Achieving 5 Nines
Business Process Reliability
With Barcodes

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Introduction

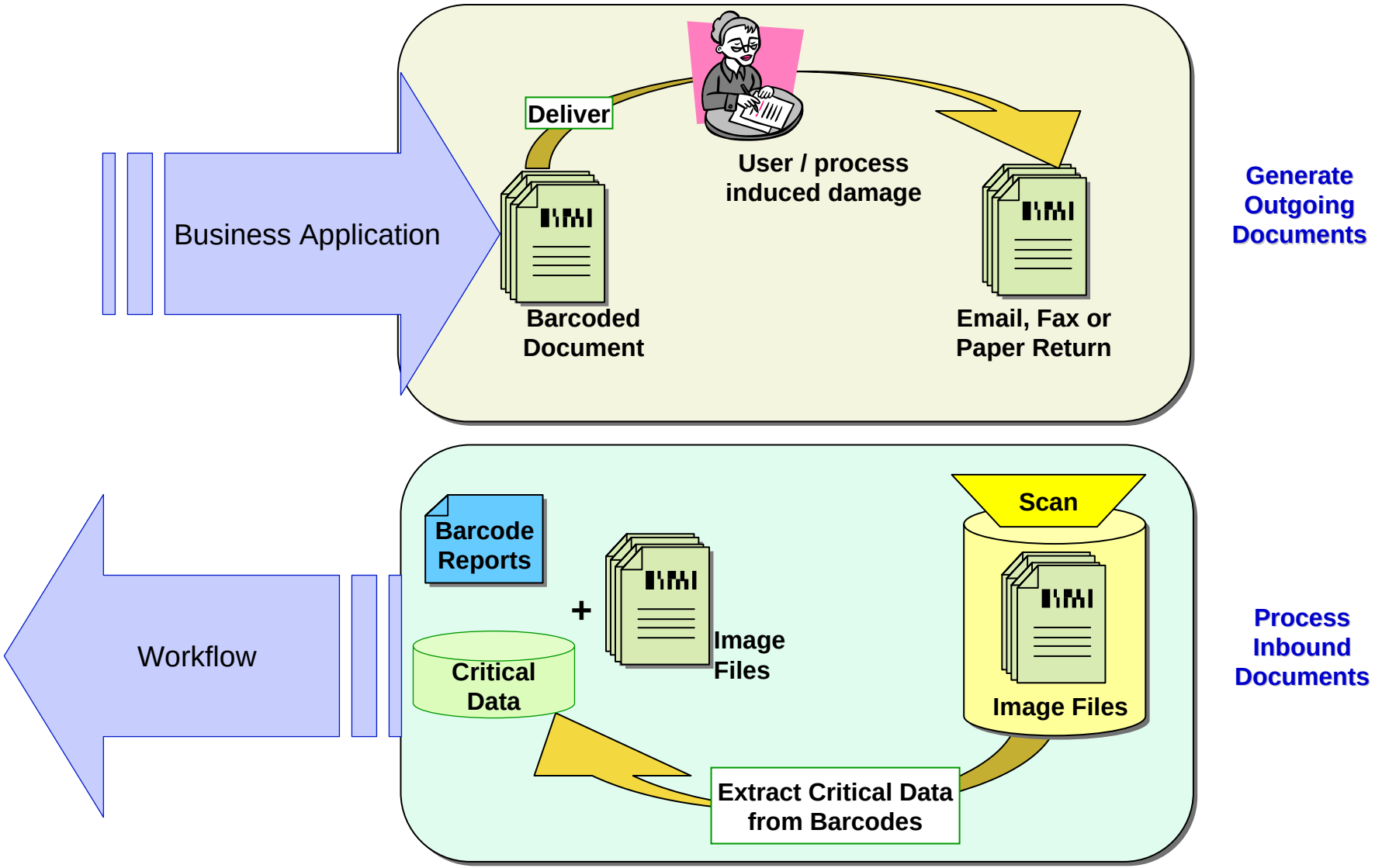
- All workflows rely on critical data to trigger and direct the workflow
  - Examples: customer ID, page No, contract No, agent ID, name, address, date.
  - These fields drive the indexing, routing or database updates in other applications

