Nolan-Norton Presentation
July 19, 1990©

by

Arthur M. Schneiderman

Presentation date:	Venue:	Notes
July 19, 1990	Nolan-Norton Study Group Meeting	None

Participants in the study, entitled "Measuring Performance in the Organization of the Future," were Advanced Micro-Devices, American Standard, Apple Computer, Bell South, GIGNA, Conner Peripherals, Cray Research, Dupont, EDS, GE, HP, and Shell Canada. Bob and I teamed in a pair of presentations; his, in part, on the HBS Analog Case and mine on the Analog story.

The Executive Summary of the study was published some time in 1991 and included materials from Bob's and my presentations. One display in the Executive Summary was used to demonstrate the linkage between performance measurement and the organization's strategy and vision. It used materials taken from slide 20 in this presentation as an example.

The interest generated by Analog's corporate scorecard prompted a second Nolan-Norton study in which the participants implemented scorecards within their respective organizations. This study provided the basis for the first Kaplan-Norton HBR article, which appeared in the January-February, 1992 issue. Although that article did make brief mention of Analog's use of the half-life method, and described the experiences of an anonymous "NYSE electronics company" (that was us!), it did not describe Analog's pioneering work on the first balanced scorecard. Nor did an article by Larry Maisel, then of KPMG, who was also part of the Nolan-Norton study. He published the study results in the Summer 1992 issue of the Journal of Cost Management in an article entitled "Performance Measurement: The Balanced Scorecard Approach."

This is the slide package I left for the meeting participants. I can't be sure that I used all of these slides in my presentation since I've been unable to locate a copy of the videotape that was made.

Since nearly all of the slides that I used are described in other presentations on this website, I've omitted explanatory notes.

Revised 8/30/00 9:18 AM

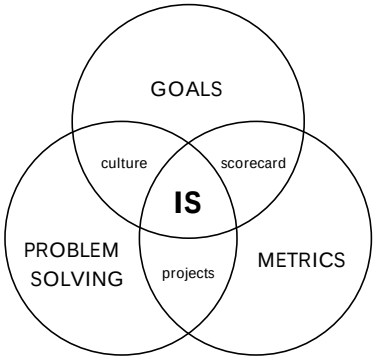
Slide 1

TOTAL QUALITY MANAGEMENT

Art Schneiderman

Analog Devices

- **ANALOG DEVICES "at a glance"**
- **QUALITY IMPROVEMENT PROCESS**



Nolan-Norton, July 19, 1990

6/11/90-06110-5

Slide 2

Analog Devices at a Glance

- Headquartered in Norwood Massachusetts
- Publicly Held (NYSE Symbol ADI)
- $453 Million in Sales (FY1989)
- 48% of Sales Outside United States
- 5200 Employees Worldwide

c. 2/13/90-PREZ_1

Slide 3

ANALOG DEVICES AT A GLANCE

(cont)

- Products: ICs, assembled products, subsystems
- Applications: precision measurement & control
- Markets: data acquisition
  - 40% industrial/instrumentation
  - 30% military/avionics
  - 13% computer
  - 17% other
- Integrated supplier
  - design
  - manufacturing (8 locations)
  - direct sales (100 locations)

c. 1990-PREZ-1a

Slide 4

ADI CORPORATE QIP COUNCIL

MEMBERS:	Jerry Fishman	Executive VP
	Kozo Imai	VP, Japanese Operations
	Larry LaFranchi	Operations Controller
	Bill Manning	Division GM
	Doug Newman	VP, Sales and Marketing
	Art Schneiderman, Chairman	VP, Quality/Productivity Improvement
	Ray Stata	Chairman of the Board and President
	Goodloe Suttler	Division GM
	Suzanne Thomson	Director, Training & Development
	Tom Urwin	VP, European Operations

CHARTER:

QIP Organization
QIP Goals Deployment ⇨ priorities
Training ⇨ Juran
Monitoring ⇨ metrics
Incenting/Rewarding

4/8/90-QIP-15a

Slide 5

1989 Top Customers Worldwide

Customer	*Bookings*	*Cumulative*
	$M	*%*
IBM (US, Japan & France)	26.8	6.0
GE/RCA	10.5	8.3
Fuji (Japan)	10.3	10.6
HP (US, UK & Germany)	9.1	12.6
Honeywell (US, Germany)	7.4	14.2
General Dynamics (US)	5.4	15.5
Raytheon (US)	5.1	16.6
Siemens (US, Germany)	5.1	17.7
TI (US)	4.1	18.6
Mitsubishi (Japan)	4.0	19.5
Fujitsu (Japan)	4.0	20.4
Toshiba (Japan)	3.7	21.1
Marconi (US, UK)	3.6	22.0
Hughes (US)	3.4	22.8
Rockwell (US)	3.3	23.5
Hitachi (Japan)	3.3	24.3
Westinghouse (US)	3.1	25.0
Philips (US, Europe)	3.1	25.6
Motorola (US)	3.0	26.3
DCASR (US)	2.7	26.9

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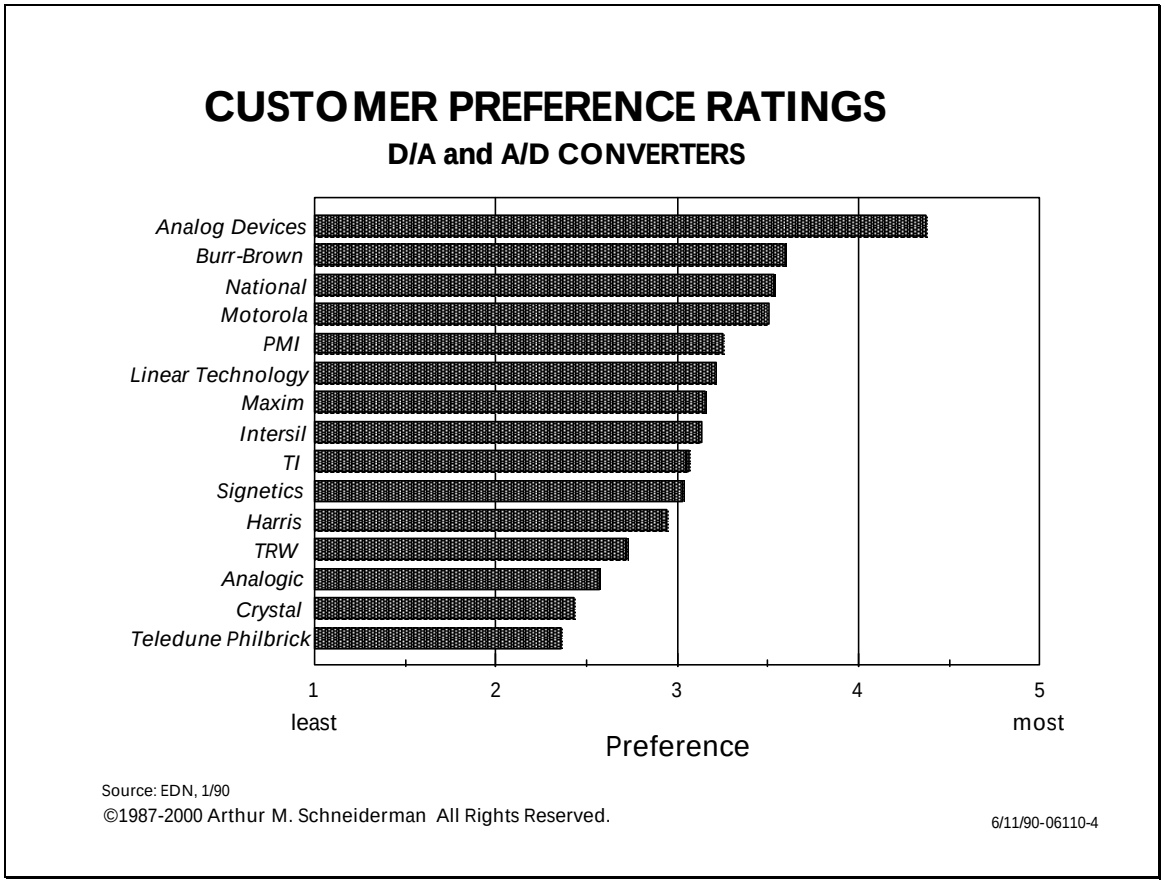
Slide 6



