of Work (LOW) (2000). The BEM provided a framework for considering individual behavior and environmental issues, while the LOW model provided a means to consider factors such as clear communication and interdependency among employees and the effect of well-defined work processes. Langdon's LOW model was also used to help us extend our focus beyond individual and group performance to the whole organization in a systematic way. This aided us in identifying ways to ensure adequate communication between stakeholders so they could continuously act both tactically and strategically to align performance at all levels of this small business. It also

allowed us to identify gaps in performance so we could decide what interventions would be best. Finally, the LOW model allowed us to identify data and relationships between data which, in combination with systems-thinking techniques, allowed us to develop a detailed graphic called a Causal Loop Diagram (CLD) (Anderson & Johnson, 1997). With the CLD, we could visualize the dynamic relation between factors contributing to the QC problem.

In addition to the quality scorecards, we gathered and reviewed existing data which included the company QC manual. We also conducted semi-structured interviews with all three employees, and performed a series of on-site observations. Collected data was coded and placed into a BEM-like table and a LOW framework to identify commonly occurring factors and relationships between factors. When analyses of our initial data did not provide a reliable picture of the quality problem, we accomplished a second set of interviews and observations to dig deeper into factors that appeared to have impact on the identified problem. Analyses of these data enabled us to both confirm our initial analyses and identify new factors and relationships to better understand the causes of the quality problem.

## Findings

Through analysis we determined that the quality problem was caused by the interaction of three factors. First, the problem arose from inaccurate following of established production and QA processes that allowed parts to be manufactured outside the client's specifications. Second, the problem resulted from inaccurate or incomplete engineering drawings provided by clients. Third, the problem appeared when office duties pulled E1 off the production floor. Other factors related to gaps in E2's and E3's knowledge, skill and confidence in performing QC duties contributed to identified problems, but only when E1 was pulled off the production floor. We also discovered that demands on E1's time increased after the departure of one office staff member who had handled the majority of sales and quoting duties. This departure was especially difficult because nobody else in the company was familiar with those duties, or of the organization of the front office.

As indicated above, as a product of our data analyses, we were able to convert empirical data into a Causal Loop Diagram which highlighted relationships between the owner's decreased line presence, gaps in employee's knowledge, skill and confidence, and how these factors contributed to decreased accuracy and quality, and ultimately the rejection of product by clients.

A Causal Loop Diagram is a systems-thinking tool that illustrates the dynamic interrelationship among variables within a system and the effects of those interrelationships. Our CLD consists of two loops. To read Figure 1, begin in the center box, "E1 Workload" and follow the directional arrows. The "s" notation refers to a direct or "same" relation between factors (as one factor increases, so does the other factor), the "o", refers to an inverse or "opposite" relation (as one factor goes up, the other factor goes down, or vice versa). For example, the factors named "E1 Workload" and "E1 Time on Floor" are connected by an "o", meaning that as one factor increases, the other decreases. Reading this part of the diagram as a statement, we would say "As E1's workload increases, his time on the floor decreases".

Additionally, as noted at the right side of Figure 1, the direct relation between “E2 and E3 working independently” and “Coaching/OJT of E2 and E3” is not an immediate effect, but rather a delayed effect that occurs gradually rather than immediately.