- Why barcodes are the solution
  - Barcodes are optimized for recognition by computers
  - They contain the most information in the least amount of space

- Best practices to achieve reliability
  - Inlite's nearly 20 years of experience can contribute to your success
  - Follow along to learn how to create ultra reliable processes

- Misconceptions about barcodes
  - There are many
  - Don't fall into the trap

Barcode Based Business Cycle



Typical user questions

- What barcode to use?
  - So many choices – Code 39, Code 128, PDF417, Data Matrix, UPC, 2of5,
- Where to put it?
  - Top, bottom, sides, any open area, special zone ?
- How big to make it?
  - Is it too small?
  - It looks too big?
  - Seems to fit – go with it
- Why can’t I read it?
- What is the impact of doing it wrong?

Critical Data in Workflows

- Accurate recognition of critical data drives reliable imaging workflows

- Why? Examples include:
  - Waybill tracking numbers
  - Faxed insurance applications need account numbers
  - Legal documents use unique ID on each page to make sure all pages are present.
  - Patient identification on medical forms
  - Cover pages with unique batch or transaction code
  - Smart forms contain multiple entry fields

- You definitely don't want to read them wrong!!!
  - That's worse than not reading them at all
  - But that's what can happen with OCR

What is Reliability?

- Related to the number of failures to correctly read critical data from an image
  - It is actually 100% minus the sum of those failures

- Typically expressed as a number of “9s”. For example:
  - 1 failure out of 100 pages is 99% reliability – two 9s
  - 1 failure out of 1,000 pages is 99.9% reliability – three 9s
  - 1 failure out of 100,000 pages is 99.999% reliability – five 9s

- Customers who plunge into this process usually fail to achieve even 1 9
  - Their error rates are often in the 20% or worse rate
  - They think that this is “just the way it is”

- Wrong!!!
  - Inlite strives for 5 9’s
  - Inlite customers usually achieve 3 9’s or better
  - That means 99.9% reliability

Cost of Low Reliability

- We all know that high reliability has a price.
  - **What about low reliability – what does it cost?**
- Consider the impact of recovery from errors
  - Interrupt workflow
  - Find them in the stack and correct misfiles
  - Rescan or Manual data entry
  - Reorganize archives to remove error items
- How much can it cost?
  - Let's assume average of 5 minutes per item, $24/hr for the Tech
  - Annual Cost of reprocessing shown below

Success Rate	90%	99%	99.9%	99.999%
Pages per day **1,000**	$44,000	$4,000	$440	$4.4
10,000	$440,000	$44,000	$4,000	$44
100,000	$4,400,00	$440,000	$44,000	$440

Why barcodes?

- What alternatives exist to enter critical data?
  - Human operator data entry
    - Fairly reliable (with double key entry) but expensive.
    - Offshore data entry presents security concerns.
    - Very slow
  - Optical character recognition (OCR)
    - Low reliability
    - Complex to setup and program
    - Slow
  - Barcodes
    - Reliable (can achieve 99.999%)
    - Inexpensive
    - Fast

- The only purpose of barcodes is to reliably acquire critical data to drive a business process