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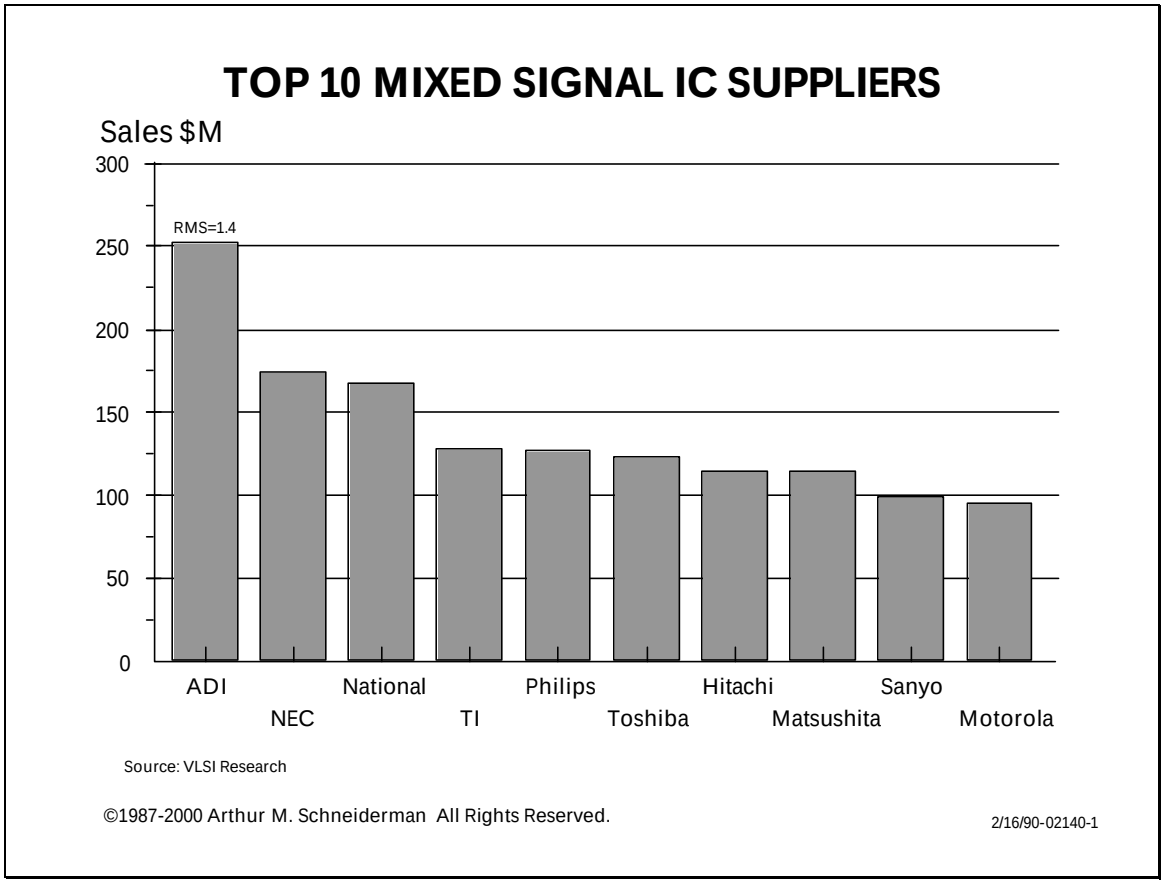
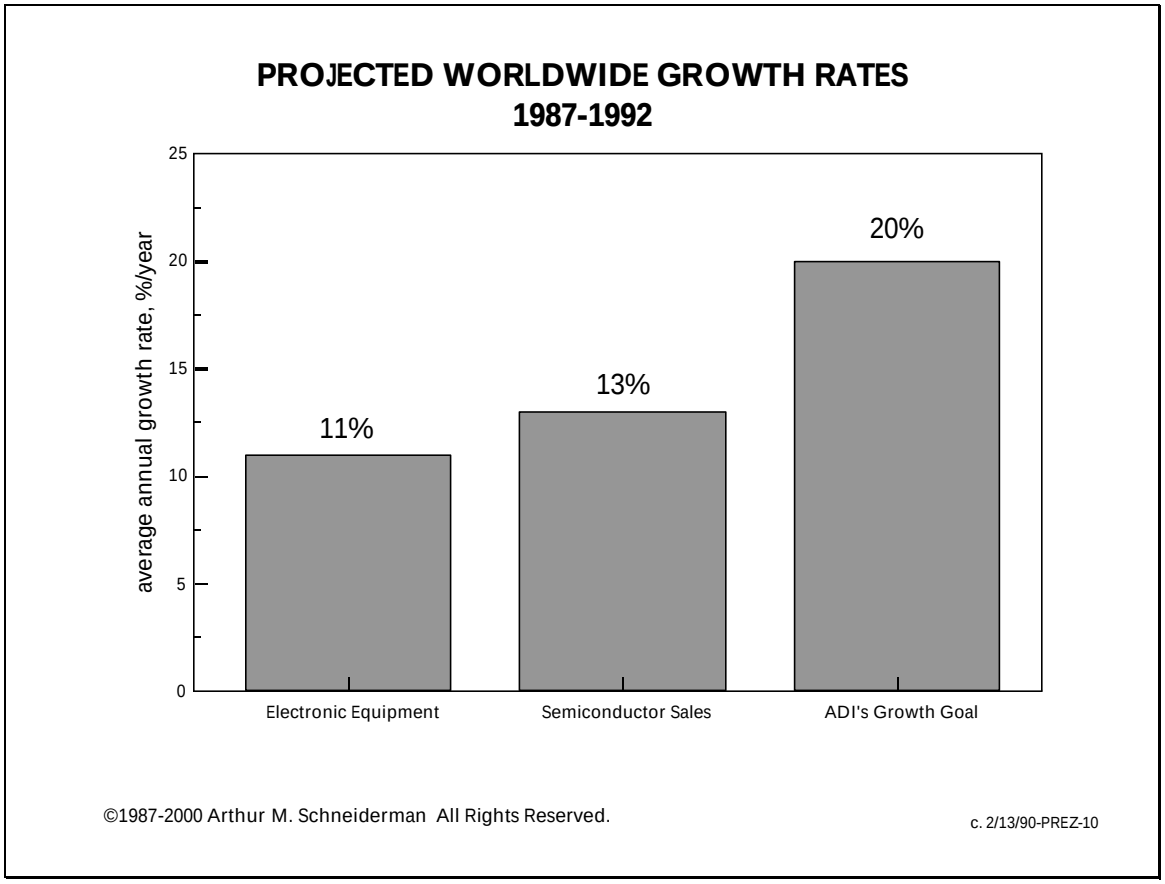
Slide 7

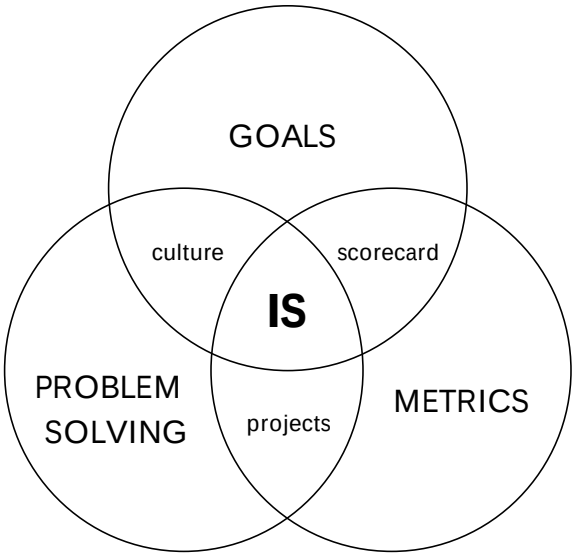


Slide 8



Slide 9

QUALITY IMPROVEMENT PROCESS



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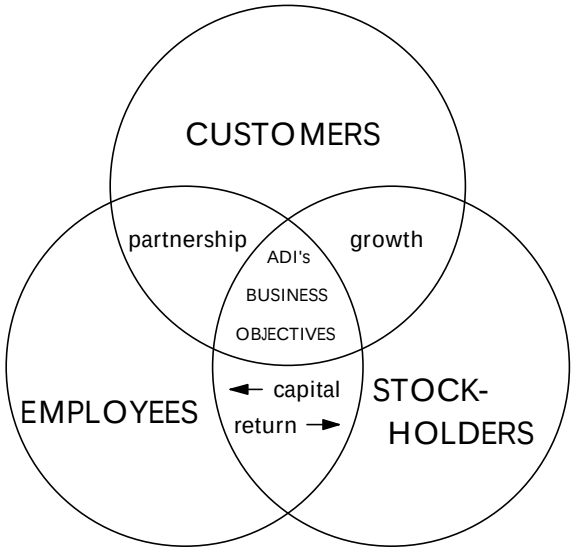
rev 4/8/90

Slide 10

ADI's CONSTITUENCIES



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rev 4/8/90

Slide 11

ADI QIP GOALS

BUSINESS OBJECTIVES:	MARKET LEADERSHIP (RMS) REVENUE GROWTH PROFITABILITY
DRIVERS:	BE RATED #1 BY OUR CUSTOMERS IN **TOTAL VALUE DELIVERED**
EXTERNAL LEVERS:	PRODUCTS DEFECT LEVELS ON-TIME DELIVERY LEADTIME PRICE RESPONSIVENESS
INTERNAL LEVERS:	TIME TO MARKET PROCESS PPM MANUFACTURING CYCLE TIME YIELD