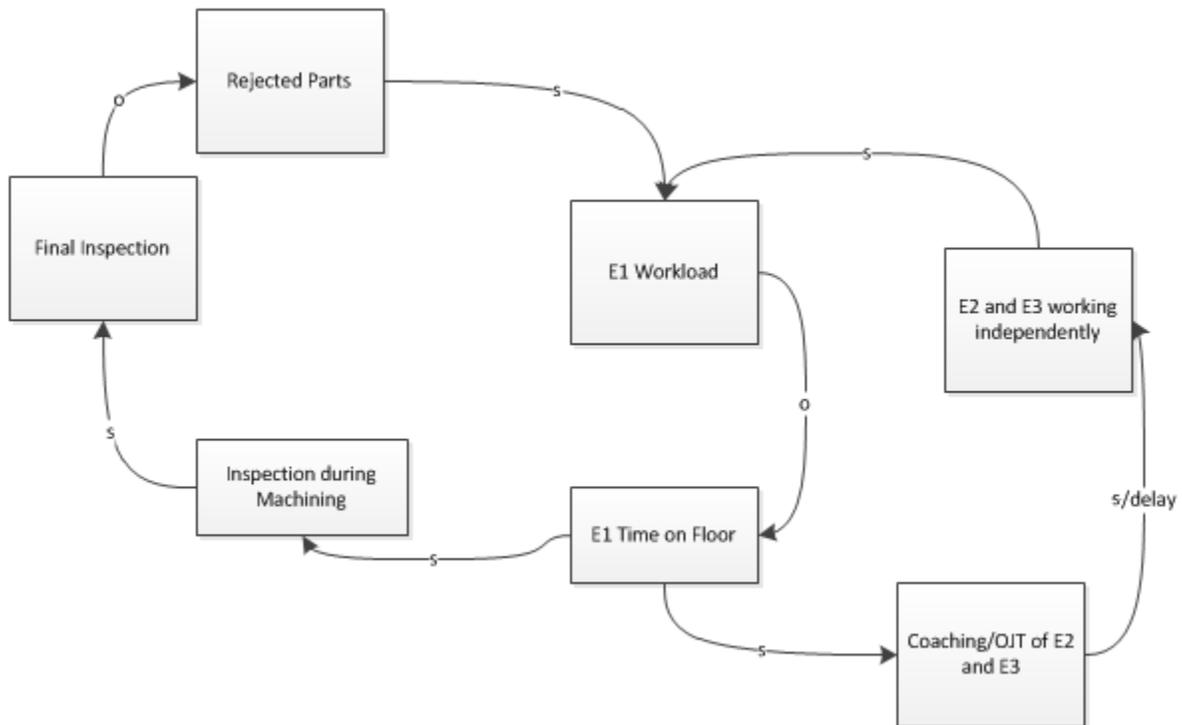


Figure 1. A causal loop diagram depicting the QC problem.

As his workload in the company increases, E1's inability to be in two places at once (in the office and in the shop) appears to be the root cause of many of the quality issues. These competing demands on E1's time could be traced to a single event – the loss of competent office support staff. However, even if adequate support staff were available, due to their relative inexperience in the company, it is still the case that E2 and E3 have not yet achieved full autonomy on the shop floor. Both of these factors make strong demands on E1's time in two different parts of the company.

If E1 were able to spend more time with E2 and E3, he could provide on-the-job training in knowledge and skills that would enable them to become more independent, and in turn to develop greater confidence. This would have the effect of returning more time to E1, so he could focus on overall production and operational issues including quality control checks at the required frequency. Considering the organization in terms of Langdon's LOW allowed us to see that E2 and E3 *are learning* to become autonomous in addition to being competent machinists, but at a slower rate than expected due to E1's need to be away from the shop floor to handle office work.

## Recommendations

We provided the company with the following recommendations:

1. Hire an additional person to handle office duties. Until a new office person is hired, schedule E1's office work to be done after shop production hours. This will allow E1 to focus on production and quality control, and offering coaching/OIT when E2 and E3 are at work.
2. Develop job aids to help E2 and E3 make the most common production and QC decisions that would otherwise require E1's greater expertise.
3. Take steps to ensure that production and QC processes are implemented as established in the internal production manual.
4. Take steps to ensure compliance with in-process inspections and record-keeping at required intervals; ensure that records are entered on the job card and add in-process information to the final inspection report.
5. Implement a verification step upon receipt of all orders to ensure that engineering drawings and specifications provided by the client reflect actual job requirements.

## Lessons Learned

Members of our needs assessment team came from diverse backgrounds and experiences. However, in the end, we took away many of the same lessons from this consulting experience. First, rely on systematic data collection and thorough analysis of empirical data rather than gut-feelings. If we don't make data-based decisions as HPT professionals, we are not working to truly solve problems, and we leave improvement to chance. On the surface, this may seem commonsensical, but in our professional lives we recognized that we often make some emotional investment in a situation where we feel we "know what the problem is", and this sometimes takes the place of being data-driven. Second, stay open to what the data is telling you, and use appropriate tools to help you. In our project, we saw many different possibilities and ultimately reached understanding of the system by applying models and frameworks that allowed us to analyze and synthesize our data. Because we followed the data, we were then able to prioritize issues and focus on interventions that promised the most impact for the client. Third, avoid dependence on a single model, framework or theory. If your data does not dovetail with your favorite model, experiment with other models to see if they allow you to identify and verify causal relationships. Lastly, while they may be common, training interventions are not the only possible solution. Keep an eye on environmental factors and the interrelationships between factors to help you identify causes and interventions which will have the most impact.

## References

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