Major public domain symbologies

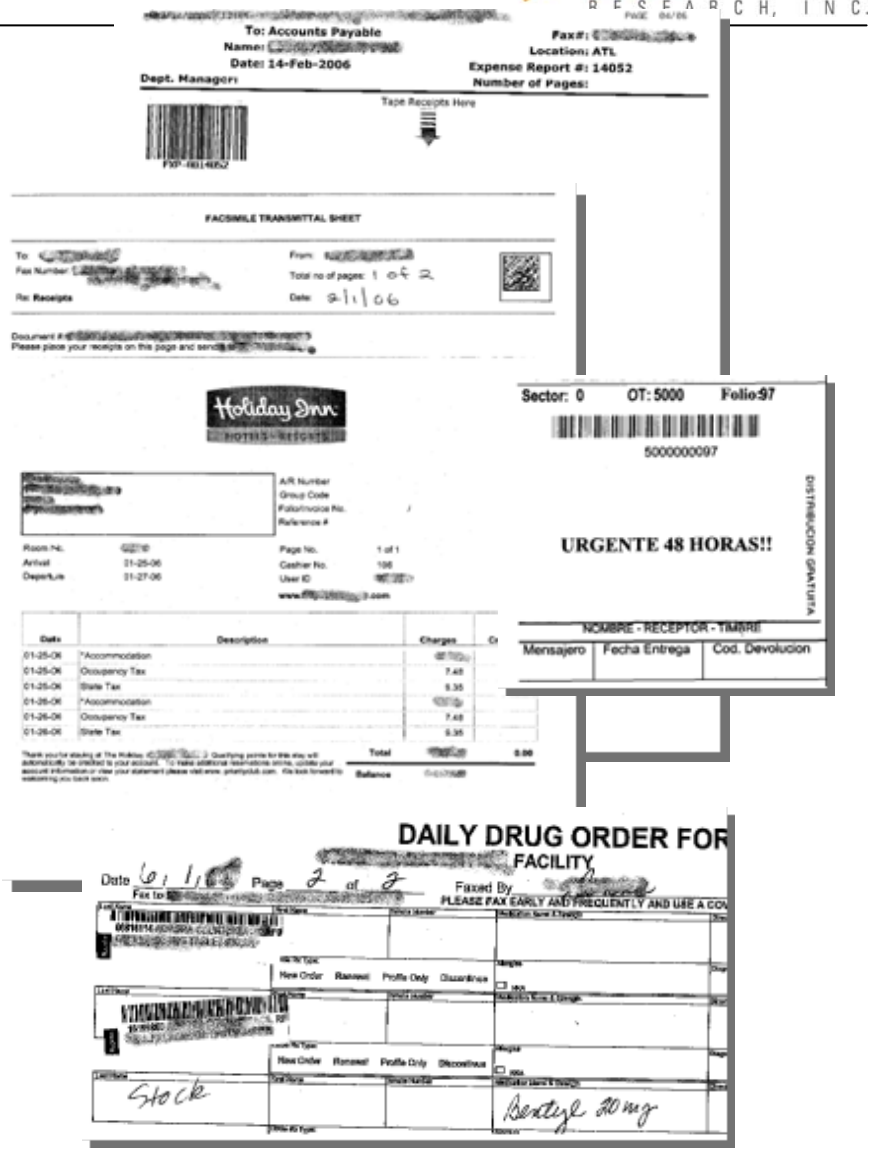
- 1D – Code 39, Code 128 and others

- PDF417 - Logistics, ID cards, Driver Licenses

- DataMatrix - Postal Services, legal docs, Cover Pages

Common Applications

- Cover pages
  - Batch separators for scanning
  - Routing documents,
  - e.g. expense reports, invoices
- Document (and page) identifiers
  - Track each page of contract
- Document or Check security
  - Encrypted, private data fields
- Inventory
  - Reorder SKU's,
  - Refill prescriptions
- Smart Forms
  - Barcodes carry multiple data fields
  - Database on a sheet



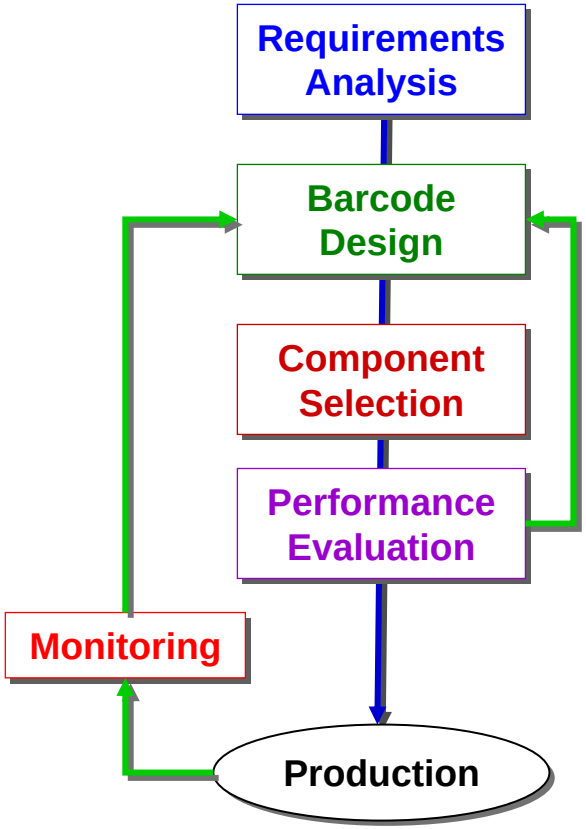
Barcode Carries and Delivers Critical Data