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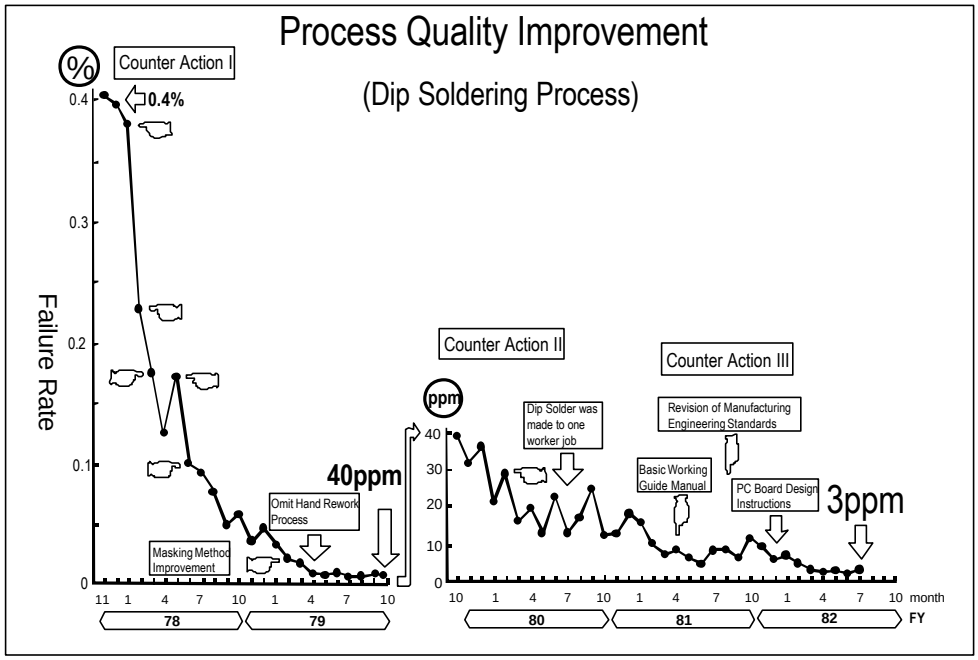
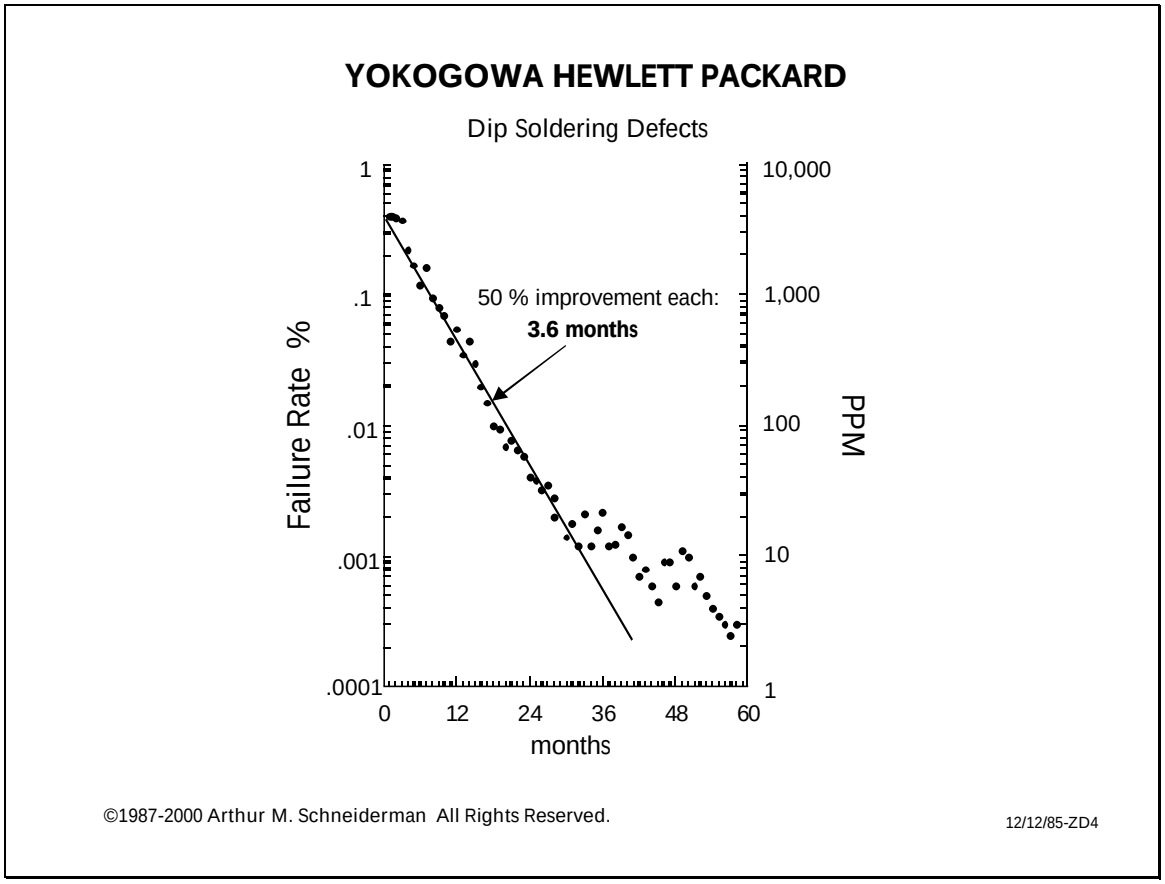
rev. 4/8/90-04080-2

Slide 12



Source: Kenzo Sasaoka, President
Yokagowa-Hewlett-Packard 7/84

Slide 13



Slide 14

PROPOSED HALF-LIFE MODEL VALUES

		MONTHS	
PROJECT TYPE	***EXAMPLES***	***MODEL HALF-LIFE***	***EXPECTED RANGE***
uni-functional	operator errors WIP	**3**	**0 to 6**
cross-functional	new product cycle time outgoing PPM	**9**	**6 to 12**
multi-entity	vendor quality warranty costs	**18**	**12 to 24**

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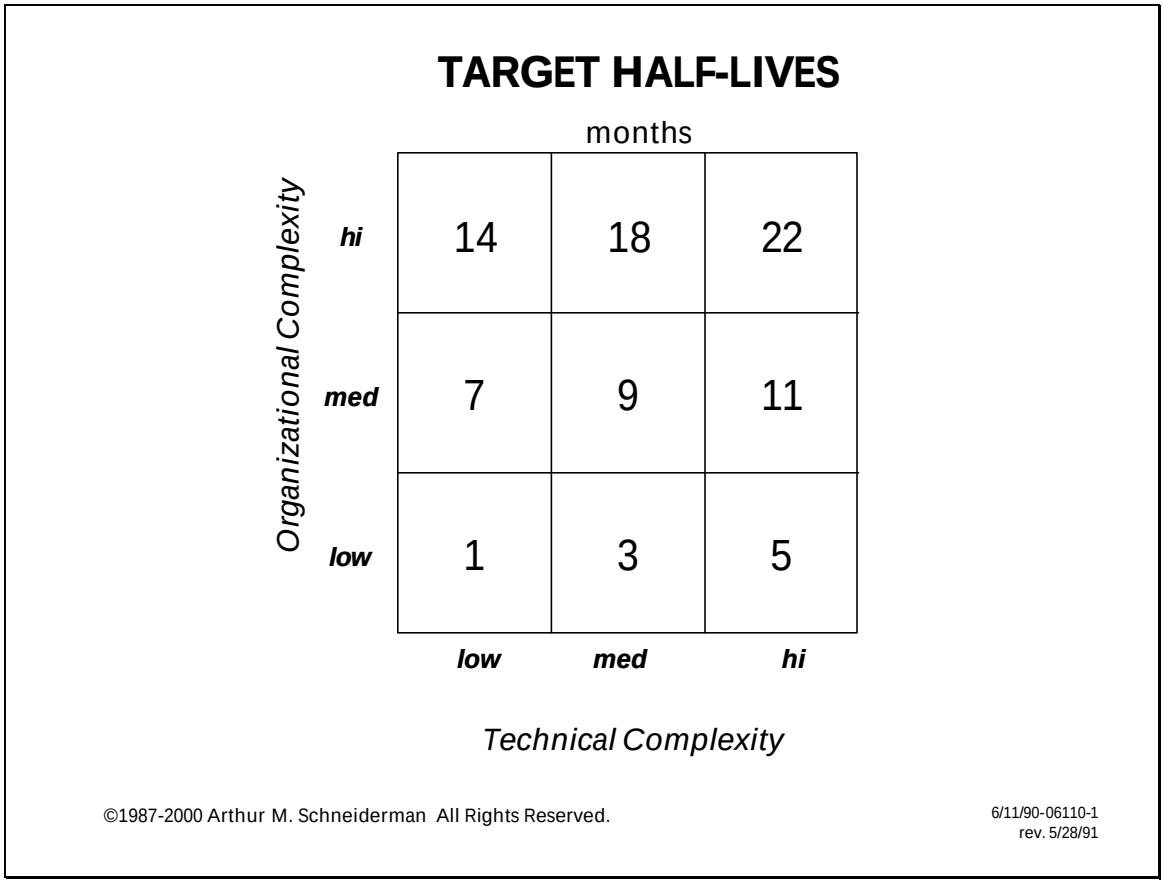
Slide 15


