Quality Management in Printing

by Dr. Jerry Waite

UNIVERSITY of HOUSTON
The “Legal” Definition of Quality Printing*

- A *True Reproduction* of the original
- Problems with this definition
  - What does “true” mean?
  - What if there is no original?
  - What if the original cannot be accurately reproduced?
  - What if the original is NOT to be exactly reproduced?

- Instead, quality should be defined in terms of how well a printed product meets the client’s needs.

* Source: Don Piercy, PIGC
Quality Vs. Measurement

- **Quality** is a subjective term related to how well a printed product meets its stated objective – it’s more “feel” than “measure."
  - If a product does its job, it can be called a “quality” product
- **Measurement** of print variables is objective
Printers and buyers need a framework of quality expectation levels to accurately communicate with each other.

- Not every job must be "perfect."
  - Perfect jobs do not exist
    - There would be no variations on any copies
  - "Nearly perfect" jobs cost too much for many applications.
Agenda

- What is Quality?
- What is Variability?
- What are the Print-Quality Variables?
- Relating Variability to Levels of Print Quality
- Deming’s 14 points
How do People Define Quality?

- **PRINCIPAL DEFINITION** – meeting or exceeding the needs and expectations of the customer the organization serves.

- **OTHER COMPONENTS**
  - perfection – a goal to be sought
  - elimination of “weak links” – everyone must be involved in improving processes so that quality can be improved
  - the outcome of a series of quality-conscious steps
  - a philosophy of living and working in organizations emphasizing the relentless pursuit of improvement
Implications of the Definition of Quality

- Quality can vary from one job to another.
- A central task of quality management is to constantly define quality in terms of the job at hand.
- Quality is a result of thoroughly understanding who the organization’s clients are and what they need/want.
Three Central Principles of Quality Management

- The most important part of any organization is the people it serves.
- To attract new clients (and hold existing ones), you have to satisfy their needs.
- You can’t satisfy their needs unless you know what their needs are.
Determining the Client's Needs

- The client and the printer do not necessarily view print-quality in the same terms.
- Clients may need assistance in determining their print-quality needs.
Start at the Beginning

- What is the function of the printed product?
- How long must it last?
- Who will read it?
- What is the intended message?
- What is the budget?
- What image does the client wish to portray?
Suggested Print-Quality Levels

- **Basic**
  - Single color memos, circulars, etc..

- **Good**
  - Single- and multi-color books, magazines, direct-mail advertising

- **Premium**
  - Better catalogs, annual reports

- **Showcase**
  - Annual reports, art books, printers’ sales literature
Once the buyer and printer agree upon the level of quality to be attained, acceptable variations in print quality variables can be defined.
What are Variables?

- An attribute or characteristic of some person or object that can differ from object to object or person to person.
- No two things are exactly the same
  - the length of automobiles
  - the weight of humans
  - the ink density on a press sheet
- Variables can be measured and recorded
  - length of cars can be measured in feet or meters
  - weight of humans can be measured in pounds or kilos
  - ink density can be measured in density numbers
Recording Measurements of Variables

- **Sampling**
  - Must have method to measure
  - Workers must know how to measure (using appropriate tools)

- **Record measurement on control chart**
Making Sense of Variable Measurement

- **Mean** – average measurement
  \[
  \bar{X} = \frac{x_1 + x_2 + x_3 \ldots x_n}{n}
  \]

- **Mode** – most often occurring measurement

- **Median** – the middle measurement
How Much Variation Occurs?

- Variability is the range of measurements from high to low.
- Frequency of each measurement can be graphed on a bar graph or smoothed into a "standard curve."

![Histogram and bell curve diagram]
How Much Variation is Normal?

- Variation from “average” is common.
- If something is slightly different than average, it can still be considered normal.
- “Average” variation is called “Standard Deviation.”
Enter the measurements of a given variable into a spreadsheet or calculator to determine the value of the Standard Deviation.

\[
\text{Standard Deviation} = \sqrt{\frac{\sum x^2 - (\sum x)^2}{(n - 1)}}
\]
Standard Deviations

- Curves of large vs. small amount of variation
About 97% of all measurements will fall within a range of ±2 standard deviations from the mean.

Mean + 2 standard deviations is the “Upper Control Limit.”