- Reliability relates directly to the Error Rate of the communication system
  - This is a general rule that applies to all communications

- Barcodes are simply one kind of communications technology to transfer data.
  - Uses paper and ink to carry information
  - Instead of electronic or radio signals
  - Think of them as packets on paper

- The design of RELIABLE barcode system is an engineering process
  - It is NOT a trial and error process
  - It is not mysterious and magical
  - It requires thinking about the whole system

Inlite's Five Step Design Process



Identify barcode design and lifecycle requirements

Design robust barcode per requirements

Select barcode generator and reader.

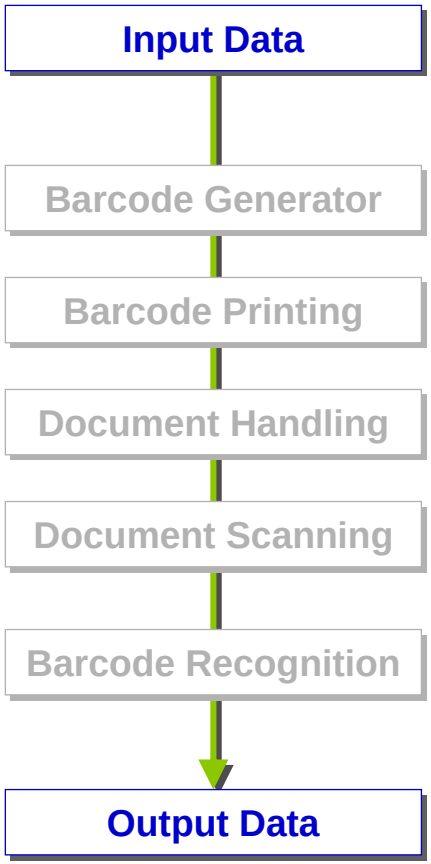
- Reader should be able to read many "unexpected" barcodes outside of design specification

Measure resilience using worst case workflow case

Monitor production process

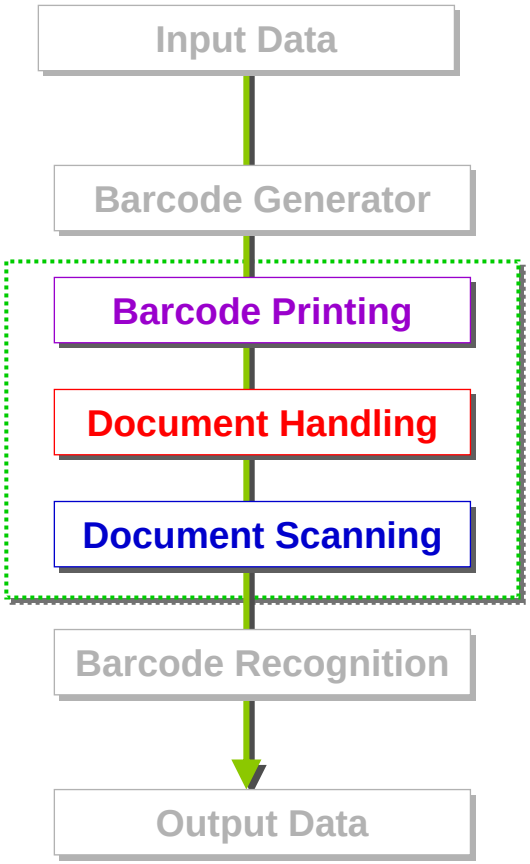
- Adjust barcode generation and recognition for evolving requirements

Business Process Performance Requirements



- Specify maximum required data capacity
  - How many characters of data do you need to use
- Identify available space for the barcode symbol
  - Look for esthtetically acceptable, open areas on the form
  - Stay away from signature areas, to reduce overwriting on the barcode
- Determine volume and reliability targets
  - How many documents will be printed
  - How many will be scanned? By whom? How?
  - What error rates can be tolerated?