TARGET HALF-LIVES
months
Organizational Complexity
hi
med
low
14
18
22
7
9
11
1
3
5
low
med
hi
Technical Complexity
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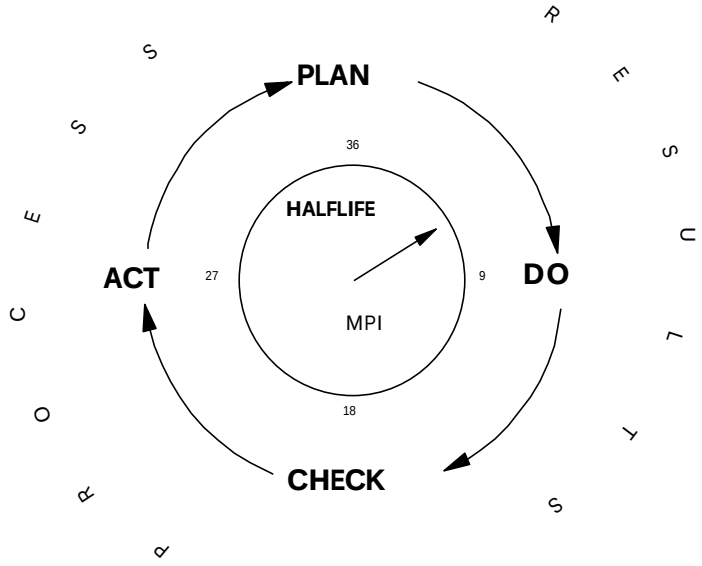
Slide 16

THE DEMING CYCLE



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Slide 17

ADI RESPONSE TO HALF-LIFE CONCEPT

Supporters	*Critics*
Embodies the concept of KAIZEN	Doesn't reflect where we need to be
Easy to understand	Hard to understand
Makes sense	Hard to use
Data not negotiation based ⇨ realistic	manual vs. computerized
Accepted by line organization	assumes instant startup
Works	assumes constant rate of learning
focuses on results not process	focuses on results not process

"…the rate at which individuals and organizations learn may become the only sustainable competitive advantage…"

Ray Stata

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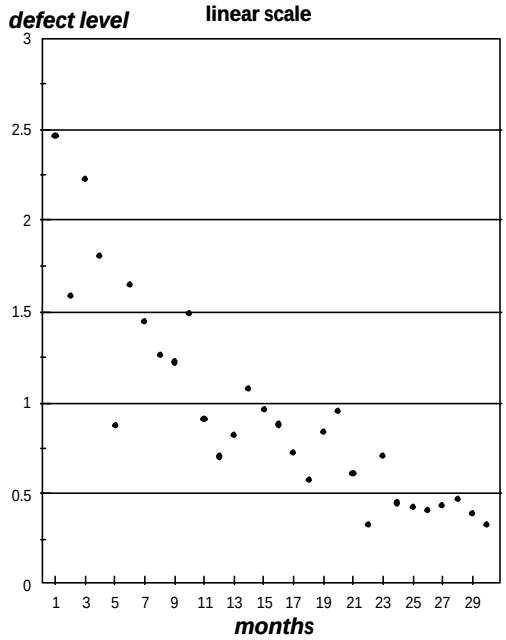
Slide 18

SAMPLE IMPROVEMENT CURVE



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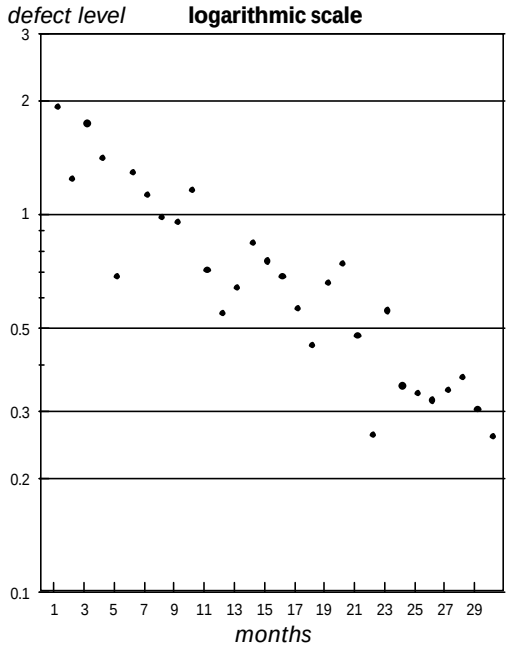
Slide 19

SAMPLE IMPROVEMENT CURVE



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Slide 20

ADI QIP GOALS

IC OPERATIONS, ESTABLISHED PRODUCTS

METRIC	1987	HALF-LIFE	1992
EXTERNAL			
On time delivery	85%	9	>99.8%
Outgoing defect levels	500 PPM	9	<10 PPM
Lead time	10 wks	9	<3 wks
INTERNAL			
Manufacturing Cycle Time	15 wks	9	4-5wks
Process Defect Levels	5000 PPM	6	<10 PPM
Yield	20%	9	>50%
Time to Market	36 mths	24	6 mths

WHILE AGGRESSIVELY PURSUING

CORPORATE-WIDE COST MANAGEMENT

c. 7/12/87-QIP-16/QS-16B
rev. 7/25/87

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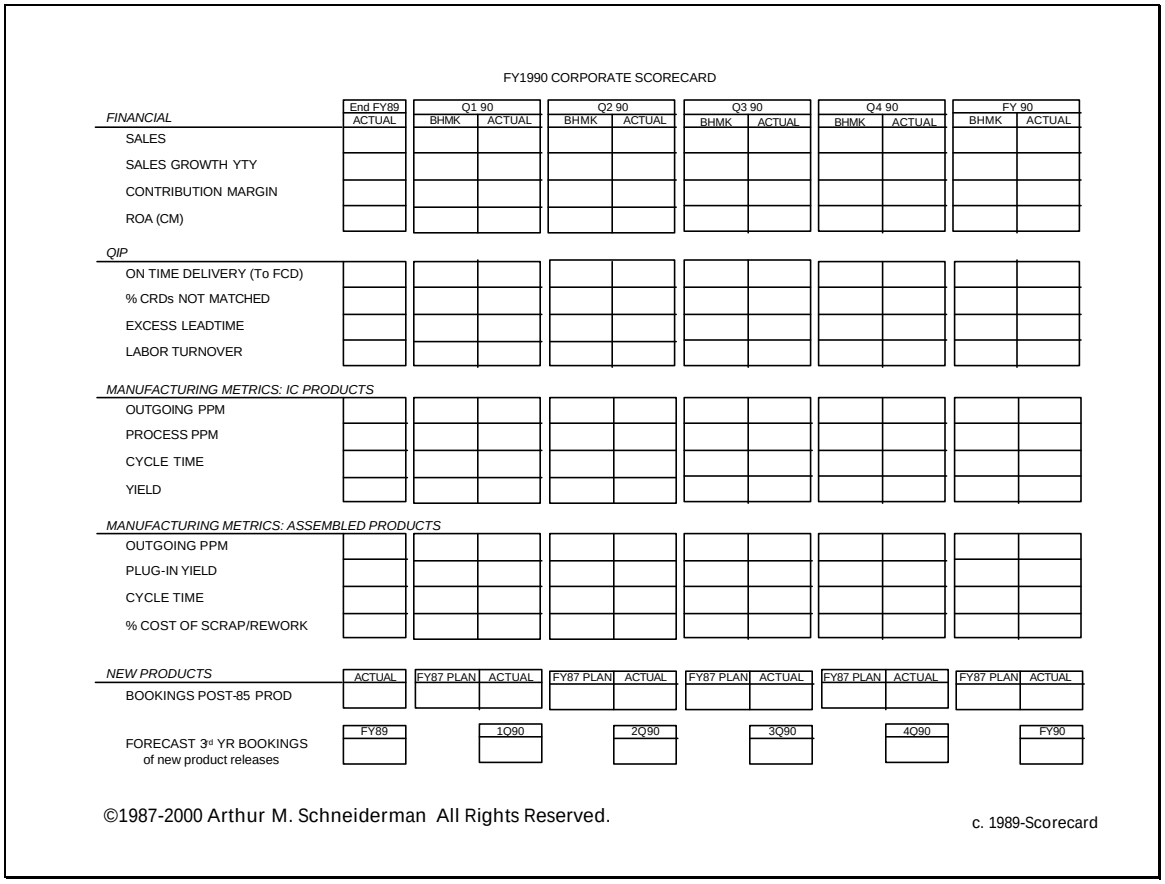
Slide 21