Mean – 2 standard deviations is the “Lower Control Limit.”
Causes of Variation

- “Common” causes are a result of flaws in the process.
- “Special” causes are a result of out-of-the-ordinary occurrences.
Common Causes

- Improvement requires constant process improvement.
- Variations that occur as a result of common causes are not the fault of the employee.
- Measurement of these variations fall within ±2 standard deviations from the mean.
Special Causes

- Improvement requires isolating the cause and applying a “one-time” fix.
- Measurement of these variations often fall outside $\pm 2$ standard deviations.
Limiting Variation

- Stop blaming workers for common causes – improve the system
- Applying a one-time quick-fix to a common cause results in increased variation.
- Treating a special cause as if it were a common cause wastes the organization’s time and money.
The real goal is to limit variability by decreasing the standard deviation. This requires constant process improvement. Before and after curves.
Within the printing industry, a product with a higher “quality-level” will have less variation than one with a lower “quality level.”
What are the Print-Quality Variables?

- Register
- Density
- Screen percentages
- Dot gain
- Color Match
- Halftones
- Separations
- Minor flaws
- Coatings
- Finishing
Register

- How well the images align with one another and to the sheet
- Variation caused by problems with press front stops, side guide or grippers
- Tools: Register marks and magnifier: measure variation in thousandths of an inch or millimeters
  - Avoid subjective terms like “hairline” or “two rows of dots”
Quality-Levels and Register

- **Basic:** $\pm 0.015''$
- **Good:** $\pm 0.010''$
- **Premium:** $\pm 0.005''$
- **Showcase:** $\pm$ no variation
Density

- Darkness of the printed ink layer measured in logarithmic numerals
  - a density of 1.00 means that 1/10 of the light striking an area is returned
  - a density of 2.00 means that 1/100 of the light striking an area is returned

- Variation caused by amount of ink or water fed to plate
Variations can be overall or specific to given areas
- the entire sheet can be too light/dark
- certain areas may be too light/dark
- some sheets may be darker/lighter than others

Tools: Densitometer and color patches

Appropriate density numbers vary by color and by job.
- Yellow: ± 0.90; Cyan and Magenta: ± 1.40; Black: ± 1.60
Quality-Levels and Density

- **Basic:** ± 7% variation from established density numeral
- **Good:** ± 5% variation from established density numeral
- **Premium:** ± 3% variation from established density numeral
- **Showcase:** ± 1% variation from established density numeral
Screen Percentages

- Percent of printed area covered by dots
- If you specify a screen tint of 20%, you shouldn’t get 30%!
  - Some variation is likely, due to dot gain
- Variations caused by errors in imagesetting, stripping, platemaking and presswork.
- Tools: Densitometer (dot area function), color patch, printed screened area.
Quality Levels and Screen Percentages

- **Basic:** $\pm 10\%$ from nominal percentage
- **Good:** $\pm 5\%$ from nominal percentage
- **Premium:** $\pm 2\%$ from nominal percentage
- **Showcase:** no variation from nominal percentage
Dot Gain

- Enlargement of printed dot due to application of pressure and effect of rubber blanket.
  - All offset presses gain – and they all gain somewhat differently
    - range from 5% for sheetfed printing to 40% for webfed on newsprint
    - presses in poorer mechanical condition usually gain more than those in good condition
  - Allowances for dot gain should have been built into the separations and proofs
Dot Gain

- Dot gain is predictable and not a flaw if the printer makes proper allowances
  - Gain in excess of allowance results in a too-dark image
  - Dot gain should remain the same throughout the run
- Tool: GATF Star Target (often included in color patches) visually depicts the extent of dot gain.
Dot Gain

- Percentage of dot gain can be calculated by comparing the dot on the plate with a corresponding dot on a press sheet using a densitometer (dot area function).
Quality-Levels and Dot Gain

- Basic: ± 10% from nominal percentage
- Good: ± 5% from nominal percentage
- Premium: ± 1% from nominal percentage
- Showcase: <± 1% from nominal percentage
Color match

- Comparison of the printed sheet to the proof and/or swatch book.
  - Do not compare a press sheet to a computer monitor
- Applies to both flat (spot) color and process color
Variations occur when
- the wrong ink color is put onto the press
- when a PANTONE color is incorrectly mixed
- when a PANTONE color is incorrectly simulated with process inks
- dot gain
- color viewed under incorrect lighting
- paper alters perceived color
Color match

- Tools:
  - Color swatch book (PANTONE, etc.)
  - Contract proof (one that is made from the negatives) such as Match Print
  - GATF/RHEM light indicator
  - Photo Spectrometer

- Be absolutely sure to compare colors under controlled lighting conditions (5000 °K)
Quality-Levels and Color match

- Basic: Slight perceptible differences
- Good: Just noticeable differences
- Premium: No perceptible differences
- Showcase: No measurable differences
Halftones

- Reproduction of single color (usually black and white) pictures

- Quality variations due to:
  - density differences inherent in the printing process – ink is not as black as silver
  - errors in scanning, halftone photography, platemaking, dot gain
  - surface and absorbency of the paper

- Tools: densitometer, magnifier, proof
Halftones

- **Measure halftones using densitometer**
  - Measure density of darkest area and density of lightest area
  - Subtract lightest area density from darkest area density. Result is density range.