Process Requirements



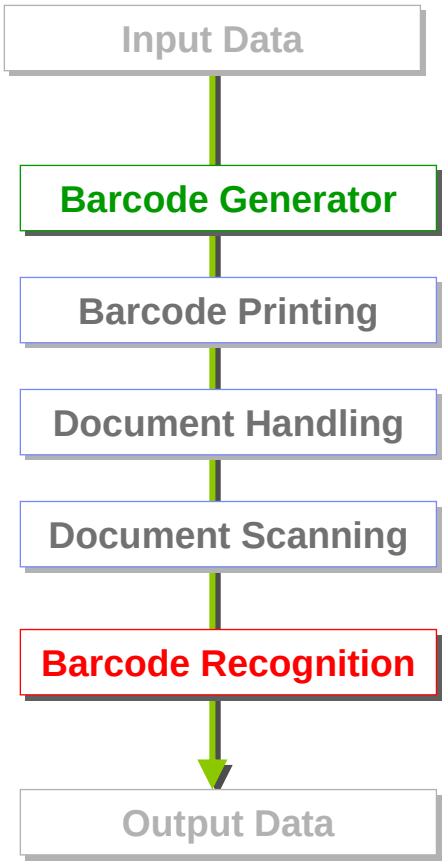
- Printing Equipment and Processes
  - Laser, Inkjet or Impact printers
  - Resolution of the printer
  - Ink spread measurements
- Type and quality of paper stock
  - Background pattern
  - Decorative border
  - Carbon copies
- Handling
  - Writing or stamping on symbol, bleed-through
  - Dirt, smears, smudges, scuffs
  - Creases, tears
- Scanning Equipment
  - Scan settings (too dark/light, framing)
  - Resolution too low
  - Black & White, Grayscale, Color
  - Fax (1 or 2 cycles, standard or fine)

Barcode design

Design a barcode that satisfies performance requirements under the worst case process scenario

- Specify barcode symbology:
  - 1D (prefer Code 128 or code 93)
    - Error detection is built in
  - Prefer 2D barcodes: PDF417, DataMatrix
    - Error correction provides resilience against damage
    - Efficient use of space
- Specify barcode geometry:
  - Size of barcode elements: bars, space or modules
  - Shape, Row and Column count
- Specify barcode placement on a page
  - Ensure proper distance from other elements (quiet zone)
  - Account for printing tolerances
- Inlite's Visual Barcode Designer enables the user to automatically design a barcode correctly to meet these criteria

Components selection



Select **barcode generation tools** to:

- Generate barcodes within design specs
- Compensate for print and paper tolerances
  - Stock and symbol interaction
  - Print resolution
- Does the tool provide sufficient control of the design?

Select **barcode recognition software** to:

- Read the barcodes produced within design specs
- Compensate for expected deviations in high-volume production environment:
  - Printer runs low on ink.
  - Barcode too light or too dark
  - Barcode is distorted
  - Stamp imprint on a top of barcode.
  - Barcode is damaged.
  - Barcode printed out of tolerance.
  - Quiet zone violations

Design Evaluation

- Measure resilience of the design to assess its survivability under adverse conditions.