FY1990 CORPORATE SCORECARD

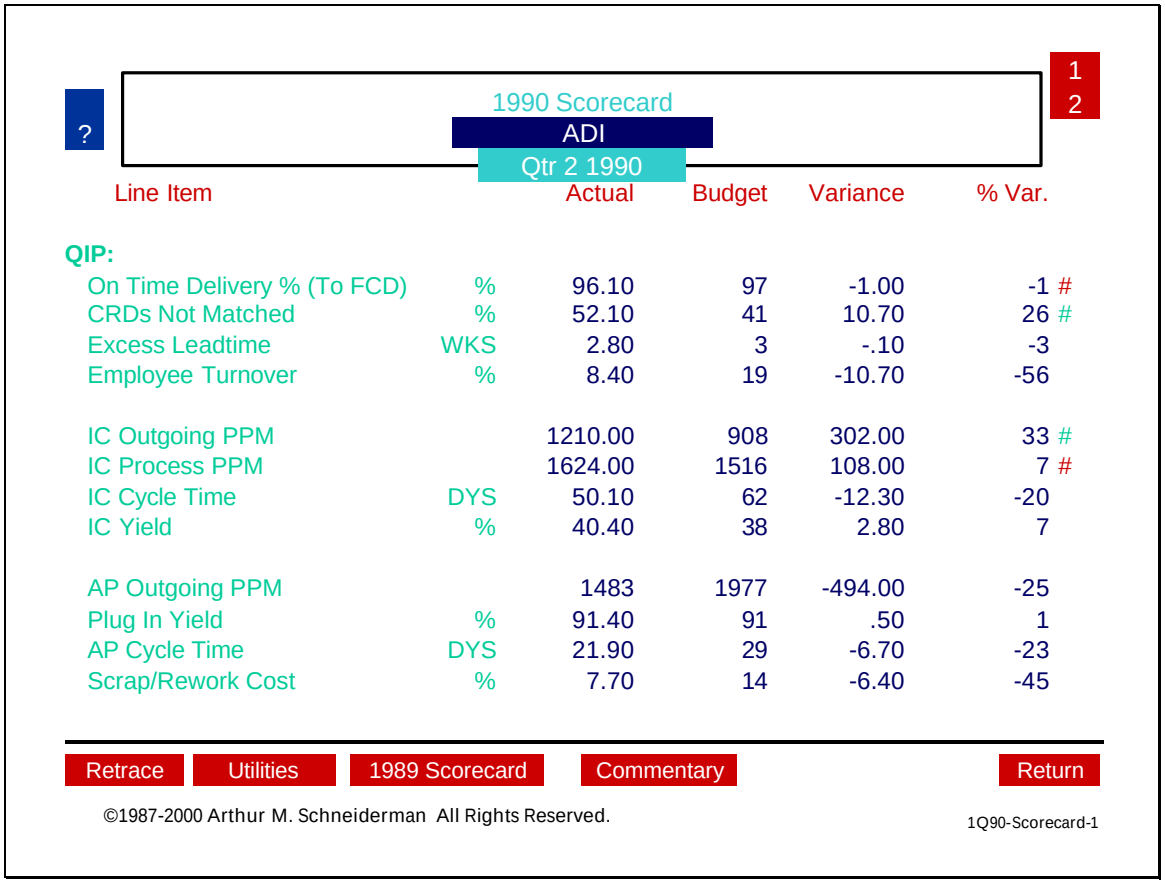
	End FY89	Q1 90		Q2 90		Q3 90		Q4 90		FY 90	
FINANCIAL	ACTUAL	BHMK	ACTUAL	BHMK	ACTUAL	BHMK	ACTUAL	BHMK	ACTUAL	BHMK	ACTUAL
SALES											
SALES GROWTH YTY											
CONTRIBUTION MARGIN											
ROA (CM)											
QIP											
ON TIME DELIVERY (To FCD)											
% CRDs NOT MATCHED											
EXCESS LEADTIME											
LABOR TURNOVER											
MANUFACTURING METRICS: IC PRODUCTS											
OUTGOING PPM											
PROCESS PPM											
CYCLE TIME											
YIELD											
MANUFACTURING METRICS: ASSEMBLED PRODUCTS											
OUTGOING PPM											
PLUG-IN YIELD											
CYCLE TIME											
% COST OF SCRAP/REWORK											

NEW PRODUCTS	ACTUAL	FY87 PLAN	ACTUAL	FY87 PLAN	ACTUAL	FY87 PLAN	ACTUAL	FY87 PLAN	ACTUAL	FY87 PLAN	ACTUAL
BOOKINGS POST-85 PROD											

	FY89	1Q90	2Q90	3Q90	4Q90	FY90
FORECAST 3rd YR BOOKINGS of new product releases						

c. 1989-Scorecard

Slide 22



1990 Scorecard

ADI

Qtr 2 1990

Line Item		Actual	Budget	Variance	% Var.
QIP:					
On Time Delivery % (To FCD)	%	96.10	97	-1.00	-1 #
CRDs Not Matched	%	52.10	41	10.70	26 #
Excess Leadtime	WKS	2.80	3	-.10	-3
Employee Turnover	%	8.40	19	-10.70	-56
IC Outgoing PPM		1210.00	908	302.00	33 #
IC Process PPM		1624.00	1516	108.00	7 #
IC Cycle Time	DYS	50.10	62	-12.30	-20
IC Yield	%	40.40	38	2.80	7
AP Outgoing PPM		1483	1977	-494.00	-25
Plug In Yield	%	91.40	91	.50	1
AP Cycle Time	DYS	21.90	29	-6.70	-23
Scrap/Rework Cost	%	7.70	14	-6.40	-45

1Q90-Scorecard-1

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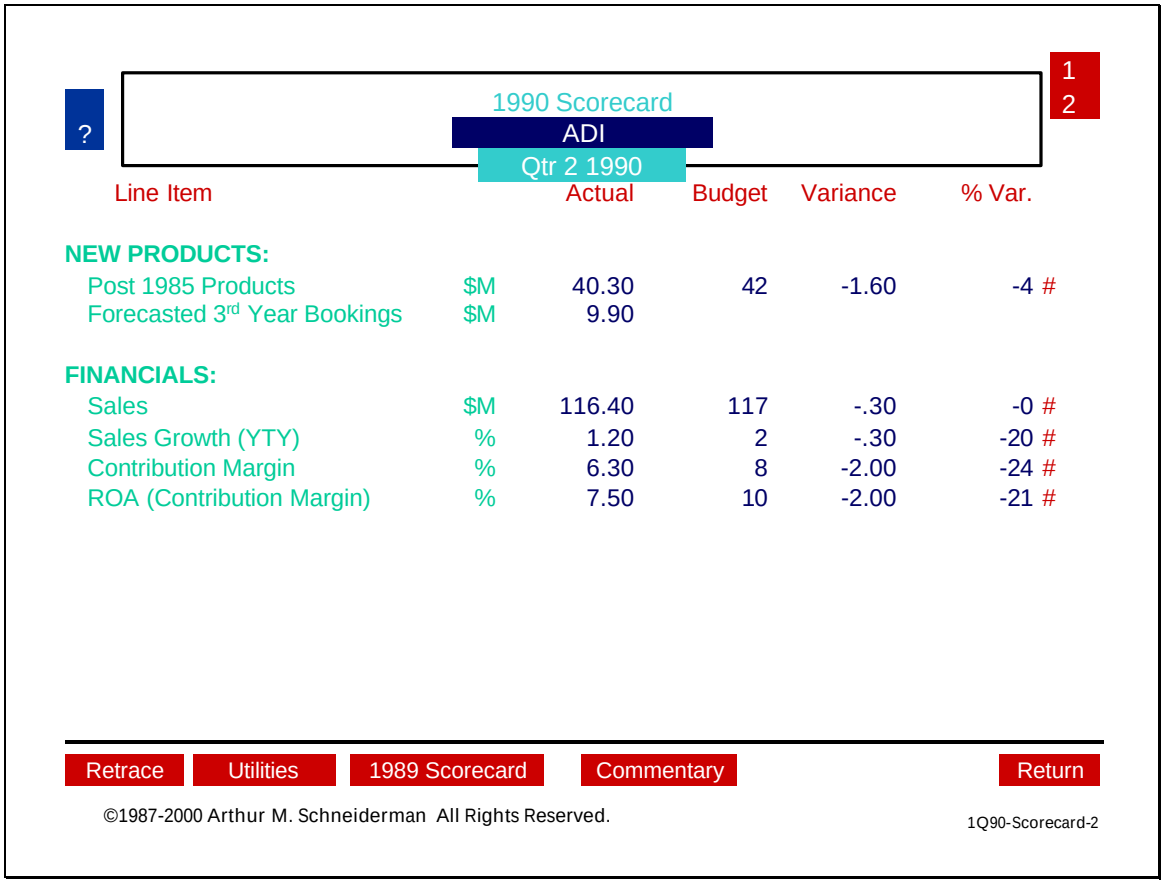
Slide 23



Line Item		Actual	Budget	Variance	% Var.
NEW PRODUCTS:					
Post 1985 Products	$M	40.30	42	-1.60	-4 #
Forecasted 3rd Year Bookings	$M	9.90			
FINANCIALS:					
Sales	$M	116.40	117	-.30	-0 #
Sales Growth (YTY)	%	1.20	2	-.30	-20 #
Contribution Margin	%	6.30	8	-2.00	-24 #
ROA (Contribution Margin)	%	7.50	10	-2.00	-21 #