- **Inspect halftone dots with magnifier**
  - Inspect edges of halftone dots: they may range from fuzzy to sharp

- **Compare shadow areas to the proof— are shadow dots clean or plugged?**
Quality-Levels and Halftones

- **Basic**: Density range = 0.90; no shadow detail; slightly fuzzy dots
- **Good**: Density range = 1.20; some shadow detail; sharp dots
- **Premium**: Density range = 1.50; full shadow detail; very sharp dots
- **Showcase**: Density range = 1.80; almost match original prints
Separations

- Calibrated sets of halftones designed to simulate full color photographs
- Quality variations due to:
  - density differences inherent in the printing process – ink is not as black as photographic dyes
  - errors in scanning, platemaking, dot gain
  - color, surface and absorbency of the paper
  - ink colors
  - trapping (ink sticking to previous color)
Separations

- **Tools:** densitometer, proof, GATF/RHEM light indicator, magnifier

- **Measure separations using densitometer**
  - Measure density of darkest area and density of lightest area
  - Subtract lightest area density from darkest area density. Result is density range.

- **Inspect halftone dots with magnifier**

- **Compare print to proof under controlled lighting conditions**
Quality-Levels and Separations

- Basic: Not applicable
- Good: Pleasing color; density range 1.20
- Premium: Almost match transparencies; density range 1.60
- Showcase: Almost match product or scene; density range 2.00
Quality-Levels and Minor Flaws

- Include scumming, setoff, hickies, smudges, wrinkles, doubling, slurring, or any other visual defect
- Basic: On maximum of 10% of the sheets
- Good: On maximum of 5% of the sheets
- Premium: On maximum of 2% of the sheets
- Showcase: On 0% of the sheets
Varnish, UV, film laminates should have no cast (discoloration) and should not peel, blister or cause curling

- **Basic**: Not applicable
- **Good**: Uniform, slight cast and flaws
- **Premium**: Uniform, no cast or flaws
- **Showcase**: Uniform, no cast or flaws
Quality-Levels and Finishing

- Accuracy of die cuts, drills, folds, trims, scores and perfs.
- Measure with an accurate ruler
- Basic: $\pm \frac{1}{16}$
- Good: $\pm \frac{1}{32}$
- Premium: $\pm \frac{1}{64}$
- Showcase: $\pm \frac{1}{64}$
A Quality-Oriented Management Philosophy
Deming’s 14 points

1. Create consistency of purpose toward improvement of product and service.
2. Adopt the new philosophy.
3. Cease dependence on inspection to achieve quality. Build quality into the product in the first place.
4. End the practice of awarding business on the basis of price tag. Move toward a single supplier for any one item – based upon loyalty and trust.
Deming’s 14 points

5. Improve constantly and forever the system of production and service to improve quality and productivity.
6. Institute training on the job.
7. Institute leadership. The aim should be to help people and machines to do a better job.
8. Drive out fear, so everyone may work effectively.

10. Eliminate slogans, exhortations, and targets for the work force. Errors caused by common causes are due to the system, not the fault of the employee.

11. Eliminate quotas, management by objectives and goals. Substitute leadership.

12. Remove barriers that rob the worker of pride of workmanship.
Deming’s 14 points

13. Institute a vigorous program of education and self-improvement.
14. Put everybody in the company to work to accomplish the transformation.
Summary

- While quality is a subjective term, measurement is objective.
- Quality expectations can be defined through descriptive labels called quality levels.
- Acceptable levels of variation in each printing variable can be assigned to each quality level.
Summary

- Such a scheme will help designers decide how critical to be for various jobs.
- Such a scheme will help printers meet the needs of their clients.
Where to Get More Information

- *Getting it Printed* by Mark Beach
- *GATF Test Images for Printing* Book
- *Quality and Productivity in the Graphic Arts* by Miles and Donna Southworth

- Equipment manufacturers
  - Scanners
  - Imagesetters
  - Proofing
  - Presses