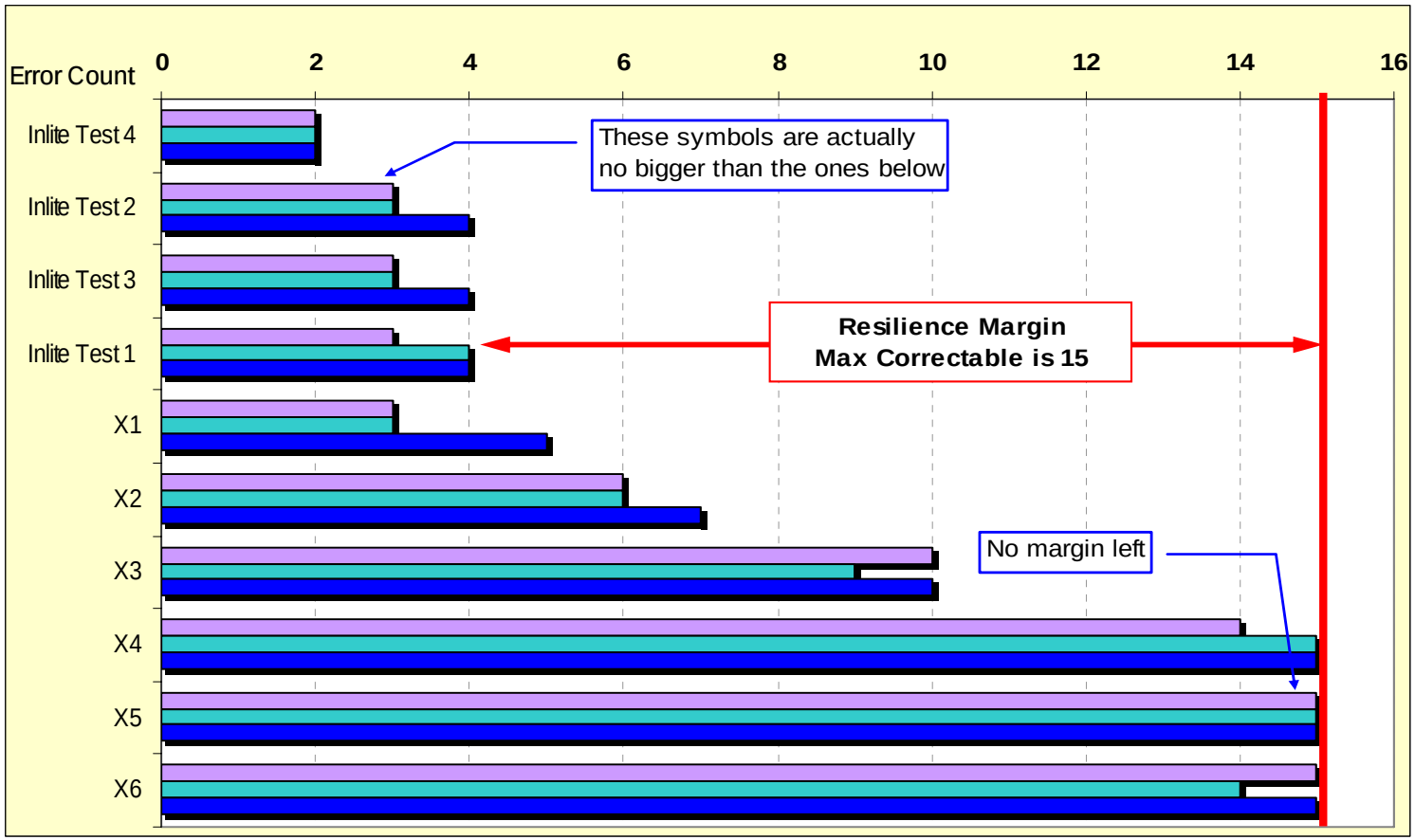
- Stress test methodology
  - Produce barcode images using worst case scenarios (Printing, handling, scanning)
  - 100-300 images suffice
  - Evaluate ability to read these barcodes.
  - Identify failure modes
  - Iteratively improve design

- Resilience margin analysis for 2D barcodes
  - Measure resilience margin
    - Correctable error budget
    - difference between maximum number errors that can be corrected and actual number of corrected errors
  - Optimize design to increase resilience margin

- Inlite Research provides consulting services to perform these functions

Barcode Resilience Margin

- Example of several barcode designs with the same capacity, similar geometry, similar area.
- All of these barcodes allow for maximum of 15 correctable errors.
- All of these barcodes are successfully read by the same reading engine.