Retrace | Utilities | 1989 Scorecard | Commentary | Return

1Q90-Scorecard-2

Slide 24

PERFORMANCE MEASUREMENT

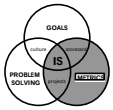
If you don't measure it,
it will not improve.

does not mean

measurement ⇨ improvement

5/22/90-05220-4

Slide 25



GOAL:
IMPROVE CUSTOMER SERVICE

CUSTOMER SERVICE METRICS

ON TIME
- % late
- % early

⇨ % on time

RESPONSIBILITY
- factory
- warehouse
- credit
- customer

LATENESS/EARLINESS
- shipped late, how late?
- shipped early, how early?
- still late, how late?
  - months to ship late backlog

LEAD TIME
- customer requested lead time
- % CRD's matched
- excess lead time

RESPONSIVENESS
- time to schedule an order

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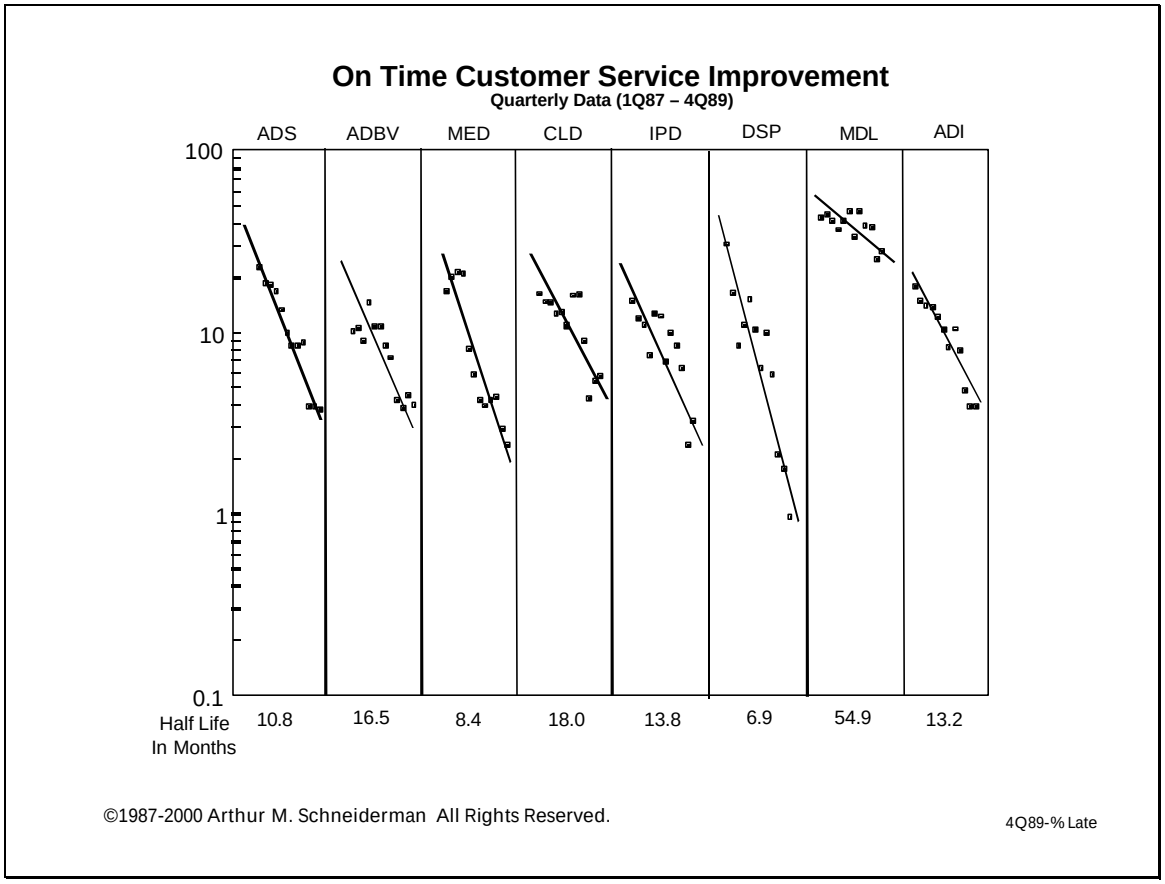
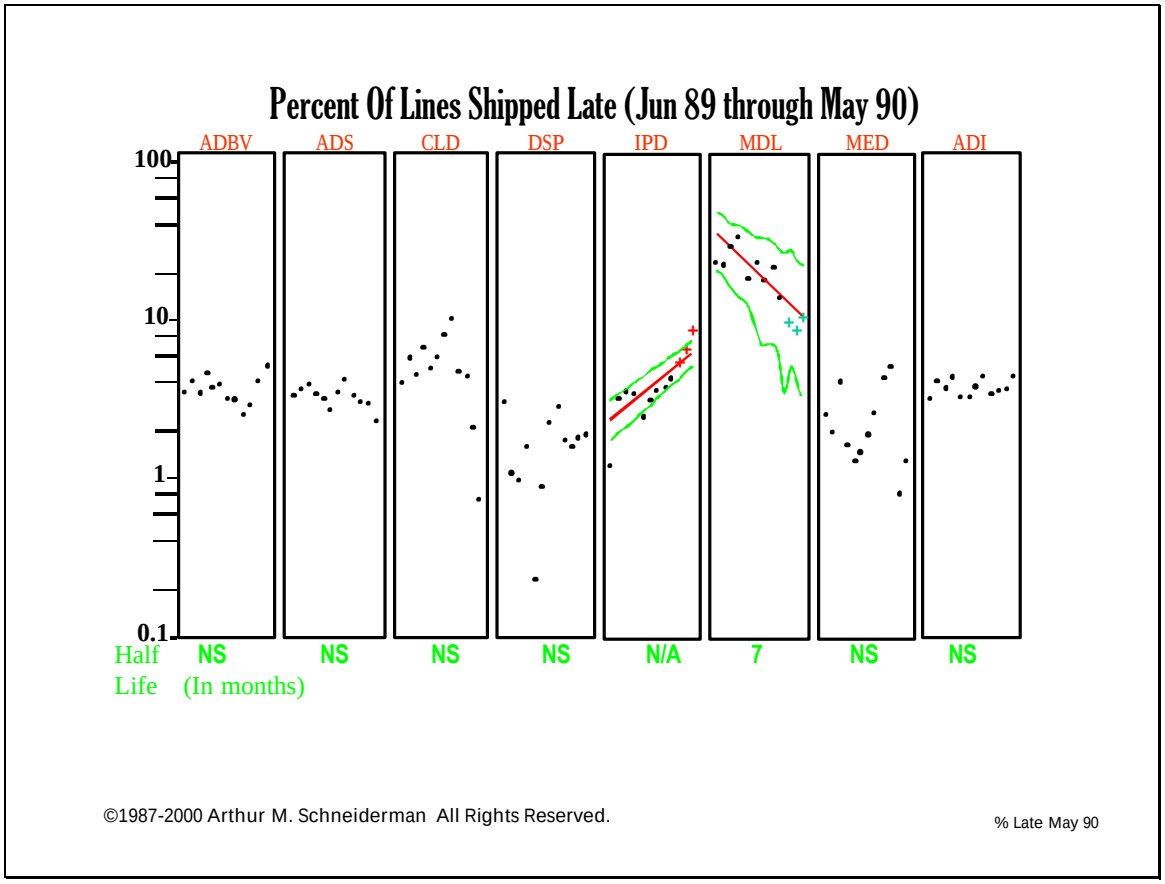
rev 5/13/90

Slide 26



Slide 27



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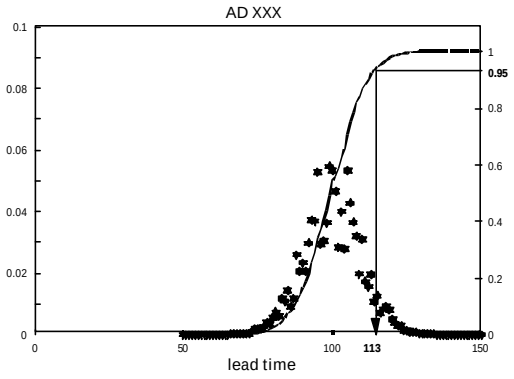
Slide 28

RELATIONSHIP BETWEEN LEADTIME
AND ON-TIME DELIVERY



Market requirements: OTD > 95%
leadtime < 100

Our requirements: OTD < 50%
or
leadtime > 113

LOSS OF MARKET SHARE

5/16/90-05160-1a

Slide 29

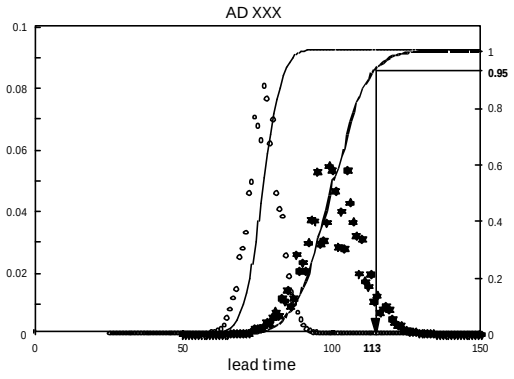
IMPROVING ON THE OTD/LEADTIME TRADEOFF

1. increase inventory
2. build to good forecasts
3. reduce manufacturing cycle time

5/16/90-05160-2

Slide 30

RELATIONSHIP BETWEEN LEADTIME
AND ON-TIME DELIVERY

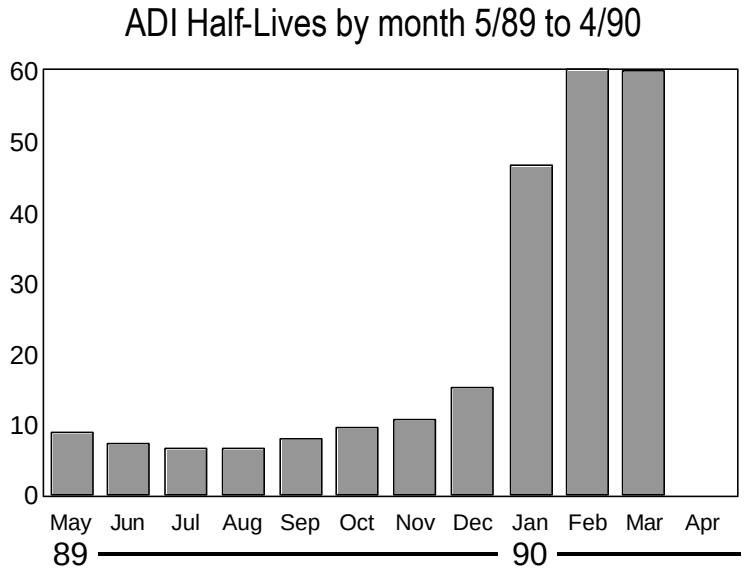


Market requirements:	OTD > 95% leadtime < 100
Our requirements:	OTD < 50% or leadtime > 113

LOSS OF MARKET SHARE

5/16/90-05160-1a+b

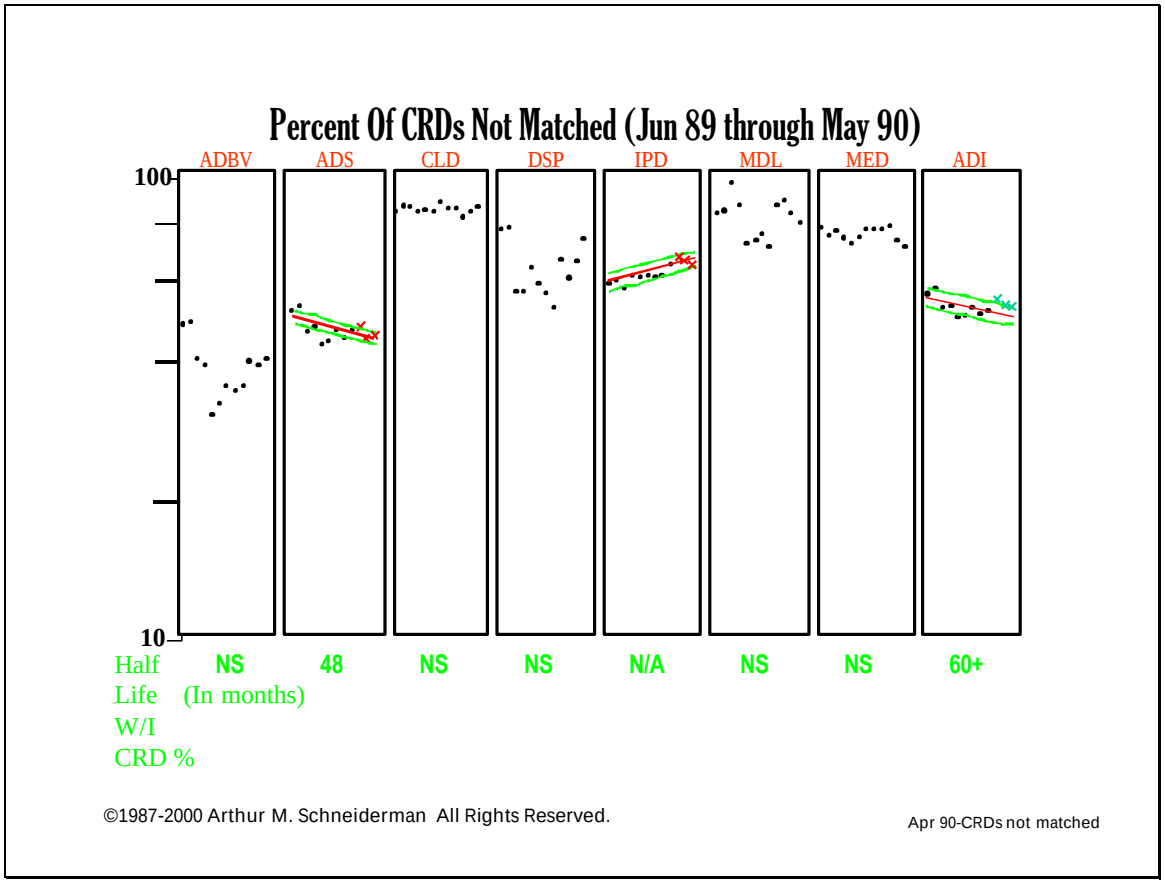
Slide 31



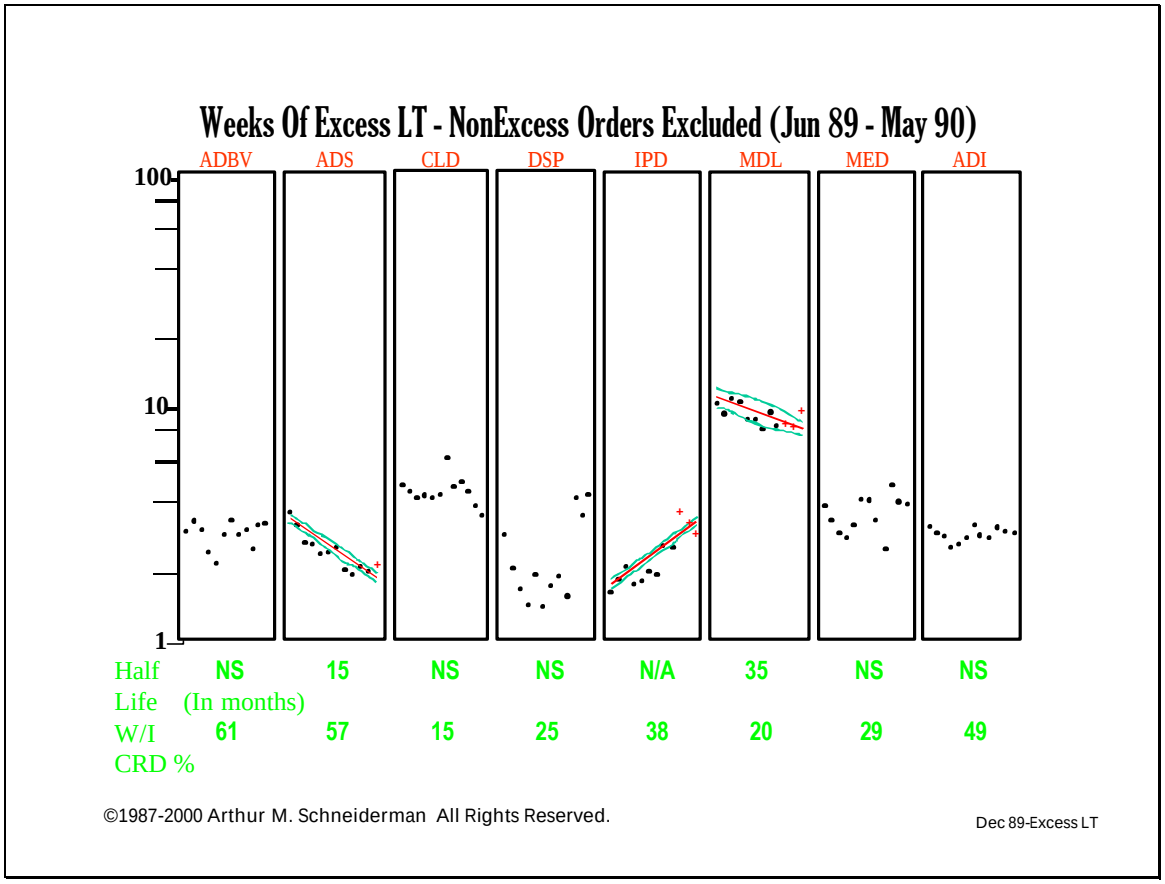
	Hlf Life
5/89	9
6/89	7
7/89	7
8/89	7
9/89	8
10/89	10
11/89	11
12/89	15
1/90	47
2/90	60
3/90	60
4/90	N/A