Current Reality

How barcodes are used in Imaging

Multiple challenges

- Most software developers have expertise in other areas, such as IT
  - Lack familiarity with barcode issues
  - When problem reading barcodes is encountered, they fail to identify causes and develop remedies
- Vendors deliver partial one sided solutions
  - Barcode generators and labeling solutions
  - Image Capture devices (scanners, fax)
  - Barcode recognition products
  - Printing vendors
- Variability of real-life process requirements
  - No one-fits-all solution exits

How do you capture images?

Low cost fax

Hot Dog

Web cam

Low volume scanner

MFP

Cell Phone

Desktop Scanner

Digital Mailroom

Production Scanners

Check Scanner

High Speed Check Scanner

Today's Methodology: Trial and Prayer

- Users generally select components based on
  - Price
  - Ease of use in their application
  - Stumble on advertisement, etc.

- Do some testing
  - Print few pages with barcodes OR
  - find some barcodes (on vendor demo sites)
  - Simulate damage, e.g. distort with Photoshop
  - Run few tests on a dozen or so documents

- Put system together and pray that it works in production

What are the results?

- System works.

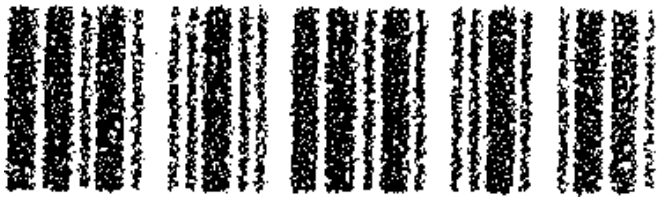
  - It often does
  - Due to inherent reliability of barcodes and
  - Low level system requirements
  - Do you know where the failure limits lie?

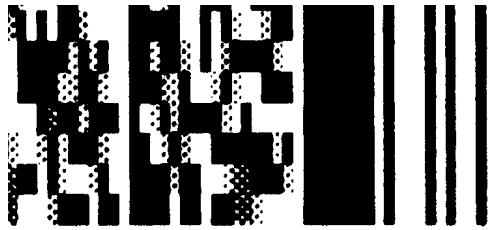
- System does not work

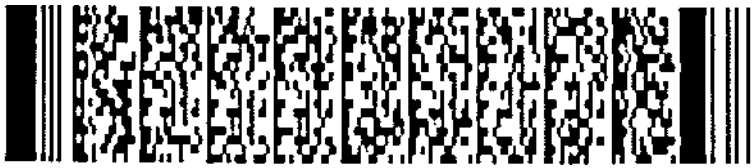
  - Contact components supplier – some may answer, most don't know better
  - Good supplier might provide useful advice
  - Are you fixing the "broke" part of the system?
  - Or tinkering?

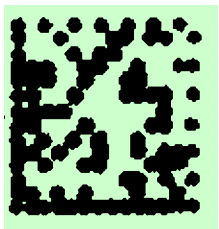
What's wrong with these barcodes?

- All of these barcodes "look good"
- Eye cannot detect distortions that affect readability of barcode, e.g.
  - Barcodes loaded from internet pages.
  - Look like barcode, scaled down to fit Web page.
- Magnified images shows poor printing or scanning quality (in this case)
- Incorrect barcode generator almost impossible to identify visually









Barcode Scanner vs Image Recognition

- Barcode Scanner vs Imaging Scanner
  - Barcode scanner has optics and specialized analysis hardware specifically designed for a single task - reading barcodes
  - Imaging scanners are general purpose devices
    - not designed or configured for reading barcodes

- Scanning process
  - Barcode scanner keeps scanning till it succeeds
  - With imaging – there is just “the” one image
    - No retries – read once and make it work