c. 1990

Slide 32



Slide 33



Slide 34

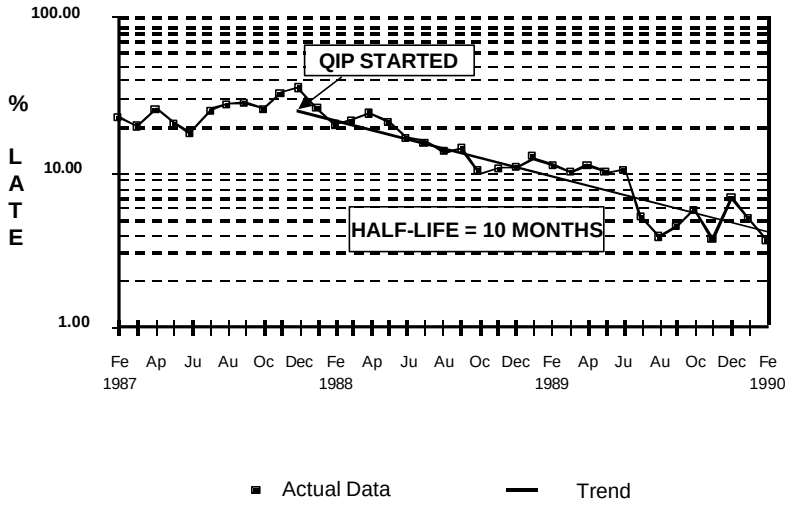
48 CUSTOMERS IN VENDOR RATING DATABASE

ABB	M/A-COM
AGFA	Martin Marietta
Allen Bradley	Marquette Electric
Allied Signal	Masscomp
Ametek	Microcircuits Semiconductor
Apollo	McDonald Douglas
AT&T	Parker Air & Space
Brown Engineering	Penastar
Compugraphic	Perkin Elmer
Currie-Peak-Frazi	Raytheon
Eaton	Reliance Electric
Finnegan	Rockwell
Ford	Sanders
General Electric	Siemens
GEC	Sikorsky
Gould	Tektronix
Hewlett-Packard	Teleco
Honeywell	Teledyne
Hughes	Teradyne
Instron	Texas Instruments
JET Electronics	Trillium
Kodak	United Technologies
Loral	Waters Associates
Lucas	Westinghouse

c. 7/90-VRS Database

Slide 35

ON TIME DELIVERY, CUSTOMER MEASURED



(Ave: 21 C9ompanies per point)

Feb 90-CMD

Slide 36

HEWLETT-PACKARD VENDOR RATINGS

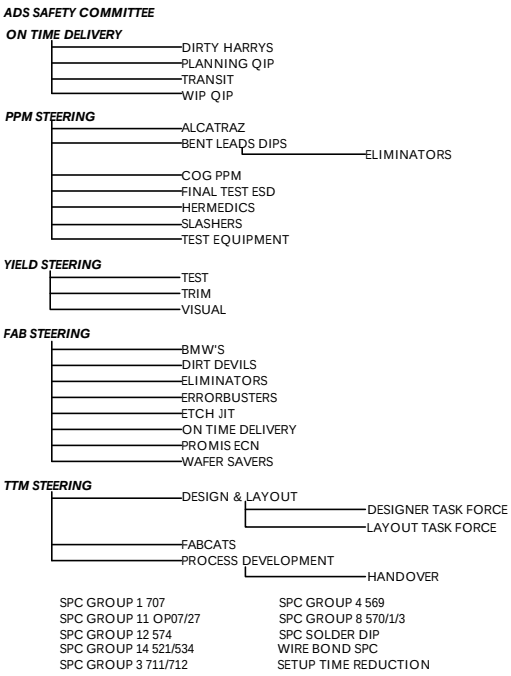
year	*ADI rank*	*total suppliers*	*category*
1986	8	16	linear IC suppliers
1987	5	8	linear IC suppliers
1988	5	15	all IC suppliers
1989	1 *	12	all IC suppliers

* tied with one other supplier

5/22/90-05220-1

Slide 37

ADS QIP TEAM STRUCTURE



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Slide 38

TYPICAL QIP PROJECTS

NAME	MEMBERS	PROJECT	METRIC
BMW'S	8 FAB LINE OPERATORS 2 FAB TECHNICIANS 2 FAB ENGINEERS 3 FAB SUPERVISORS	REDUCE THE QUANTITY OF BROKEN/MISSING WAFERS PER MILLION MOVES	YIELD
ERRORBUSTERS	6 FAB LINE OPERATORS 3 FAB TECHNICIANS 1 FAB ENGINEER 1 FAB MANAGER	REDUCE MISPROCESSING IN PHOTO	YIELD
DIRT DEVILS	2 FAB LINE OPERATORS 2 YIELD ENHANCEMENT 1 FAB SUPERVISOR 1 Q.C. INSPECTOR 1 FAB TECHNICIAN 1 EQUIPMENT REPAIR	REDUCE PARTICLE COUNT IN FAB	YIELD
PLANNING QIP	2 BUSINESS PLANNING 2 MANUF. SUPERVISORS 5 P.C. PLANNING 1 FINANCE 1 PURCHASING 1 CUSTOMER SERVICE	INCREASE CUSTOMER SERVICE WHILE REDUCING CYCLE TIME AND MINIMIZING INVENTORIES	ON TIME DELIVERY
ALCATRAZ	5 TEST OPERATORS 2 BRAND OPERATORS 1 Q.A. ENGINEER 1 BRAND SUPERVISIOR	ELIMINATE FACTORY ESCAPES	PPM
FABCATS	1 C.A.S. OPERATOR 1 MASK FAB MANAGER 1 Q.C. MANAGER 1 FAB MANAGER 1 P.C. PLANNING 2 P/L COORDINATORS 1 FAB COORDINATOR	MINIMIZE TAT ON NEW PRODUCT DEVELOPMENT LOTS	TIME TO MARKET

6/11/90-06110-3

Slide 39

PROBLEM SOLVING

Participants:

Cross Functional Problem Solving Teams (QIP Teams)
Task Forces
QC Circles
Individuals

Systematic Approach:

Deming Cycle (PDCA)

Tools:

7 QC Tools (fishbone, histogram, ...)
7 Management Tools (KJ Method, affinity diagram,...)
Design of Experiments (Taguchi, etc.)
SQC (control charts)
SPC (Cp, Cpk)
Quality Cost (failure, prevention, appraisal)
QFD
Hoshin Kanri
SMED
TPM
EI
JIT/Kanban (cycle time, WIP reduction)

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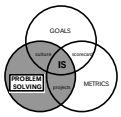
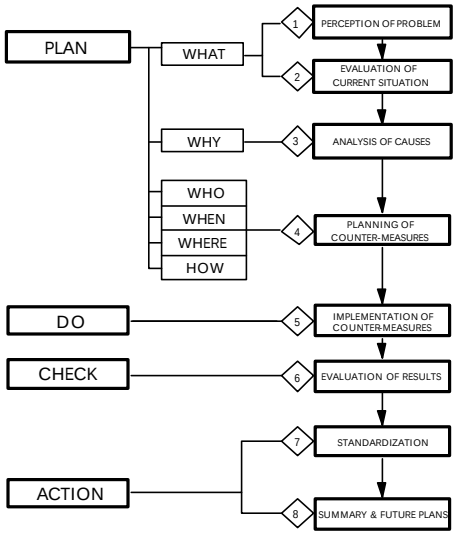


PROBLEM SOLVING

The Deming Cycle (PDCA)



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CENTRAL PRINCIPLES OBSERVED IN TQM IMPLEMENTATION

- Primacy of the Customer
  - customer first
  - customer satisfaction
  - market-in
- Use of the PDCA cycle for continuous improvement
- Strong CEO and top management leadership
  - policy deployment
- Education and training for all
- Respect for all people
  - teamwork
  - participative management

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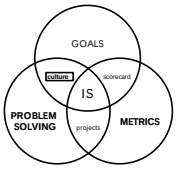

THE QIP CULTURE

- We each have a dual function
  - daily job ⇨ SDCA cycle
  - process improvement ⇨ PDCA cycle
- We are committed to improving customer satisfaction
- We are dedicated to (kaizen) continuous improvement
- We are part of a parallel organization: functional and cross-functional
- We are a continuously learning organization

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REQUIREMENTS FOR QUALITY IMPROVEMENT

Top Management Commitment

leadership
changed objectives
hands-on management
visibility
support

Sense of Urgency

profit opportunity
competition
fuel for change

Systematic Method

proven results
kaizen
data driven
cross-functional

Pilot Projects

overcome skepticism
build credibility
get ball rolling
develop champions

Company Wide Involvement

weakest link
internal customers
policy deployment
vendors/customers

Organization/ Systems

training
guiding
:
monitoring
rewarding
:

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