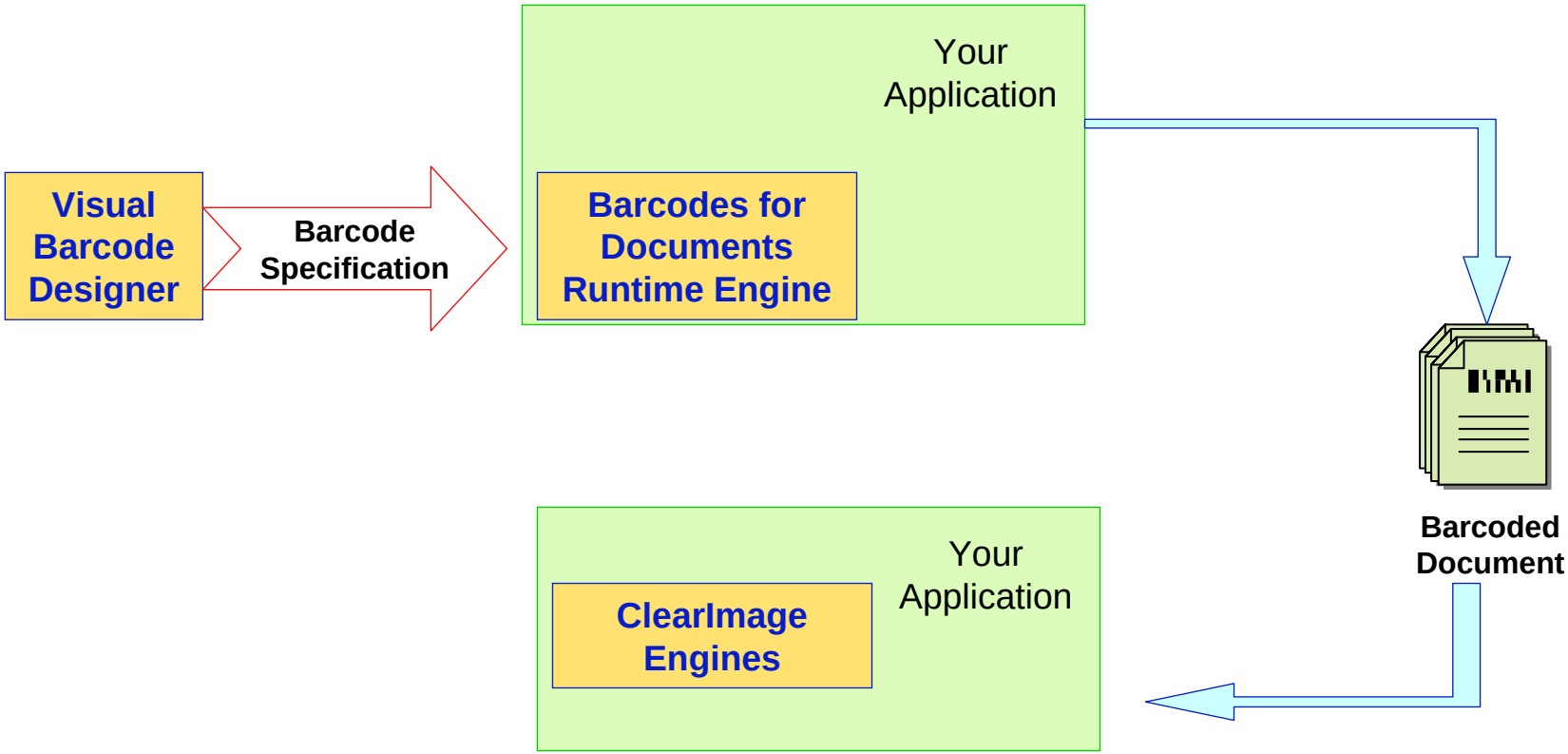
- Success depends on the capability of recognition software to read substandard images
- This is why it is important to use ClearImage Engines – the leading recognition engines in the industry

Inlite Products for the Business Cycle

- Inlite offers engines for developers
  - Tight integration into the user application
  - ClearImage engines for Image Processing and Barcode Recognition
  - Barcodes For Documents Runtine engine for barcode creation
  - Support any windows based development environment and language
  - Source code examples

- Inlite Applications automate the business cycle without programming
  - Many configuration possibilities
  - Powerful built in functions
  - Simple integration
  - No change to existing applications

Using Engines to Tightly integrate Businss Cycle



Inlite Applications Automate Business Cycle